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**OPERATING IN UNCERTAINTY; GROWING RESILIENT
CRITICAL INFRASTRUCTURE ORGANIZATIONS**

by

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**OPERATING IN UNCERTAINTY: GROWING RESILIENT
CRITICAL INFRASTRUCTURE ORGANIZATIONS**

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ABSTRACT

Publicly owned utilities as natural monopolies have historically operated in a relatively controlled environment. As they have become increasingly networked and interdependent with similar enterprises, the level of management complexity has increased dramatically within their operating environment. The leadership skills and worldview of the management of public utilities, based on the Newtonian paradigms of the last century, have not kept pace with these rapidly changing environmental conditions. A gap exists today among leaders of public utilities in understanding that their environment and organization are part of complex adaptive systems and that the implications of operating in a complex environment are substantive.

The findings developed through a research process based on written questionnaires and interviews of industry leaders confirmed and expanded the emergent theory of the current situation facing utilities. The findings further support a framework to assess where utilities are today regarding growing resilience into their organization.

As utility management teams develop a clearer understanding of their current position and the nature of complexity, they can cultivate a strategy using a variety of methods developed in the research to begin the process of adjusting the tacit values, norms and assumptions that comprise the organizational culture to improve resiliency within their enterprise.

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LIST OF ACRONYMS AND ABBREVIATIONS

AWWA	American Water Works Association
CAS	Complex Adaptive Systems
EPA	United States Environmental Protection Agency
FERC	Federal Energy and Regulatory Commission
FHCS	Federal Human Capital Survey
ODQ	Organization Description Questionnaire
PUHCA	Public Utility Holding Company Act
SOTI	State of the Industry Report

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EXECUTIVE SUMMARY

Publicly owned utilities as natural monopolies have historically operated in a relatively controlled environment. As they have become increasingly networked and interdependent with similar enterprises, the level of management complexity has increased dramatically within their operating environment. The researcher contends that many publicly owned critical infrastructure organizations, like many other enterprises, have yet to develop an understanding of this changing complex world. As a result, they have not allocated the time or resources required to educate management and staff as sensors of the environment or implemented the organizational changes required to meet the challenges posed in the post-9/11 world. A gap exists today among leaders of public utilities in understanding that their environment and organization are part of complex adaptive systems and that the implications of operating in a complex environment are substantive.

The findings developed through a research process based on written questionnaires and interviews of industry leaders confirmed and expanded the emergent theory of the current situation facing utilities. The findings further support a framework to assess where utilities are today regarding growing resilience into their organizations.

As utility management teams develop a clearer understanding of their current position and the nature of complexity, they can cultivate a strategy using a variety of methods developed in the research to begin the process of adjusting the tacit values, norms and assumptions that comprise the organizational culture to improve resiliency within their enterprise.

A resilient organization structures itself in such a manner as to be able to meet the challenges of the environment and still prosper. Those who work in publicly owned utilities need to understand that a fundamental change in thinking about their environment is required, and that changes in organizational structures, norms, values and the tacit assumptions that define culture are necessary to achieve this adaptive, organism-like enterprise.

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I. INTRODUCTION

A. PROBLEMS, DEFINITIONS AND CONVENTIONAL WISDOM

After the dust settled on 9/11, it became apparent to government and public organizations that they could not protect all the elements of an increasingly networked society. To meet the new challenges of a post-9/11 America, it became clear that a paradigm shift was required to meet the new “normal” of interdependent enterprises. The notion of developing resiliency within systems, organizations and society in general developed out of the work of ecologists who had been seeking ways to manage what they recognized as Complex Adaptive Systems (CAS) in nature to support long-term ecosystem sustainability and meet the human requirements of those systems. Other disciplines have taken that work and applied it to other CAS of society to develop both a better understanding of their ever-expanding networked world, but also find levers available to leaders to adjust their organization to better survive in a world of potentially destabilizing uncertainty.

This theoretical perspective focuses on the organization and the individuals in it as agents or actors in a larger system that is best studied and understood from a holistic perspective. CAS are individual agents (person, molecule, species, and organizations) with the freedom to exhibit diverse and robust varieties of behaviors, including some that are not in accordance with what is in their best interest. These agent actions are interconnected using rules (mental models of reality, such as norms, mores and values) that change over time and that change the context for other agents within the system, who then adjust their actions to adapt to the new environment (Grobman, 2005). An agent in a CAS is a self-learning, self-organizing unit that adjusts to its environment and seeks the adaptations needed to survive in the environment.

The Department of Homeland Security and other regulating agencies that influence critical infrastructure protection schemes have focused their energies on changing the paradigm from one of protection to one of resiliency. The United States Environmental Protection Agency (EPA) regulates water and wastewater public utilities

and suggests an effective protection program should “encourage awareness and integration of a comprehensive protective posture into daily business operations to foster a protective culture throughout the organization and ensure continuity of utility services” (USEPA, 2008). The issue, of course, becomes how does one define resilience and how does this new construct differ from the previous protection paradigm. If utilities are to provide communities with “resilient” critical infrastructure organizations, these public enterprises need to develop the internal ability to adapt to changing environmental conditions. With this new view of the world, an enterprise can begin to both understand how to develop resiliency in the organization that identifies their vulnerabilities and develop strategies to limit their exposure to risk.

The concept of resiliency is relatively new in the critical infrastructure protection lexicon, so little exists in terms of research on the concept. Most of the documentation is in the form of discussion papers and government reports. The definition of “infrastructure resilience is the ability to reduce the magnitude and/or duration of disruptive events. The effectiveness of a resilient infrastructure or enterprise depends upon its ability to anticipate, absorb, adapt to, and/or rapidly recover from a potentially disruptive event” (National Infrastructure Advisory Board, 2009, p. 8). The author thinks this definition limits the scope of the issue to event-based occurrences or an emergency management approach rather than a more holistic approach that views resilience in terms of an organization interacting within an environment. A more complete definition of resilience with an information management focus is “an organization’s capability to maintain its functions and structures in the face of internal or external change, and to respond positively when it can, or to degrade gracefully when it must, consistent with its business interests and investment capacities” (Moody, 2007, p. 98). The key element in this definition is the focus on proactively understanding the environmental conditions facing the organization and then implementing strategies to adapt to those changing conditions. If an ecological definition is considered in line with the idea that an organization and the world in which it exists are CAS, then resilience is the capacity of a system to absorb disturbance, reorganize while undergoing change, and retain essentially the same function, structure, identity and feedback mechanisms. This definition captures the idea

of what it means to be resilient in a complex world. To survive at the edge of complex environments where small changes in condition can yield diverse outcomes making prediction impossible or “on the edge of chaos,” organizational leaders need to understand the elements contained within this ecological definition of resilience:

- The latitude or the maximum amount the system can change before losing its ability to recover.
- An organization or system’s resistance to change that limits its ability to adapt to the changing environmental conditions.
- The precariousness or how close the system or organization is to that chaotic threshold from which recovery is not possible.
- The panarchy or the impact of outside cross-scale interactions that can trigger a surprise shift in the operating environment (Walker, Hollings, Carpenter, & Linzig, 2004).

A resilient organization develops the ability to know where it stands in relation to these aspects at all times and uses this assessment to navigate through its complex environment. Adaptability refers to this capacity to adapt along with agents and actors within the system who express resilient behaviors with the intent to influence environmental conditions. This capacity determines whether the organization can successfully avoid crossing into an undesirable domain or succeed in moving into a desirable state (Walker, Gunderson, Kinzig, Floke, Carpenter, & Schultz, 2006).

In the natural world, a critical organizing principle is that successful organisms rely on multiple, semi-autonomous units or agents that sense the environment and develop solutions toward adaptation. Sagarin (2001) has noted five evolutionary strategies that apply to security issues that foster resilience. One of these strategies is that organisms can form symbiotic relationships with other organisms that allow them to co-exist and adapt to rapidly changing environmental conditions. Similarly, public utilities need to seek out partners in an attempt to solve the wicked problems (those issue difficult to solve because of opposing or ambiguous requirements often difficult to recognize) in the environment. Moreover, because of complex interdependencies, the effort to solve one aspect of a wicked problem may reveal or create other problems.

In nature, change is inevitable and constant. This requires organisms to continue to adapt to stay in the same strategic position. An organization in a complex environment

is no different and the need to adapt is similar if it is to survive and grow. Competing demands (shelter, food, water and procreation) limit an organism's ability to adapt. Enterprises face the same issues with differing demands. For example, where leadership focuses its resources ultimately plays a major role in its adaptability. Redundancy in nature improves adaptability where practical and cost effective, utilities should engage in similar behavior. To adapt, an organism needs to be forward looking, remain agile and adjust to conditions in the environment. It is no different for an organization that must develop the means to interact within the environment, to sense and/or pro-actively address new conditions in the environment if it is to be adaptable (Sagarin, 2001). Ramo (2009) reinforces Sagarin and describes this new reality as the need to build systems that have the ability to adapt under conditions of extreme pressure much like the human immune system's response to flu or infection. "In practice, this means widening how an organization interacts with the world—the better to learn new skills and make new connections—instead of narrowing to the fewest possible essential threats or plans or policies" (Ramo, 2009, p. 178). In other words, a need exists to keep decision-making options open based on the assumption that there is limited knowledge in an uncertain world.

The role of leadership in addressing the challenges faced in this new world is critical. The ability to manage in a more complex world and adjust organizational cultures to address this rapidly changing world will be a primary role for utility leadership in the 21st century. It is the author's contention that publicly owned infrastructure organizations (public utilities like water departments, for example), as with many other enterprises, have yet to develop an understanding of this changing and complex world. As a result, public utility leaders have not allocated the time or resources required to educate management and staff as sensors of the environment nor have they implemented the organizational changes required to meet the challenges posed in the post-9/11 world.

Utilities organized as hierarchal bureaucracies with heavy command and control structures lack the flexibility to adjust to changes within this new environment. A rigid bureaucratic control structure is but one of many constraints on leadership discussed in

further detail throughout the paper. The challenge for any organization seeking to change its culture is developing strategies that define the desired end state and provide organization to achieve that end. This requires an understanding of both the long time continuum required for change and the environmental constraints on an organization that tends to support the status quo. The need to develop leaders throughout the organization with the skill sets needed to conduct effective organizational change is essential for a successful transition as leadership change is inevitable. To achieve this advanced state, utilities need a roadmap that can provide direction toward the development of an organizational culture that fosters resilient behaviors and allows for integrating new core values into the organization.

The term “organizational culture” in this case is synonymous with a wider area of study classically referred to as organizational behavior and more recently as organizational dynamics. This approach focuses on how and why organizations change. The primary debate has revolved around whether an organization recognizes and deliberately adapts to changing environmental conditions, or do these environmental conditions dictate an organization’s ability to survive. Schein (1984) describes organizational culture as a pattern of basic assumptions that a given group has invented, discovered or developed in learning to cope with its problems of external adaptation and internal integration. These assumptions have worked well enough to be valid and taught to new members as the correct way to perceive, think and feel in relation to those problems. Culture then represents an adaptive process that includes a shared set of values that hold an organization together, because these values worked well in the past and because of their success, they have become resistant to change.

Conventional wisdom would lead one to believe that public utility enterprises, if they develop and test continuity of operation plans, should be prepared to respond to and quickly recover from any disaster. This may or may not be true, but to place the primary focus on these plans simply limits the scope of the enterprise in terms of its ability to address the holistic nature of its environmental conditions.

In today's difficult environment, a multitude of risks and constraints exists associated with operating a public utility. Instability occurs because (1) utilities may not be able to generate the revenues necessary to break even, (2) an aging and retiring workforce may strip an enterprise of its corporate knowledge, and (3) aging equipment may impose unpredictable expenses on the government. Contingency plans may not cover all of these situations, and to pretend that one could plan for all possible situations is unrealistic. A resilient enterprise will structure itself in such a manner as to be able to meet the challenges of the environment and still prosper. Those who work in publicly owned infrastructure need to understand that a fundamental change in thinking about its environment is required, and that changes in organizational structures, values and focus are necessary to achieve this adaptive organism-like enterprise.

B. RESEARCH OBJECTIVES

This thesis attempts to answer several questions related to understanding resilience as the term relates to public utilities using the concepts defined above:

- How can publicly owned utilities create a resilient organization that can adapt to environmental conditions in an effort to provide their communities a more resilient critical infrastructure?
- What is/are the process or processes required to adjust organizational culture to adapt to these changing environmental conditions?
- What set of skills and/or training will utility leadership need to manage adaptive organizational change?
- What are the internal and external constraints to organizational change and what is their impact on resiliency?

The goal of this project is to expand the knowledge base on organizational change as that concept relates to publicly owned utilities. This research may also be at least partially transferrable to other public sector organizations that have limited market impact as those entities attempt to adapt to their ever-changing environmental conditions. Future research efforts may focus on validating the findings of this proposal using the same methodology but a different set of subjects, or applying this methodology to another public sector utility.

This research seeks, with the assistance of experts in the field, to begin the process of defining what the elements of a resilient critical infrastructure organization look like, and developing a roadmap that the industry can use to move toward resiliency. Leaders in public organizations may find this work useful in developing or managing organizational change.

C. BACKGROUND

The literature that provides a foundation for this research is varied and broad-based. The body of the academic studies splits into a number of sub-literatures:

- Research on the concept of resiliency and its impact on a critical infrastructure organization;
- A theoretical understanding of cultural change and complex adaptive systems theory and its influence on organizational change;
- An understanding of leadership and its role in the adaptation of an organization to its environment;
- And, an understanding of the constraints and/or obstacles that face enterprises that attempt organizational change.

1. Resilience

The current concept of resilience used in homeland security-related literature developed out of the field of ecology. The concept, when linked with human activity, describes an integrated socio-ecological CAS with the understanding that the system functions with a high level of uncertainty and a need to learn from past events to adapt to future conditions (Berkes, 2007). An organization that uses an ecological model as a means to understand the complexity of its environment sets the foundation for developing resiliency in the enterprise. The firm develops similarly to the adaptive cycle in nature; it initially grows and exploits its environment over time, then moves to a conservation phase where the system is reasonably predictable, but continues to use resources while becoming increasingly less flexible. Inevitably, the system breaks down, as it is unable to withstand the changes in its environment, which gives way to a reorganization phase where innovation and new opportunities are possible (Walker et al., 2004). It is important to understand that this is not a continuous cycle in either nature or the business world but

rather a way of seeing adaptations impact the organization as it moves both forward and backward through the cycle over time. It requires an organization to be forward looking using all available data sensors to gather information and to use that data to make decisions about the environment. If or how an organization gathers data about the environment by using all available sensors (e.g., technical, employees, others in the environment) is a variable in determining how resilient a particular organization may be.

The notion that an organization or institution can learn and adapt to environmental conditions is the essence of adaptive capacity or the ability of agents to influence or manage resilience. Adaptation is not a predetermined outcome but rather a set of behaviors for individuals, institutions and leaders that attempts to influence outcomes (Berkes, 2007). This implies that leaders and others within an organization can positively influence the capability of the organization to adapt if certain conditions exist within that organization. If agents influence the movement of an organization towards resilience or any other cultural adaptation, then measuring that change is possible once a list of variables is developed.

What are those elements needed to build resilience in an organization? At its core, four factors appear to play a role in growing resilience. To live with the uncertainty of the world, an organization needs to develop a shared documented memory of past events to choose appropriately from multiple decision options during a crisis. A change in the way the organization views the world must also occur, abandoning the notion that the world is static and stable. The organization must now accept complexity and chaos as the “new norm.” Specifically, an organization can focus on expanding competencies through education and training and can build excess capacity, which increases flexibility and resilience. An enterprise can work towards developing flexible decision-making structures that empower decision making at the lowest level or where the experts exist within the organization. It can accelerate the feedback loop to provide accurate and timely information to decision makers who can act quickly prior to the system reaching a tipping point and moving into the chaotic domain (Weick & Sutcliffe, 2001). Utilities need to become learning organizations from top to bottom with a focus on the environment in an effort to detect issues early and correct for them prior to reaching that

threshold where organizational failure begins. This requires not only the technical requirements to complete a particular function, but just as important, the ability to educate employees on how the organization functions in the larger environment to prevent disruption and to capitalize on opportunities. Thus, the level and focus of learning in an organization is a variable in determining organizational resilience. Further, by reviewing the existing education and training programs in an organization, leaders can measure the level of resilient behavior.

In nature, diversity or an organism's ability to survive by high levels of procreation, symbiotic relationship with other organisms, camouflage from predators, and the ability to survive on a variety of food sources or in a variety of environments are strategies aimed at reducing risk in the face of a multitude of hazards in the environment. An organization needs to see diversity in terms of the ecological differences in the environment found in the form of people, ideas or economic opportunities (Berkes, 2007). This means that an organization needs to seek out a wide variety of people and ideas to insure creativity and innovation so that new goods and services are developed and that the company grows. These new goods and services need to continue to meet customer demand at a reasonable price point and to be continually developed to meet public taste. For utilities, diversity in this context becomes problematic, as these organizations generally provide only one product, which is heavily regulated and price-controlled. The industry leadership is primarily composed of individuals from a limited number of academic fields (engineering, science). Thus, in many cases, the diversity of thought found in public sector companies is lacking. Utilities were developed during the 19th century and used the managerial and bureaucratic organizational practices of that time that tended to be mechanistic and rigid.

In rigid bureaucracies with a lack of diverse thinking, it is unlikely an organization would be able to develop the adaptive processes that support life in a complex world. These organizations operate in a less than optimal fashion and face a higher probability of failure when placed under stress. The traditional top-down rigid command and control decision-making associated with the bureaucratic model works best in the simple domain as outlined by Snowden (2007) below. As the world has become

more networked and complex, the traditional levers used to manipulate the bureaucracies have become less effective. This can be seen in many public and private sector organizations that fail to understand the environmental conditions of their existence and make ineffective decisions because of not understanding or acting on the current environment. Bureaucracies in the private sector fail in part due to the inefficiencies of corporate bureaucracy. Consumer and stock market pressures and free-market competition also influence organizations using this model. No such discipline exists in government, where bureaucratic failure is perversely rewarded (DiLorenzo, 2002).

Government bureaucracies always fail to live up to their promises because they are not market institutions. As such, there is no possible way of ascertaining how efficiently the bureaucracy runs since there are no profit-and-loss statements in the government sector, only “budgets.” The amount of a bureaucracy's budget has nothing to do with how well it pleases consumers, since there are no consumers in the sense that there are consumers in a private-sector marketplace. (DiLorenzo, 2002, p. 1)

These elements of government bureaucracies lend themselves to the simple domain of inputs and outputs and fail to provide the innovation or creativity required to operate in a more complex environment. A utility that wishes to become more resilient requires a more decentralized or hybrid structure that provides both the accountability required for government service and the flexibility in decision making found in a more decentralized model.

The level of centralized bureaucracy can be determined by looking at a number of different variables. The greater the reliance on networks in an organization and the more links between people will lead to less bureaucratic organizations and where power is shared. The flow of decision making is another variable, if everything is top-down and individuals are reluctant to make decisions without seeking leadership support, then top-down centralized management exists within the organization. This type of structure works well with the simple domain as described below, but as complexity increases, the uncertainty that enters into the decision-making process makes it difficult to choose the correct path for an organization. Indicators of organizations having difficulty managing the complex domains might be the assumption, values and process that had worked in the past no longer seem to address the condition at hand. For example, in the information

technology (IT) domain, the increased demand for mobile technologies and security policies and procedures that had worked well in the past no longer apply in this new environment, potentially exposing the organization to significant loss and leaving IT departments in a lurch.

Another variable in determining resilience is the ability to combine different kinds of knowledge for learning. This concept focuses on seeking out a wide variety of information from multiple sources not necessarily related to the organization and remolding that information to create something new. Bringing these disparate information sources together and focusing on complementary elements of these sources provides new information from which an organization might increase its knowledge. Another variable that may indicate an organization's capacity to develop new learning from disparate sources is the existence of a business intelligence program. Business intelligence may be defined as "the process of analyzing large amounts of corporate data, usually stored in large databases, such as the data warehouse, tracking business performance, detecting patterns and trends, and helping enterprise business users make better decisions" (Gonzalas, 2004, p. 1). Those organizations using these technologies to act as external sensors to the environment and a means to capture that information should use the new information to make decisions about that environment. Such behaviors would indicate that the organization is successfully completing this element of resilience.

The resilience of a system or organization is closely tied to the capacity of its members for self-organization. Due to the complex nature of the world, a need exists for both renewal and reorganization during adaptation (Berkes, 2007). The need to rapidly innovate or create new responses or arrangements to environmental conditions can be improved by applying the process of adaptive co-management. Institutional arrangements and environmental knowledge are tested and revised in a dynamic, ongoing self-organized process of "learning by doing." This is the decision model of "probe, sense and respond" used in the complex domain discussed in detail later (Snowden & Boone, 2007). Adaptive co-management is typically executed by networks of actors sharing power and responsibility and is normally an iterative process of feedback-based problem solving

(Berkes, 2007). In other words, when an organization implements this behavior, it uses teams or groups of interacting agents to solve specific problems where power is shared and the process defines the group.

The application of collaborative problem solving through team activities is another characteristic of a resilient organization. That trait should be seen in internal organizational activities and with other groups in the pursuit of solving problems and issues that impact the organization but are outside its control. An indicator of resilient behavior would be if the organization were engaged with the private sector, non-governmental organizations, and agencies in an attempt to solve issues (wicked problems) that impact all stakeholders in the group (Gerencser, Van Lee, Napolitano, & Kelly, 2008).

2. Organizational Change

A multitude of theoretical perspectives exist dealing with organizational change that have grown out of the disciplines of psychology, sociology, political science, economics and anthropology over the past 60 years, each studying this phenomenon through its own lens. The primary debate has revolved around whether an organization can deliberately adapt to changing environmental conditions or do the environmental conditions determine that organization's survival. As a result, two major areas of thought have developed within the field of organizational behavior, one with a focus on natural evolution and the other on the social dynamics of the group. The primary divergence in the field relates to the level of control exhibited by individuals in affecting a specific desired change. There appears to be a great deal of difficulty in applying the scientific method to this type of behavior. In attempting to control for all possible variables, the scope of the study becomes so limited as to provide little generalized information on organizational change. It is for this reason the focus is on studying publicly-owned utilities using CAS theory to both explain how change occurs, and also the variables in play that allow for change to occur (Demers, 2007).

The construct of natural evolution is the first area of study and traces its roots back to life cycle approaches of the 1970s. The life cycle approach espoused by Chandler

(1962) and Stopford and Wells (1972) sees the organization as a living organism that evolves through a predetermined series of phases from birth to death with each phase leading to increased organizational complexity and specialization. Outgrowths of this perspective are the population ecology and neo-institutionalism perspectives of the 1980s and 1990s. Population ecology, as expressed by Hannan and Freeman (1977), views competitive selection in the population of organizations as the primary driver for change. An organization having the characteristics required for adaptation or securing scarce resources will adapt, and those who do not adapt, will disappear over time and new organizations will continually appear that are better suited to adapt to existing environmental conditions.

Traditionally, science was driven by the quest for truth using the Newtonian paradigm based on a mechanistic philosophy, which states, “the enormous diversity of things found in the world... can all be reduced completely and perfectly and unconditionally (i.e., without approximation and in every possible domain) to nothing more than the effects of some definite and limited general framework of laws” (Bohm, 1951; Dooley, Johnson, & Bush, 1995, p. 3). In this paradigm, understanding the world is a process of reductionism where systems are composed of elements or building blocks. To understand any system, it is necessary to divide into its smallest elements or components and describe how those elements interact. One important implication of the paradigm is that the natural state of any system is in equilibrium and changes to the system occur through directed mechanisms. The concepts derived from this paradigm have carried over to the study of social systems and have had a major impact on how organizations have developed. Many of the characteristics associated with modern organizations and bureaucracies are predicated on the principles of scientific management (e.g., division of labor, specialization) derived from the Newtonian paradigm in which an organization views the world as predictable and it is able to maneuver in a deterministic planned way to achieve desired goals. Snowden would call this operating space the simple domain where cause and effect relationships are easy to determine, everyone understands how to address issues in the environment, directive management is most useful, and best practices are the models for success. In this domain, enhancing systems

performance occurs by optimizing the functional components while the bureaucracy ensures coordination and accountability (Dooley, Johnson, & Bush, 1995). As a result, no need exists to grow resilience in an organization as external elements are static and internal elements are controlled. If this is the case, then an enterprise, if controlled correctly, should grow and prosper to infinity, and yet many start-up businesses fail and, without continuity of operations plans, sustain a much higher failure rate during a crisis. It would seem this approach does not consider situations where the environment is dynamic like a disaster or where rapid changes occur in technology and market conditions. Neither does it attempt to address those situations where heavy internal controls may not allow for the innovation or creativity necessary to drive new product development or ideas.

To address those issues, it is necessary to view an organization differently, as CAS are dynamic and composed of individual agents (e.g., people, groups or organizations) at lower levels of aggregation. Aggregation is the process of individual agents coming together to form a single unit (e.g., team, group). These agents act based on their own individual view of the world, self-interests and understanding of the environment. The system adapts and evolves with the entry and exit of agents and the changes in behavior that results as those agents interact. The organization, although it consists of many individual agents, may develop a character or culture not entirely consistent with the character of the individuals within. An organization, much like an individual agent, will then act based on worldview, self-interest and how it perceives its environment (Dooley, Johnson, & Bush, 1995; Grobman, 2005).

These agents interconnect by feedback loops so that the behavior of each agent influences the others by the information it receives from the other agents to which it is connected. This refers to the concept of self-organization, where no centralized control exists directing an agent's behavior (Grobman, 2005). The dynamic system that emerges is not predictable in terms of the Newtonian paradigm, but rather learning or patterns of learning occur within the organization based on the environment conditions detected and acted on by the individual agents.

These symbiotic relationships among agents exist to improve the adaptation to the environment and cooperation as a means to improve individual chances of survival. The probability of survival for each agent is dependent on the choices made by others. Equilibrium is achievable in this system, but the normal state will be uncertainty, where small changes in behavior by individual agents lead to significant consequences for the entire system. Others can learn the factors that make some agents more successful in the environment, and the resulting adaptation changes the outcomes for the entire system (Dooley, Johnson, & Bush, 1995; Grobman, 2005). Through an unpredictable process of acting and interacting with others, an organization can learn to adapt to its environment. If organizations are CAS and they have the capacity to learn and adjust to their environment, then why do organizations fail?

An organization fails due to an inability to adapt or by adapting too slowly to rapidly changing environmental conditions or become incorporated into another organization through merger or acquisition. Complexity theory posits that a point just short of system collapse exists where the system will maximize its complexity, and as that occurs, an opportunity for innovation and creative thinking occurs to change that system (Grobman, 2005).

The edge of chaos is also the point where small changes in a system can produce cascades of change consistent with the power law. A power law is a mathematical relationship that predicts that a small change can affect a system in a small way or a large way, such that the probability of the amount of change is inversely proportional to the size of the change. (Grobman, 2005, p. 371)

Per Bak first posited this idea of Self-Organized Criticality (SOC). The theory was explained using a sand pile experiment where a single grain of sand is dropped continually on a pile until a single grain of sand triggers either a small or a large landslide. This mimics the conditions where continuous change occurs in an evolving system until it reaches a critical state then abruptly change occurs. These systems are self-organized because they reach this state on their own. This construct is useful in the application of these theories as they relate to organizational behavior, particularly, the paradox for management of creating both a stable and flexible organizational structure.

As an example, an organization can fail if it is too stable due to an inability to grasp market or other environmental conditions. It can also fail if it is so flexible that change is occurring at such a high rate that the organization spins out of control. The edge of chaos then is that location between uncontrolled change and not enough change to be innovative and effective.

Once understood, the ability to function in such an environment would seem to require a particular type of organizational structure to maximize the benefits and insure that enough controls are in place to maintain that location. What might be some of the characteristics of such an organization? One key element it would seem is decentralization that incorporates the traits of flexibility, shared power or empowerment of employees, and some level of organizational ambiguity to create enough anxiety for innovation and creativity to blossom (Brafman & Beckstrom, 2007). Information that passes between agents creates the linkage that both holds the system together and provides the opportunity for growth and discovery. The need to maximize the information flow would seem essential. It would follow that each of these agents is a sensor in its environment, and the greater the number of sensors an organization has, both human and technological, the more likely that organization is to understand its environment. It requires management to solve problems in a less directive manner that allows staff the flexibility to develop multiple options to situations that managers can use to develop an emerging solution. (Grobman, 2005). The assumption of this school of thought is that change is continuous, evolving and incremental and that an organization is seldom in a state of equilibrium, but rather mostly unstable. The next school of thought views change as more episodic in nature. Planned change is usually the result of maladaptive behaviors or failures of some type, or in some cases, are rapid and unexpected changes in the environment that require immediate action (Demers, 2007).

The social dynamics area of study has its roots in the rational and organic adaptation theories of the 1970s. Rational adaptive approaches include contingency theory (Lawrence & Lorsch, 1969), strategic choice perspective (Child, 1972), and resources dependency theory (Pfeffer & Salanik, 1978). While these perspectives differ on the amount of influence a manager has, they all agree that an organization can adapt

existing goals to achieve desired results (Demers, 2007). These theories led to a host of transformational approaches in the 1980s, and are grouped as follows: configurational, cognitive, cultural and political. These approaches differ from the early rational and organic adaptation views in that they view change as not only a cumulative, gradual adaptation to the environment, but that change can also be transformative or revolutionary within an organization (Demers, 2007).

The configurational approach views organizations as composed of tightly interdependent and mutually supportive elements only understood by reference to the whole (Miller & Friesen, 1984), much like CAS, where networked linking agents are best understood by looking at the whole. The political approach to organizational change focuses on power structure and relationships, as best understood as resulting from the possession of resources and control of sanctions and rewards. The cognitive view draws attention to the idea that organizational change has a subjective dimension; the way actors interpret the world influences how they change (Demers, 2007). The cognitive approach based on the notion that an organization is essentially stable and the desired state is equilibrium. If change is to occur in an organization this stable, the current state must be altered under complex physiological conditions because the driving force toward change will be counterbalanced with a force that seeks equilibrium. This restraining force is difficult to counter because physiological defenses or group norms are embedded in the organizational culture (Schein, 1995). To break down these forces, it is necessary to look to the groundbreaking ideas of psychologist Kurt Lewin's approach to psychological processes and organizational change to identify how change occurs within an organization. Of particular interest in this theory are his ideas about motivating change, fostering participative management, using goal setting as a tool for change (Miner, 2007), and the model of unfreezing culture, acting or making a change and then refreezing the organizational to internalize that change (Lewin, 1951).

Lewin's model provides a structural framework from which to understand the linear process of change from ice to water and back to ice in different form. The original state of the organization is a cube, but management realizes an adjustment is required (a different shape); therefore, the need exists to unfreeze or change the tacit assumptions at

the core of an organization. This first stage of change involves preparing the organization for accepting that change is necessary and involves breaking down the existing status quo before a new way of operating can be built. After uncertainty is created in the unfreeze stage, the change stage is where people begin to resolve their uncertainty and look for new ways to do things. People start to believe and act in ways that support the new direction. To accept the change and contribute to making the change successful, people need to understand how the changes will benefit them. When the changes are taking shape and people have embraced the new ways of working, the organization is ready to refreeze. The outward signs of an organization moving into the refreeze phase are a shift or return to a more stable form and back towards the equilibrium. The refreeze stage also needs to help people and the organization internalize or institutionalize the changes. With this new sense of stability, employees feel confident and comfortable with the new ways of working.

For Schein, organizational culture was the key to understanding change. Using the Lewin model, he developed a three-tiered model to explain the interrelationships between the elements of organizational culture (see Figure 1). At the top level are the artifacts of culture—those items that can be seen, such as technology, art, or pattern of behavior for example. These artifacts may provide some insight, but to garner additional understanding, it is necessary to dig deeper into the organization values. These values reflect what the organization seeks to be, not necessarily what the organization is today. Their purpose is to drive behavior towards organizational goals, and over time, if successful, the values will become internalized in the organization as tacit or basic assumptions. These assumptions, if taken for granted, lie at the core of the organization. The values can define how people relate within the organization, as well as how these individuals function or do their work. These assumptions become the key elements taught to new members that define a group and its function inside an organization. These tacit assumptions provide the basic glue to hold an organization together and provide the primary restraint to organizational change.

Since these tacit assumptions or ideologies are the glue that holds organizations together, and as such, are resistant to change, Schein expands upon the Lewin model to

provide further understanding in how to understand and manage change in an organization. For Schien, all forms of learning and change start with some level of dissatisfaction or frustration generated by data that fails to confirm to expectations or hopes and provide the force to change the equilibrium in self and organizations (Schein, 1995). Disconfirming information is not enough to move people to action or change as they may not agree with the changes, or they may find the information provided as not credible. A need exists for the individuals to accept the information and connect it to something they care about before that change can occur. Schien calls this state “learning anxiety” or that uncomfortable feeling that occurs when entering the learning or change process that indicates something is wrong and that challenges the individuals’ effectiveness, self-esteem, and at some level, their very being. Therefore, this is a restraining force to change, and as Lewin stated, to initiate change, a need exists to help people reduce this anxiety by creating a safe psychological environment, but if the environment is too safe, then change will not occur (Schein, 1995; Schein, 1993). This tension between learning anxiety and physiological safety parallels the notion of the “edge of chaos” or space between the complex and chaotic domains in the Cynefin framework discussed below. The idea of unfreezing an organization to make changes uses a more linear and episodic context for change than would CAS theory, but the elements for change appear to be similar.

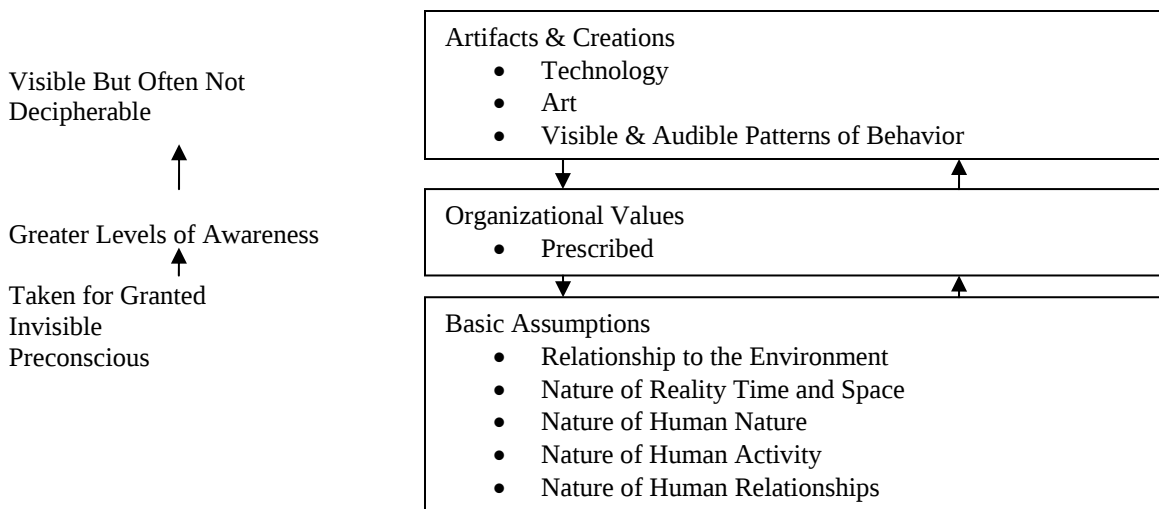


Figure 1. Framework for Understanding Organizational Culture (From: Schein, 1984)

Schein also draws upon Lewin's notion of "cognitive restructuring" or the reframing or frame breaking necessary to initiate change in the second phase of the model when individuals internalize the behavior associated with the change. This process occurs as new information enters the system and reevaluation happens due to one the following impacts.

- Semantic redefinition is the idea where people learn that words can have different meaning than previously known and that new meaning changes the context or meaning of the situation.
- Cognitive broadening is the idea where people understand a given concept in much broader terms than they originally understood it to mean.
- People can develop a new standard of judgment or evaluations where they learn the anchors (values, norms and attitudes) they used previously to make judgments are not absolute when those anchors shift and then they adjust their judgment accordingly.

As new information enters this environment, genuine learning and change can occur as these elements create the framework for a motivated individual to learn, but this framework does not necessarily control the direction of that learning. For learning to occur, one of the two following mechanism must be in play: (a) learning through positive (mentor) or negative role model (marine drill instructor), or (b) trial and error based on scanning the environment (Schein, 1995). The concept of using role models to direct change is straight forward as discussed in terms of the role of change agents in episodic change (Weick & Quinn, 1999), or the Schein (1993) concept of using mentors to facilitate psychological safety and cognitive redefinition. The idea of scanning for new information in the environment that may reveal the solution to an issue or problem is less management directed and leans back toward the notion that humans are adaptive to nature and have the ability to self-organize. It is clear that for learning based on trial and error to occur, an environment of psychological safety must exist in which employees feel free to experiment with various new mental schemas. These new mental models of that learning organization will lead to the tacit assumptions that become organizational culture (Weick & Quinn, 1999; Schein, 1993).

Weick and Quinn (1999), in their analysis of continuous (adaptive) change and episodic (directed) change using a model for explaining compressive change in

organizations, find that the differences between the two reflect the perspective of the observer (see Table 1). In their macro-level analysis, what seems to be repetitive actions and routines with infrequent episodes of revolutionary change, upon a closer view, are ongoing adaptation and small adjustments that can lead to change in strategy and structure.

When speaking of developing resiliency in a public utility, the need to understand and manage change from either perspective is required for two reasons. In the event of rapid unexpected change, such as a natural disaster, the need for short run adaptation is necessary if the organization and its systems are going to survive and serve the community. Change is part of everyday life and occurs everywhere. The ability to manage in a complex environment is necessary to mitigate against those rapid and unexpected changes in the environment. For utility managers, the ability to understand their roles as change agents or sense-makers and the intervention strategy associated with each perspective is critical in successfully managing whatever situation arises. What is important is to understand that these are not mutually exclusive perspectives, and both add value dependent on the situation.

There are times when maladaptive behavior occurs in organizations and management must implement change to address that behavior. This concept of examining change as both an episodic and evolutionary occurrence provides the framework for management to understand organizational culture and adjust it using an episodic intervention. From the intervention theories, it can be seen that each perspective starts from a different point and thus changes the flow of Lewin's model. The episodic change perspective follows Lewin's model, where the organization starts at a point of equilibrium then moves in a linear fashion through the process returning to a new equilibrium. The continuous change perspective starts with the idea that an organization that is in continual flux to effect change management will need to freeze or stop that momentum so that reinterpretation and rebalancing of the change can occur before returning to that state of flux or continuous change (see Table 1). This perspective provides a model that uses complementary elements of both CAS theory and cognitive approach to change management.

This line of thought dovetails with the social dynamic theories in that actors make rational choices that drive social dynamics, where in CAS, that same behavior looks like the freedom to act using mental models of the world. Thus, both areas of study provide information to understand change in complex adaptive systems; they differ in the amount or level of control they give an individual.

Table 1. Comparison of Episodic and Continuous Change (From: Weick & Quinn, 1999)

Properties	Episodic Change	Continuous Change
Metaphor of Organization	Organizations are static and change is infrequent and intentional.	Organizations are emergent and self-organizing, and change is constant, evolving, and cumulative.
Analytic framework	Change is an occasional interruption from equilibrium and is seen as a failure of the organization to adapt its deep structure to a changing environment. Perspective: macro, distant, global Emphasis: short-run adaptation	Change is a pattern of endless modifications in work processes and social practice. Is caused by organizational instability and alert reactions to daily situations. Perspective: micro, close, local Emphasis: long-run adaptability.
Ideal Organization	The ideal organization is capable of continuous adaptation.	The ideal organization is capable of continuous adaptation.
Intervention Theory	Change is created by intention. Change is Lewinian: inertial, linear, progressive, goal seeking, motivated by disequilibrium, and requires outsider intervention. 1. Unfreeze: disconfirmation of expectations, learning anxiety, provision of psychological safety. 2. Transition: cognitive restructuring, semantic redefinition, new standards of judgment. 3. Refreeze: create supportive social norms and make change congruent with personality.	The change is a redirection of what is already under way. Change is Confucian: cyclical, processional, without an end state, equilibrium seeking, eternal. 1. Freeze: make sequences visible and show patterns through maps, schemas, and stories. 2. Rebalance: reinterpret, relabeled, re-sequence the patterns to reduce blocks, use logic of attraction. 3. Unfreeze: resume improvisation, translation, and learning in ways that are more mindful.
Role of the Change Agent	Role: Prime mover who creates change. Process: focuses on inertia and seeks points of central leverage.	Role: Sense maker who redirects change. Process: recognizes, makes salient, and reframes current patterns.

3. Leadership

The role of leadership within an organization has been under study since the late 1930s when psychologist Kurt Lewin set out to identify different styles of leadership. While further research has identified additional specific types of leadership, this early study was very influential and identified three major leadership styles. In the study, he placed groups of schoolchildren into one of three groups with an authoritarian, democratic, or laissez-fair leader, respectively. The children completed a directed arts and crafts project. Lewin observed the behavior of children in response to the different styles of leadership. Lewin found that decision making was less creative under authoritarian leadership and the abuse of this style is usually viewed as controlling. He viewed democratic leadership as the most effective because leaders allow the group to participate in decision-making processes that affect their lives. In this study, children in the democratic group were less productive than those in the authoritarian group, but their quality of their contribution was much higher. Lewin also found that it is more difficult to move from an authoritarian style to a democratic style than vice versa. The children in the laissez-fair group were the least productive of all the groups. In this group, the children made more demands on the leader, showed little cooperation and were unable to work independently. Leaders offered little guidance and abdicated decision making to the group (Lewin, Lippit, & White, 1939).

Bass expanded on these concepts to develop a theory of how leadership transforms organizational culture and how culture influences leadership that he described as transactional/transformational leadership (Bass & Avolio, 1993). The Bass theory will provide insight into the potential skill set required to lead change within organizational cultures. The theory also provides a starting point to classify organizational cultures using the constructs of transactional and transformational leaders (Bass & Avolio, 1993). For Bass, it is important to note that a symbiotic relationship exists between leadership and organizational culture. Leaders, by focusing on those issues they feel are important and by setting directions, help form the cultural assumptions and norms within the boundaries of the culture. In other words, leaders, if not explicitly, certainly implicitly by their actions, direct the formation or adjustment of norms and values within the culture. Much

like Schein, Bass would argue that organizational culture also develops those leaders through its tacit assumptions, and therefore, for an organization to develop the ability to change, it needs to develop the tacit assumptions, values and norms that support organizational change.

It would be consistent for Bass to see changes as both episodic and evolutionary. Episodic change becomes necessary to address a situation or event that occurs within the environment (internal or external) that requires a change in culture or direction. It is the role of leaders to adjust the organizational vision and refocus resources to address these critical situations. Change can also be evolutionary provided a level of physiological safety exists that allows for new ideas to generate and experimentation to occur or when new members join the organization with different norms and values that challenge existing culture.

Bass saw two-archetype leadership styles, transformational leadership characterized by the “four I’s” (idealized influence, inspirational motivation, intellectual stimulation and individualized consideration). The archetype characteristics are built on the assumptions that people are trustworthy and purposeful and each has a unique contribution to make to the organization and that complex problems are best handled at the lowest level possible (see Figure 2). Transformational leaders exhibit a sense of vision and purpose and have the ability to align others along that vision through facilitation and teaching. They seek to develop a culture of creativity and innovation where change and growth are the norms. Transactional leaders develop exchanges or agreements with their followers, pointing out what the followers will receive if followers do something right, as well as something wrong. Transactional leaders work within the existing culture, framing their decisions and actions based on the operative norms and procedures that characterize their respective organization (Bass & Avolio, 1993). For Bass, this model is not a continuum on which an individual or organizations leadership group would be placed; rather, both leaders and organizations need to have parts of each type of leadership dependent upon organizational environment and needs (Trottier, VanWart, & Wang, 2008).

To assess the type of leadership style found in an organization, Bass developed a 28-item survey. The Organizational Description Questionnaire (ODQ) measures the leadership style within a culture. The ODQ generates two scores: the Transactional Culture (TA) score and the Transformational Culture (TF) score. He used the mean score obtained from respondents to describe the leadership style. This survey provided managers a starting point from which to view and measure their current culture with the goal of moving that culture in a direction to meet the goals of the organization.

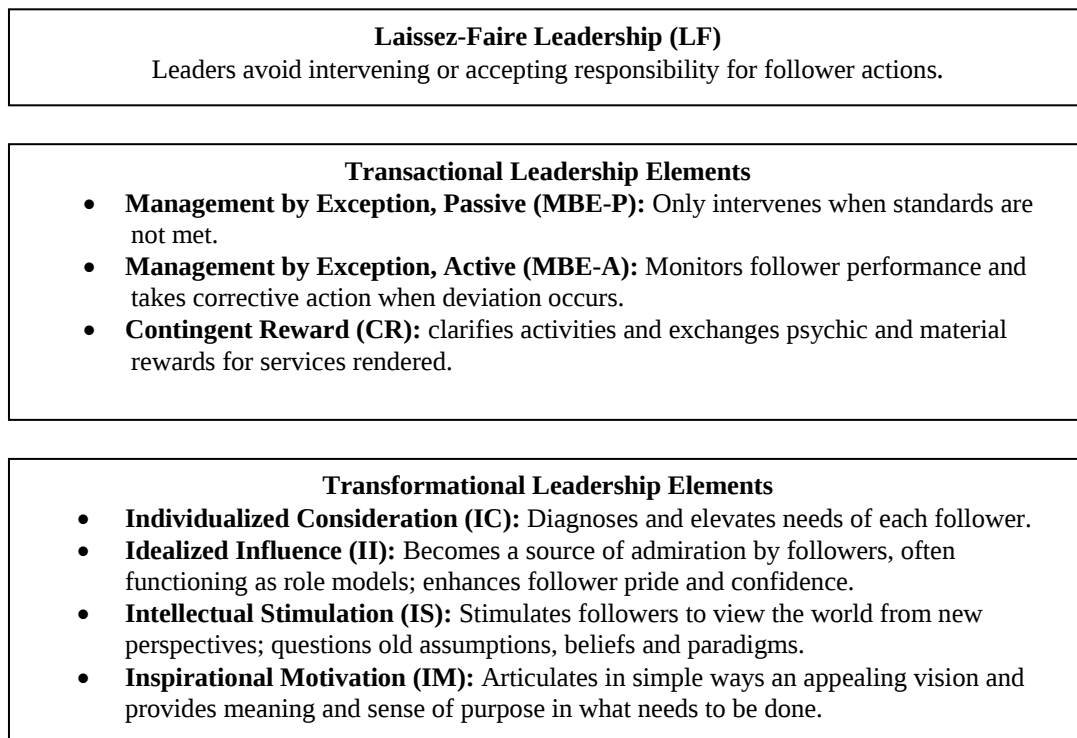


Figure 2. Bass's Leadership Styles (From: Trottier et al., 2008)

Bass defines nine organizational leadership cultures: predominantly/moderately transformational, high contract, coasting, predominantly/moderately contractual, pedestrian and garbage can based on the styles noted in Figure 2. He characterizes the predominantly transformational and moderate-transformational organizations by organizations constantly talking about vision, value and fulfillment without the need for formal agreements or controls. The organizational structure is likely to have trust as an internalized norm or value and is likely to be loose, decentralized and flat. This type of

organization is dynamic, flexible, and adaptive to changing conditions as individual employees seek to grow and improve the organization. Employee and organizational creativity and innovation are likely bi-products of this type of organization due to high levels of experimentation and the continual questioning of the current state of affairs within the group. As the transactional score increases, the culture will reflect greater emphasis on agreement, exchanges and rewards for performance that will lead to greater balance (Bass & Avolio, 1993).

A high-contract organization is characterized by high levels of both transactional and transformational scores, which leads to conflict within the organization as to which way is best to proceed. A pushback against the current set of rules or organizational culture is likely to occur, but much of this conflict can be constructive. The organization is not highly structured and most of what is accomplished is the result of informal relationships. Trust is required to get things done, but this type organization can easily break down due to lack of formal structures and controls when trust fails. A coasting organization is neither transformational nor transactional. External controls are balanced with an effort to generate self-control. This organization generally maintains its current position with little change and tends not to do as well as might be expected given the resources and opportunities it possess (Bass & Avolio, 1993).

High transactional scores that translate into a large number of control, directions, and standard operating procedures characterize the predominantly and moderately contractual organizational cultures. Self-interest and short-term goals prevail, trust in many cases is non-existent, and actions occur through negotiating the rules of the game. The organizational structure is stable, has a top down command and control, and centralized where employees have little discretion and are watched and controlled. The organization looks like a traditional 19th century bureaucracy—rigid and mechanistic. The pedestrian organization is moderately transactional with little or no transformational leadership and little occurs without formal agreements. It is a risk adverse environment and change is minimal. By in large there is little commitment to the organization or others in the organization, leaders believe they have little discretion and conduct business in a management by exception mode with all things being black and white. Based on

Gerstberger's (2010) study of utility leadership discussed below, many publicly owned utilities might be categorized as pedestrian. The "garbage can" organizational culture is lacking any leadership and little consensus with everyone going their own way. Anarchy would be the best way to describe the organization that has little purpose, vision or values and lacks any rules or regulations to control activities (Bass & Avolio, 1993).

If Bass's theory is accepted, then it would follow that enterprises seeking to become more resilient would look to develop a more transformational leadership style within the culture. Looking to other research to validate this theory in an environment similar to public utilities, Trottier, Van Wart and Wang conducted a study of federal employees. The goals for this study were to determine the inclusiveness of Bass's full range theory, to see how much impact Bass' theory had on the level of follower satisfaction, and to determine how important transformational leadership was compared to transactional leadership in a government setting. For the purpose of this paper, the second two questions are of primary importance, using the Federal Human Capital Survey (FHCS) of 2002 that addresses organization performance, leadership and employee satisfaction through a 118-question survey. Trottier, Van Wart and Wang (2008) measured five leadership dimensions as outlined by Bass—management by exception, contingent reward, idealized influence, inspirational motivation and intellectual stimulation—using 20 items from the FHCS.

The finding of the study suggests that the amount of perceived leadership effectiveness captured in Bass's theory is quite high. Based on the data, it appears that federal managers were much more likely to exhibit transactional rather than transformational leadership competencies. The need for compliance and the rule-based mentality of the federal bureaucracy may suggest that this finding is the result of internal environmental conditions. The data also highlight that although federal managers excel at the transactional competencies, their followers place a higher importance on effective leadership in the transformational dimensions (Bass & Avolio, 1993). These findings suggest that in high bureaucratic organizations like utilities, researchers should expect to

find managers who are most at home with a transactional leadership style. They should also expect to find employees who desire more individual freedom in decision making that is associated with a transformational leadership style.

When looking at follower or employee satisfaction, the same three dimensions (individualized consideration, idealized influence and inspirational motivation) were virtually tied in terms of contributing to follower's satisfaction. The key competencies noted for effective leaders to achieve follower satisfaction were trustworthiness, being considerate of follower's needs and talents, being able to instill motivational enthusiasm, and a sense of empowerment. This supports Covey's notion in the "Speed of Trust" of the four cores (integrity, intent, capabilities and results) and the thirteen behaviors or competencies that lead to trusted relationships both individually and within organizations (Covey & Merrill, 2006). These 13 competencies (talk straight, demonstrate respect, create transparency, right wrongs, show loyalty, deliver results, get better, confront reality, clarify expectations, practice accountability, listen first, keep commitments, and extend trust) are the building blocks to develop the organizational trust required to both develop transformational workplaces and breakdown the barriers that exist within utilities and between utilities and their stakeholders.

Based on the study of federal employees, leadership has a huge effect on follower satisfaction, and the transformational elements are more important to achieving that goal than are transactional (Trottier et al., 2008). It seems that the federal experience documented in this study should be translatable to the current environment of many publicly owned enterprises. There is a high level of confidence that assessing an organizational leadership culture using the ODQ will provide management with a baseline from which to develop a transformational culture. The goal for managers is to find that "sweet spot" between highly transformational cultures and the development of sufficient transactional elements: agreement, exchanges and rewards for performance that will lead to balance within the organization. To develop that leadership style and the competencies associated with it will require the organization to build trusted relationships, and Covey can provide some insight into that process.

Regardless of the organization, its mission and vision or its offering to the public, all activity is relationship driven. Covey's formula where trust influences both speed and cost is one key to understand how to affect organizational change. As an organization builds trust relationships with key stakeholders and employees, speed increases and costs go down, which in turn, increases profitability. Covey makes the case that practical economic impacts exist for low trust relationships and interactions that he refers to as a low trust tax or the hidden variable in the traditional business formula.

All human interaction requires the proper alignment of structure within a group to develop an effective level of trust. If, however, a sufficient level of trust in an organization does not exist, it is necessary to look to realign the structures and systems that communicate trust within the culture. To affect cultural trust, Covey notes several elements found in a low trust environment that leadership can adjust to improve that environment, which the following.

- Redundancy is expensive and while required in some critical infrastructures on particular systems or programs, it is an unnecessary duplication within an organizational structure, and is normally the result of excessive control on the part of management.
- Bureaucracy adds complex rules, regulations, policies, procedures and processes to the organizational structure. These practices add cost, reduce speed of service by creating inefficiencies, and in many cases, focus on retaining the status quo rather than seeking continuous improvement. Stripping away costs is an important element of any strategy and eliminating or reducing the bureaucratic structure is one way to drive that cost reduction.
- Office politics or the use of tactics and strategy to gain power is self-defeating in a high trust environment. Leadership needs to reward collaboration, information sharing, teamwork and achieving desired results to refocus the organizational culture away from those other behaviors that waste time, energy, and money.
- Employees become disengaged from the organization when they do not perceive they are trusted and simply show up for a paycheck. Low trust creates disengagement and increases turnover of those employees an organization wants to keep. This turnover is expensive, up to two times the cost of the annual salary to replace exiting workers.

- Leadership needs to reward behaviors that empower employees to make decisions at the lowest level possible, creating a culture that expects and rewards innovation and creativity and does not punish or require unnecessary approval to try out new ideas and processes.

If trusted relationships are necessary for utilities to strip out costs and empower employees, the current top-down bureaucratic structure that epitomizes most utilities may need to be adjusted or eliminated. If one looks at the elements of a “starfish” or decentralized organization, many of the elements require the level of trust as outlined by Covey. To some degree, the ability of an organization to decentralize and establish and grow trusted relationships are a key to leadership competence in the new economy. Utility leaders have not been tasked or provided with the tools to address the changes required in organizational structure to become that adaptive organism like organization.

Change by its nature threatens the status quo and may increase resistance to change from employees, business partners and the public. Transparency and communication are the key issues in dealing with these stakeholders and is another way of confirming the need for trusted relationships to be in place for an organization to move forward. The development of innovation and creativity can occur in any type of organizational structure but is less likely in rigid command and control organizations due to lack of trust usually found within that organizational structure. It is much more likely that the ideas will be developed and implemented in decentralized or hybrid organizations built on trusted relationships. If an organization is to survive in the global environment, it needs to be both innovative and resilient. Innovation drives long-term profitability and value that leads to long-term success. This creativity is generally located on the “edge of chaos” or in the chaotic domain and requires leaders who understand the complexity of the world and know how to respond. Bureaucratic rules driven structures tend to inhibit creativity by focusing on the process rather than the results and change only as the result of external pressures that push the organization to that point where traditional solutions (cause and effect) no longer work. Resiliency or the ability to understand and react positively to the environment requires relationships based on trust found both within and

outside the organization. Leadership in public utilities, given the constraints in the operational environment, need to focus on developing a hybrid organization if these organizations are to meet the challenges that lie at the core of a complex world.

Gerstberger and Gromala, at the request of the EPA, other utilities-related associations and the American Water Works Association (AWWA), conducted a study of public utility leadership. With an aging workforce and an average attrition rate of 8%, employee turnover in utilities will reach almost 50% by the year 2015 so that most utilities will see 50% of their institutional knowledge walk out the door by 2015 (see Figure 3). Research indicates that there are few people in the general population with the necessary skills to manage and operate these highly technical operations. This will require utility management to articulate a vision for the organization and then align resources and develop human resources to meet that vision.

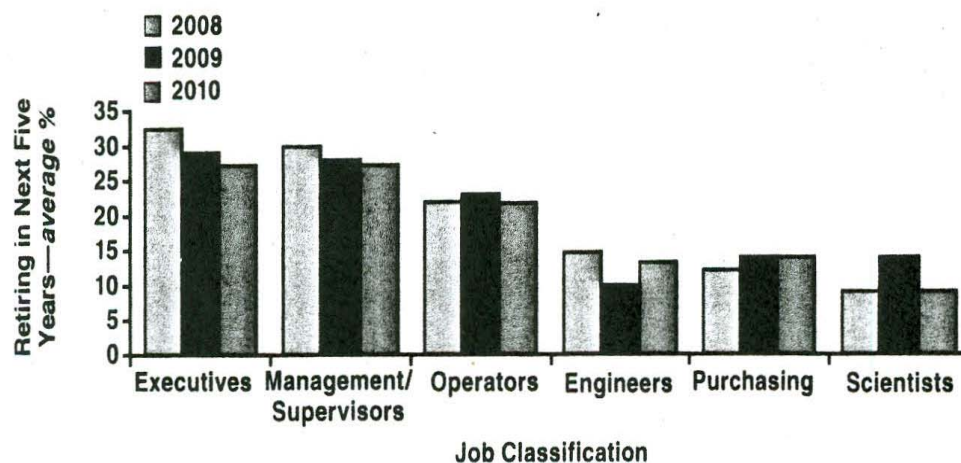


Figure 3. Utility perspective (2008–2010) on expected retirement over next five years (From: Mann & Runge, 2010)

Historically, managers in utilities come through the ranks with skill sets primarily in engineering and science. If the utility does not have a strong management development program, the likelihood is that most persons in management positions will lack the skills or will to manage effectively. In his article “Using Leadership to Make Policy Work,” Jamison notes adaptive challenges, or the ability to learn new ways of changing attitudes,

values, and behaviors is necessary if utilities are to adapt to new environmental conditions. He notes one of these adaptive challenges in a story about utility leaders at a conference to discuss key issues for the industry. After several days of talking around the constraints associated with achieving a desired set of goals, they simply tune out or walk away from the problem that seems to overcome them (Jamison, n.d.). This tendency to walk away from the difficult issue is not unique to utilities, but it does show a lack of transformational leadership that otherwise will be required if utilities are going to actively manage their organizational cultures. In Gerstberger and Gromala's study of 300 water and wastewater managers from 10 organizations, the evidence indicates that managers lack either the tools or the will to face the adaptive challenges that face utilities today.

Their research was based on the assumption that every organization provides value to its customers. For any organization to accomplish that mission, its leadership alignment must fit that particular customer focus. Using Treacy and Wiersma's (1996) typology of core focus for an organization, Gerstberger and Gromala identify operational excellence as the core focus for utilities. The operational excellence focus "provides customers with consistent, reliable and dependable products or services at low cost and at appropriate quality. The organization often dominates its marketplace, can involve life-death situations, and is distribution intensive" (Gerstberger & Gromala, 2010, p. 47). This focus in the study provided a comparative database to measure managers' responses from organizations with a similar focus. These scores develop set target ranges for the expected scores for the 22 attributes or behaviors used in the survey instrument. The data were used to create a competency map by job classification for the organization that measures management's surveyed results against the organization's competency map.

They used a nonjudgmental 360-degree survey instrument that measured the intention or energy that an individual put toward 22 management attributes or behaviors. The 360-degree review consisted of scoring an individual's leadership competencies by immediate supervisor, peers and employees who reported to the individual. An analysis of these scores determined the average number of points outside the expected range as determined by the utility. Interestingly, on all scales, the results indicate that managers self-reported scores were between 10 and 35 points out of the expect range. In most

cases, direct reports rated their managers as being further out of range than did peers and self-reporting managers. This indicates that managers in the study are neither meeting the expectations of performance set by the utilities management or follower expectations of effective management.

In reviewing the responses provided in the study, Gerstberger and Gromala provide some unsettling conclusions. The utility managers studied exhibited the following attributes.

- Most managers were comfortable with the technical and process side of their work.
- Managers tended to be cautious and focused on what worked in the past to provide answers to issues.
- Managers indicated they were reluctant to lead or manage and reluctant to hold employees accountable.
- Managers refrained from monitoring what was occurring in the organization.
- Employee saw managers a significant less aligned with the organization's competency map or less competent in their managerial duties.

The research results indicate that utility managers, for the most part, lack leadership and strategic focus. The research also indicates a backward looking or reactive rather than pro-active worldview. It seems apparent that managers in this study lacked the will to manage as well. This behavior may be explained in some part by the controlled environment in which these managers must operate. This behavior may also indicate that public utilities may not place emphasis on strong internal organizational development programs where management and leadership skills are nurtured.

To assist managers in understanding and negotiating in this complex world, a new way of seeing the environment is required. If this idea is accepted, then an organization is a complex adaptive system that exists in a world of uncertainty. Thus, the traditional managerial approaches that focus on the environment as static will be ineffective. To survive and grow in this environment, utility leaders must have a framework from which to make decisions in a world of uncertainty. Snowden and others have built an approach to develop a decision-making framework that assists leaders in understanding their organizational cultures' relation to a complex world and provides strategies to help guide

the organizations through that complex environment. The Cynefin framework or model for decision making begins with the understanding that the world is complex and dependant on the level of complexity, and therefore, different decision-making processes are required. It is a framework rather than a categorization because the data patterns drive where the domains for the organization ultimately fall, rather than plotting data within a pre-described set of categories or types. The framework is graphically presented in Figure 4.

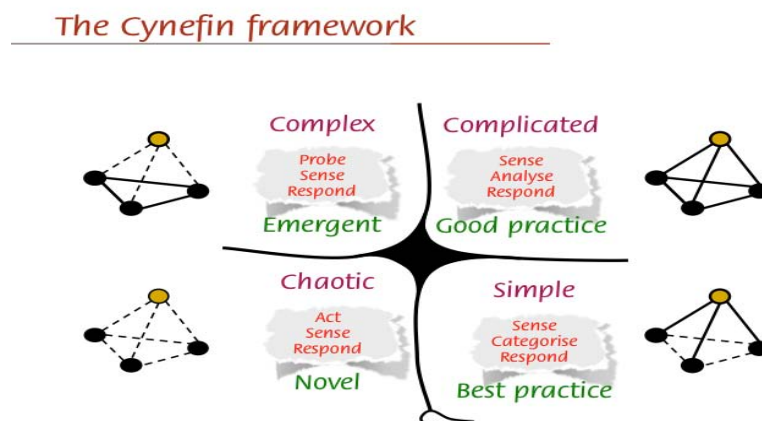


Figure 4. The Cynefin Framework (From: Snowden, 2010)

The framework can be seen as four contexts or domains defined by the nature of the relationship between cause and effect. Four of these domains of activity or decision making require leaders to understand and act in contextually appropriate ways. The framework can assist the leader's ability, sensing which context they are in to make better decisions (Snowden & Boone, 2007). The area to the left and in the center is disorder where no cause and effect relationships or emergent solutions to problems exist. Manipulating organizations away from disorder and out of chaos is the first responsibility of leadership.

The line between domains signifies the need for a change in thinking. The movement between simple and complicated, and complicated and complex is transitional, whereas the line between simple and chaotic is a cliff, where movement is limited one way and disastrous as when moving from simple to chaotic. Most leadership training

equips people to operate in the ordered domains (simple and complicated) and relies on the individual's natural capability to function in the complex domains (complex and chaotic). With increased volatility in the world today, organizational leaders need to have tools to assist them in sensing change and adapting to domain changes in the environment if they are to manage effectively and grow their organization (Snowden & Boone, 2007).

The simple domain characterized by stability where clear cause and effect relationships are the norm and all members of the organization clearly understand what needs to be accomplished. This context requires traditional management and monitoring, where the decision-making model is sense, categorize and respond, and best practices lead to success. In heavy process-oriented situations, command and control structures may work best because employees have clear information and instructions and understand how to address the situation. Little need for communication exists, as staff understands how to function and little disagreement about what needs to happen occurs. Adhering to best practices, in most cases, will provide successful completion of the function or task (Snowden & Boone, 2007). An organization will want to limit its exposure in this simple domain due to the real possibility of catastrophic failure that exists when the organization moves into the complacency zone near the cliff between the simple and chaotic domains. Leaders need to avoid micromanaging and must focus on the environment to spot the need for changes and to provide a conduit for employees (acting as sensors) to communicate early warnings about complacency and change (Snowden & Boone, 2007).

The complicated domain is characterized by multiple answers that correctly solve organizational issues and cause and effect relationships that are not clearly defined. The decision-making model is sense, analyze and respond. In the complicated context, expertise is required as many good options to addressing a given problem may exist, and therefore, good practice is a more appropriate response. "Good Practice" refers to executing a function or task using a recommended or approved methodology as opposed to "Best Practice" that refers to completing a function or tasks with a method that provided improved performance as recognized by peer organizations. Good practice is used in this domain because those cause and effect relationships are not as easily

detected. This ambiguity requires the need for experts to assist in the decision-making process using less precise tools and methodologies. The dangers in this domain are that the experts may dominate the conversation and limit innovative or creative solutions. They may also hit a stalemate and be unable to agree on any solution. Leaders can attempt to address these dangers by changing the environment of the experts and using game playing to encourage novel thinking and solutions. In this domain, decision making can be time consuming, as there is a tradeoff between finding the right answer and making a decision with less than complete data (Snowden & Boone, 2007).

In the complex domain, correct answers cannot be determined. This is the realm of the unknown-unknowns where the decision-making model is probe, sense and respond. The vast majority of decisions today fall into this complex context due to the unpredictable conditions found in the world. These conditions require decision makers to probe or conduct safe-to-fail experiments in an attempt to understand the patterns that emerge through this process and then respond accordingly. The challenge for leaders in this domain is the temptation to fall back into traditional input-output management practices of the simple domain when success seems out of reach. The natural state of this domain is uncertainty and failure, so quick results are seldom achievable and time is required to understand the emergent patterns to make good decisions (Snowden & Boone, 2007).

The chaotic context is the domain of rapid response as there are no right answers and the relationship between cause and effect is impossible to determine due to the constantly shifting patterns. The leadership model in play in this domain is “act, sense and respond” with the first responsibility being to establish order, and then sense, where stability is present, and respond by transforming the situation from chaotic to complex where patterns can be discerned. Communication in this domain is top-down and directed in an effort to return the organization to some stability. In this domain, the ability to innovate is higher than the other domains due to the crisis that requires “all hands on deck” and a drive toward a specific set of goals and objectives to address the situation. People are more apt to except novelty and directed leadership under these conditions so the ability to change an organization is greatest in this domain. The paradox, of course, is

that if the leaders fail, it is likely that the organization will cease to exist; so, as a rule, leaders should work to stay out or only minimally enter this domain (Snowden & Boone, 2007; Browning & Boudes, 2005).

Table 2. Decisions in Multiple Contexts: A Leaders Guide (From: Snowden & Boone, 2007)

Context or Domain	The Context's Characteristics	The Leaders Job	Danger Signals	Response to Danger Signals
Simple	Repeating patterns and consistent events Clear cause-and-effect relationships evident to everyone; right answer exists Known-knowns Fact-based management	Sense, categorize, respond Ensure that proper processes are in place Delegate Use best practices Communicate in clear, direct ways Understand that extensive interactive communication may not be necessary	Complacency and comfort Desire to make complex problems simple Entrained thinking No challenge of received wisdom Overreliance on best practice if context shifts	Create communication channels to challenge orthodoxy Stay connected without micromanaging Do not assume things are simple Recognize both the value and the limitations of best practice
Complicated	Expert diagnosis required Cause-and-effect relationships discoverable but not immediately apparent to everyone; more than one right answer possible Known unknowns Fact-based management	Sense, analyze, respond Create panels of experts Listen to conflicting advice	Experts overconfident in their own solutions or in the efficacy of past solutions Analysis paralysis Expert panels Viewpoints of non-experts excluded	Encourage external and internal stakeholders to challenge expert opinions to combat entrained thinking Use experiments and games to force people to think outside the familiar

Context or Domain	The Context's Characteristics	The Leaders Job	Danger Signals	Response to Danger Signals
Complex	Flux and unpredictability No right answers; emergent instructive patterns Unknown-unknowns Many competing ideas A need for creative and innovative approaches Pattern-based leadership	Probe, sense, respond Create environments and experiments that allow patterns to emerge Increase levels of interaction and communication Use methods that can help generate ideas: Open up discussion (as through large group methods); set barriers; stimulate attractors; encourage dissent and diversity; and manage starting conditions and monitor for emergence	Temptation to fall back into habitual, command-and-control mode Temptation to look for facts rather than allowing patterns to emerge Desire for accelerated resolution of problems or exploitation of opportunities	Be patient and allow time for reflection Use approaches that encourage interaction so patterns can emerge
Chaotic	High turbulence No clear cause-and-effect relationships, so no point in looking for right answers Unknowable Many decisions to make and no time to think High tension Pattern-based leadership	Act, sense, respond Look for what works instead of seeking right answers Take immediate action to reestablish order (command and control) Provide clear, direct communication	Applying a command-and-control approach longer than needed "Cult of the leader" Missed opportunity for innovation Chaos unabated	Set up mechanisms (such as parallel teams) to take advantage of opportunities afforded by a chaotic environment Encourage advisers to challenge your point of view once the crisis has abated Work to shift the context from chaotic to complex

Most managers are comfortable in the simple and complicated domains as their training and experience can guide them in these contexts. A need seems to exist to develop tools and training for operating in the complex domain due to managers' lack of understanding or experience in the complex domains (Complex, Chaotic), and the fact that more decisions are being made in these domains. Snowden and Boone outline some tools to help managers operate in this context. Their complex domain requires greater

communication, and managers who initiate group discussions across the organization can help people generate innovative ideas while providing management with options for developing and executing complex strategies (see Table 2). This speaks to both Covey (2006) and the need for trusted relationships, and Weick (1999), who spoke to the need for open communication in the continuous change process. A need exists to develop barriers or delineate behaviors so that the system can self-regulate within the boundaries where participants police themselves. This speaks to a norm-driven rather than a rules-driven set of behavior controls characteristic of decentralized organizations and requires management to back away and let the system adapt as necessary. Managers can stimulate or dampen attractors as necessary to experiment and look for emergent patterns. Attractors are the phenomena initiated by leadership that when stimulated, resonate with people and as solutions gain momentum, provide structure and coherence (emergent patterns of behavior) that leadership can use to navigate the complex domain. Managers should encourage dissent and diversity of thought within communication activities as these behaviors encourage the emergence of well-forged ideas in the complex domain. The “ritual dissent approach” is an example of how managers can work with groups of employees to hone ideas and develop consent through a communication process that requires listening carefully, speaking openly and not taking criticism personally. Managers need to create the environment that allows good things to emerge, or that psychological safe space that allows people to experiment with ideas free from fear.

The information in Table 2 provides utility managers with some guidance on how to sense which domain their organization is in and when it is moving toward a danger zone. It also provides decision-making models that work best in a particular domain and how to respond to the danger signals with each of the contexts. Resiliency requires active management and agility in decision making. Based on Gerstberger’s study, leadership in public utilities will need to make a concerted effort to change behavior if their communities are going to develop resilient critical infrastructure. Using the work of Bass, Snowden, and others, the goal is to develop a set of skills or training that when implemented in utility enterprises will provide managers a tested means to manage organizational change in an uncertain world.

4. Obstacles to Change

Management will also need a clear understanding of the internal and external inhibitors to organizational change so those charged with leadership responsibilities can choose the most effective path to achieve the goals of the utility. Constraints are items as follows.

- Legal constraints associated with the creation and ongoing operation of a utility as legal entity, or a department of government and the political manipulation that comes from that oversight
- Regulation influences both the ability to generate an appropriate rate of return to cover all the costs associated with treatment and distribution of the product
- The cost associated with both insuring public safety and environmental measures
- Economic and social conditions (e.g., poverty level within the community) also play roles in constraining the utility's ability to meet the needs of its customers by maintaining an appropriate rate of return necessary to replace the aging infrastructure throughout the system
- Internal constraints would include items, such as the existence of a hierarchical bureaucracy that is low trust and rules driven
- Unionization that adds cost through inflexibility
- Inefficient organizational structure
- Leadership issues
- Lack of employee development, and customer focus

Jamison identified four types of obstacles to change; informational obstacles described as disputes over facts and interpretations, environmental obstacles that can be defined as part of the organizational culture and internal politics, relationship obstacles that may be personality or legacy issues, and individual obstacles, such as lack of management skills or inexperience (Jamison, n.d.). Informational obstacles can be either internal or external and are essentially communication issues that are a result of low or limited trust. These external issues can be overcome through transparency of operations, development of awareness of utility issues among stakeholders (e.g., politicians, advocacy groups, citizens) and collaboration with stakeholders using the mega-community model to address issues of interdependency and utility-based issues (e.g., rate

increases, aging infrastructure, staff). “A megacommunity is any large ongoing sphere of interest where governments, corporations, NGO’s and others intersect over time. The participants remain interdependent because their common interest compels them to work together, even though they might not see, describe, or approach their mutual problem or situation in the same way” (Gerencser et al., 2008, p. 54). These groups do not give up their independence, responsibility to their constituencies nor compromise their priorities. Rather, these groups build on self-interest with the understanding that some problems are too complex to be solved alone.

To understand the external constraints utilities must confront when dealing with regulations, it is necessary to review the history of the role of regulation and politics as they relate to public utilities (telecommunications, electric and water). Evidence indicates that the greater the level of regulation, political control and hierarchical bureaucracy that exists, the less likely that an adaptive management culture required to embed core values and beliefs will be found in these public organizations. It is understood that species need to adapt to their environment to survive, but if the environment were tightly controlled, the need for adaptation would be reduced. In the United States, each of these three key building blocks to modern society has developed in slightly different regulatory environments that impacts how they operate today.

The telecommunication industry grew rapidly after the turn of the last century when Congress first vested federal regulatory authority over telephone services in the Interstate Commerce Commission, under the Mann-Elkins Act of 1910. American Telephone and Telegraph (AT&T) rapidly bought up its competition and purposed the theory of “natural monopoly” that presumed redundant telephone infrastructure was economically inefficient and that monopoly power, tempered through regulation, was sufficient. In enacting the Communications Act of 1934, Congress authorized that any deviations in product or service required government approval. Thus, with the cooperation of state and federal officials, AT&T secured its dominance over telephone service for decades.

By the early 1970s, the model for providing telecommunications service was beginning to fall apart as competitors attempted to expand market share without success

and filed anti-trust actions against AT&T. In the early 1980s, the federal government required AT&T to begin divesting itself of its local operating companies and restricting its service to the long distance market. This opened the local markets to competition that increased product innovation and reduced costs.

The lesson learned from the regulated monopoly approach is that firms who enjoy protection from competition and are guaranteed rates of return through government regulations face reduced financial pressure to innovate or operate efficiently. Moreover, bureaucrats often became so committed to the regulatory structure that they regard competition as a threat rather than as a potential solution to the structural conditions that led to the adoption of regulation (Katz & Bolema, 2003). The move to a much more deregulated local telecommunications market has resulted in increased competition and innovation, decreased cost to the consumer, and requires that management adapt to market conditions.

The electric utilities industry grew much differently as multiple providers strung power lines into neighborhoods and competed with each other for customers. In an effort to limit the infrastructure and development associated with independent contractors, consolidation of service began in the 1920s so that by the early 1930s a few holding companies controlled the majority of the investor-owned electric businesses. Power generation and distribution generally crossed municipal and state lines, creating a situation with little effective state and no federal regulation. These firms could demand any price for equipment and service knowing that the subsidiaries had to pass their expenses on to customers. The passage of the 1935 Federal Power Act and the Public Utility Holding Company Act (PUHCA) eliminated these by providing utilities a monopoly in a given service area while regulating price.

The governing concept used under this legislation is the Regulatory Compact and is a contract by the authority of state governments, represented by public utility commissions, the Federal Energy and Regulatory Commission (FERC), and investor-owned utility companies. In exchange for the obligation to provide service to all customers in that territory, the investor-owned electric utilities are authorized a territorial monopoly on service and allowed to earn a limited profit. State regulators have

historically set prices at rates that reflect the cost of building power plants and putting up the wires. Profits have reflected the cost of capital. Electric utilities are primarily investor-owned, and as such, are still driven by the profit motive and are thus impacted by market forces even though these enterprises remain heavily regulated.

Originally, utilities, such as water and wastewater operations, were typically private entities. As communities grew, the need to fund the expansion of this critical infrastructure was hampered until the U.S. Supreme Court decision of *Merrill v. Monticello*, 138 U.S. 673 (1891), which allowed municipal government to issue bonds to pay for infrastructure for growing communities. This began the move toward local public control of water and wastewater utilities. In July of 1907, Wisconsin became the first state to regulate utilities with the passage of Wisconsin's Public Utility Act. The act served as a model to regulate utilities for most of the states in the nation. According to the statute, it was the duty of the Public Service Commission to supervise and regulate every public utility in the state and to the end that "reasonably adequate service and facilities" be available at "rates that are reasonable and just" (Commission, 2010, p. 1). These utilities were treated as natural monopolies with the same issues that occurred in the telecommunication industry. These regulated monopolies enjoyed government protection from competition and provided regulated guaranteed rates of return. They faced reduced financial pressure to innovate or operate efficiently. Even under this tightly regulated environment, market forces still require an organization to be adaptable as is demonstrated by the current conundrum faced by many water utilities where increased conservation has lead to decreased revenue.

Additional constraints affect the operation of utilities from the fields of public health and environmental regulations. Water systems must treat all water moving through to ensure it is safe for human consumption even though people consume very little of the processed water. With the advancements in detection technology, utilities can now detect contaminants at levels lower than ever before. This capability has led to increased regulation of the amount of contaminant allowed that ultimately drives up the cost of treatment for a limited improvement in drinking water quality. This is not to say utilities should compromise on the water quality they provide to their customers but simply that

state environmental and public health regulations, due to the nature of the system, can add unsustainable costs. Issues of governance also exist where elected officials, seeking to keep constituents happy, artificially control the price of water. It should be no surprise then if utility managers, as discussed in Gerstberger and Gromala, feel like they have little control over the external constraints on the utility.

Utilities are a critical part of modern society, and as such, must continue to provide high quality consumables in the face of rapidly increasing environmental complexity. Publicly owned utilities, as regulated natural monopolies, exist within a relatively stable environment. This stability has lead to a situation where organizations fail to develop the instincts or decision-making skills required to be resilient. Utility managers do have some level of control over their environment in the organizational structures and operations of the utilities. To achieve this type of adaptive internal work environment, utilities must understand their organizational cultures, the skills required to change or adapt those cultures, and the constraints or obstacles to organizational change.

It is clear that most utilities face the external obstacles, governance and regulation that will remain relatively intact over time. The best chance of modifying those obstacles is through awareness and collaboration between the utility and key stakeholders. Little research specifically directed at constraints to cultural or organizational change within public utilities exists. The focus in this paper is on the general obstacles to change found in the literature. The research in this area returns to the previous discussion of cultural change with an emphasis on evolutionary theories and the work of Schein, who addresses understanding the obstacles to change by focusing on the tacit assumptions that members of the organization share and hold to be true. Through a process of truthful guided conversations with staff over an extended period, an organization can change these assumptions about reality and truth, the nature of time and space, and human nature. Kelman's study of organizational change in the federal procurement system and Paul House's reformulated Path-Goal Theory, provide a process for how to implement change in an organization.

House's Path-Goal reformulated theory of leadership provides insights into the conditions under which leadership behavior can influence employee behavior in the

pursuit of organizational goals (see Table 3). The overarching proposition of the theory is that for leaders to be effective, they must engage in behaviors that complement employee abilities and compensate for deficiencies while positively influencing employee and work group satisfaction and performance (House, 1996).

Table 3. Path-Goal Theory Assumptions (From: House, 1996)

Assumption #	Assumption
1	Leadership behavior is deemed effective (acceptable and satisfying) by subordinates.
2	If they see that behavior is a source of satisfaction either in the present or future, leadership will enhance subordinates goal-oriented performance to the extent that the behavior: (a) enhances motivation in the work group (b) improves work group skills (c) provides direction (d) reduces obstacles (e) provides the resources necessary to succeed.
3	Leadership behavior will enhance motivation in group members to the extent that the behavior: (a) requires subordinate satisfaction to be based on effective performance (b) ensures the job is intrinsically satisfying (c) ensures goal attainment is intrinsically satisfying (d) makes rewards contingent on task completion (e) creates a physiologically safe environment with the necessary rewards for effective performance.
4	Leadership behavior will enhance the group's performance to the extent that the leader serves as a role model and engages subordinates in developmental activities.
5	Leaders will enhance group performance to the extent that they: (a) facilitate collaborative relations among the group (build teams) (b) maintain good relationships between the group and the larger organization (c) make sure adequate resources are available to complete the function (d) champion the legitimacy of the work completed by the group to the larger organization

In reviewing this theory, it is clear that House believes that one primary purpose of leadership is to enhance subordinate empowerment, satisfaction and work group effectiveness. Bass as conditions for transformational leadership also describes what House describes as the boundary condition of this theory. Covey (2006) also addresses this notion in his Speed of Trust construct.

Using Bass's ODQ, an organization can assess the current state of the culture, make decisions on where they need to move and decide on how best to get there. House provides the means to develop a work plan to address episodic or directed organizational

change. His framework identifies leadership behaviors (see Table 4) that can move groups toward a more transformational culture. Managers can mix and match these behaviors as needed based on the work group composition, type of work and the goals desired.

“Clarify behaviors” will be most effective when the environmental conditions are relatively stable so that individuals can formulate accurate and rational expectations of rewards based on the effort expended (House, 1996). They will influence subordinates positively when role and task demands are ambiguous and inherently satisfying. It follows then that this behavior is less effective under conditions where subordinates perceive task demands as rigid and less satisfying. In other words, for managers seeking to move toward transformational cultures, developing work or tasks that allow subordinates to take responsibility and exercise creativity and initiative is critical.

Table 4. Path Goal Behaviors (From: House, 1996)

Behavior Type	Characteristics
Clarifying	(a) set performance goals (b) define how to effectively complete tasks (c) develop standards of performance (d) define expectations of others (e) judicious use of rewards and punishments contingent on performance.
Achievement oriented	(a) directed toward encouraging performance excellence (b) setting challenging goals (c) seeking improvement (d) emphasizing excellence (e) showing confidence in subordinates' ability to attain high levels of performance.
Work Facilitation	(a) planning (b) scheduling (c) organizing work (d) developing employees through training, mentoring, counseling, and coaching to improve skill sets to meet the expectations of performance standards.
Supportive leadership	(a) directed toward subordinate satisfaction by meeting needs and preferences (b) relationships seek to increase the quality and decrease the stress in leader follower relationships; this allows followers to maximize the application of their intelligence (c) leaders develop a culture of psychological safety and support so that employees can develop self confidence and social satisfaction.

Behavior Type	Characteristics
Interaction facilitation	(a) build successful teams and positive satisfying relationships among members of the group through open honest communication where all members can interact without fear.
Group oriented decision-making process	(a) identifying mutual interests with respect to problem solving, encouraging group participation (b) ensuring balance in discussion such that no individual or group dominates (c) searching for alternatives (d) delaying agreement of solutions until the group has exhausted all alternatives (e) facilitating evaluation of the pros and cons of each alternative and combining the advantage into a creative solution.
Representation and networking	(a) entering into exchanges (b) developing networks (c) joining groups that open doors to other contacts (d) participating in a wide variety of organizations and groups working toward similar goals.
Values-based leadership	(a) the articulation of a vision of a better future where followers have claim to a moral right (b) display passion and self sacrifice for the interest of the group and vision (c) demonstrate confidence in the vision (d) arouse those values and motives in followers that are important to reaching the vision (e) risk taking in the interest of the vision (f) defining high performance expectations and having confidence in the group's ability to achieve (g) frequent positive evaluation of the group.

“Achievement-oriented” behavior works best when individuals are motivated to achievement through their own efforts rather than influencing or delegating to others, and have the greatest impact on those subordinates with similar traits. Those who are highly achievement motivated respond to tasks in which it is possible to take personal responsibility that when done well reflect on the competence of the individual, are challenging and require some risk, and provide opportunities for development and feedback. This behavior is used only with achievement-oriented personnel as they receive limited satisfaction and experience frustration when relying on others to accomplish a task.

Managers using work “facilitation behaviors” should also seek to insure appropriate resources are available and eliminate obstacles to effective performance that empower decision making in employees. Effective use of the behavior requires a relatively stable environment where plans exist for known demands, and as uncertainty increases, a personal rather than planned coordination of work is required (the complex and chaos domain of the Cynefin framework). Which of these two modes of work a

manager would use, either facilitation through planning or personal direction, will depend upon whether work unit members have a high level of task-relevant knowledge. If there is little knowledge, personal coordination is required but if significant knowledge on task requirements exists, then reciprocal coordination within the group can direct the work. In those situations where subordinates realize that effective performance is more difficult than expected, it is the leader's job to remove the obstacles to effective performance (House, 1996).

“Supportive leadership” behavior is effective when environmental conditions include high stress and where work is not intrinsically satisfying, which is due to leadership providing the psychological support for subordinates necessary to compensate for the unpleasant aspects of the work. The goal of this leadership behavior is to provide a situation where employees can maximize their potential intelligence by improving relationships between leadership and employees.

“Interaction facilitation” behaviors will increase group cohesiveness, interdependence and team effectiveness, reducing absenteeism and attrition over time. Interdependence among group members is the key to successful implementation of this behavior.

“Group oriented decision-making,” sometime called participative management, refers to the process of managing decision making within a group towards a desired goal or objective. Significant research demonstrates the validity of the group decision-making process as it increases both acceptance and quality of those decisions. Specific behaviors associated with this process are posing problems not solutions, identifying the mutual interest of members, encouraging all members of the group to participate, guiding the discussion so no group or individual dominates, ensure all alternatives are fully reviewed prior to evaluation, and guiding the evaluation process to ensure both the pro's and con's are discussed (House, 1996).

“Representation and networking” behaviors refer to the ability of leaders and work groups to acquire the necessary resources by legitimizing their work in the eyes of the greater organization. The ability to communicate the value of the group to the

organization and collaborate with other portions of the organization are the primary behaviors. For utilities, these behaviors are particularly important when viewed in relation to external constraints. By raising awareness of utility issues in both political and regulator spheres, utility leadership can potentially mitigate issues by working within a mega-community or group setting.

“Values-based leadership” behavior builds upon Schein and others who focus on changing the underlying tacit assumptions within an organization. Appealing to the cherished values and unconscious motives of employees and making their self-worth contingent upon their contribution to leadership’s vision, managers can adjust culture. One of the primary conditions for successful value-based leadership is the need for an agreed-upon or non-conflicting (among group members) ideological goal for which the group can strive (House, 1996). This behavior and its implications focus attention on many elements of a decentralized organization as described by Brafman and Beckstrom (2007). The starfish metaphor consists of five elements or arms, circles, catalyst, ideology, existing platforms and a champion. Circles are defined, independent, and autonomous groups in which individuals enter or join a large collective that characterizes nearly every decentralized organization. Once the group is joined, everyone has equal say. It is then up to the people involved to contribute to the best of their ability. Norms become the backbone of the circle and can be more powerful than rules. As the norms of a circle develop, and as members spend more time together, something fascinating happens—they begin to trust one another. This idea fits with Covey’s notion that trust is the key to the improving organizational results. It is not surprising that these decentralized high trust groups develop an affinity to each other and the ideology that holds them together.

In an open organization, a catalyst is the person who initiates a circle and then fades away into the background. These individuals generate ideas and then allow the circle or group to follow through. They get a decentralized organization going and then cede control to the members. Letting go of the leadership role, the catalyst transfers ownership and responsibility to the circle. The catalyst is an inspirational figure who spurs others to action. Ideology is the glue that holds a decentralized organization

together. Thinking about the organizational mission, vision and shared values provides the ideology that tells potential members who they are, what they do, and where the organization is going in the future.

A champion is needed who is relentless in promoting the new idea. Where catalysts are charismatic, it takes a champion to take the ideas to the next level. Catalysts inspire and naturally connect people, but there is nothing subtle about the champion, who is a natural people person and a salesperson. In many respects, when looking at change in an organization, it comes about in a very similar manner, where an individual or small group develops an idea. Then, a member of leadership champions that idea through execution (Brafman & Beckstrom, 2007).

House suggests that value leadership behavior is much more transformational than transactional. Transactional leadership relies on the ability to negotiate contingent rewards as inducements for performance, and therefore, only exercised when leaders have the ability to link rewards to individual performance. Cognitive dissonance theory also suggests that without extrinsic incentives, those followers are more likely to look for self-related justification for their effort. When leaders need to provide rewards for performance, their ability to foster an ideological orientation toward work is limited (House, 1996). It can be seen from this discussion that House and others provide specific behaviors that utility managers can use to motivate and develop an organizational culture that fosters resilience, and that these behaviors tend to focus on the development of a less centralized organization and are more transformational as described by Bass's typology of organizational cultures.

Kelman (2005), tasked with reorganizing the federal procurement system during the Clinton Administration, produced a study on how to change a governmental organization that may assist utility managers in moving toward resilience. It is his contention that the idea that people resist change is an oversimplification and groups exist in all organizations that are looking for change. His notion is that political constituencies for change are present in all organizations and it is management's job to find those elements and activate them. His experience seems to indicate that employees within every organization exist who are dissatisfied with the current state of affairs along with

others who have a natural affinity for change. By activating these two groups, management can set in motion a political struggle inside the organization toward a desired end state. The force for change will always be in the minority at the beginning of the process, because a constituency always exists that supports the status quo. It is his contention that once change begins and is actively supported by management, it feeds upon itself in a positive feedback loop that moves the organization in a positive direction due to immediate direct benefits to change agents. In other words, change builds upon itself making it easier to initiate the next change. It feeds upon itself first, as individuals experience change in a positive way, they are more likely to increase support for additional change. Secondly, in an environment where change is occurring, the passage of time may influence an individual's perception of those events in a positive manner, thereby increasing the likelihood of that change taking hold. It would follow then that if people suffered negative experiences rather than being a positive change agent, they could just as likely become an obstacle to change. It becomes clear that the leaders need to manage perceptions and insure that sufficient time is allotted to drive the change through the organization, as moving on to the next new thing will likely cause a backslide in behavior.

In studying the federal procurement bureaucracy, Kelman conducted surveys of employees looking for areas of discontent and found that in the bureaucracy where directed work was the norm, three factors indicated areas of discontent.

- Many employees desired more autonomy in how they complete their work, the lack of employee empowerment in this system was one element for discontent.
- The nature of a bureaucracy with a top-down hierarchical structure and an inordinate amount of rules created for some a stressful, unappealing work environment that also created discontent.
- Finally, better value contracting challenged the bureaucracy preoccupation with process over results and created another group of employees who saw a better way, but were frustrated by the system.

Kelman makes the case that a level of education, risk tolerance and desire for individual self-fulfillment in employees are congruent with employee empowerment or autonomy. Employees with a higher level of education and personal self-confidence

increases risk tolerance. These employees have a need for self-fulfillment and will have a greater desire for autonomy in their work. This has implications for hiring managers in bureaucracies who desire to make changes in their organizational cultures toward a more resilient organization. If Kelman's ideas are followed, then looking for individuals with these types of traits in the hiring process will build a constituency for change within the organization. As noted earlier, the public water treatment industry currently has an aging work force with an expected turnover of almost 50% of employees over the next five years. This provides an opportunity for utility management to build resiliency into the culture through appropriate hiring and by initiating a change process now that will engrain the values desired in these individuals.

This requires that managers know their employees better than they know themselves and that they conduct the appropriate surveys to both identify if discontent is present, and if so, where in the organization it exists. Once groups know that information, management can develop the reform coalition and focus its change efforts in those areas most likely to accept the new policies and become early innovators. In this context, the idea of diffusion of innovation takes hold and follows a recognizable pattern. By implementing change and rewarding success in these early innovation pockets, others in the organization who may not have been early innovators will see the advantages, both personally and organizationally, and seek to change their behaviors. At some point, the movement of the organization toward change reaches a tipping point and a shift in organizational behavior will likely be seen. In Kelman's (2005) research, he contends that predictors exist of who might join the vanguard for change. The primary driver for the continual development of recruits is an ideological discontent with the traditional system. In other words, people jump on the change bandwagon at different points in time, but the reason for the jump is discontent with the current system. He also notes that trust and idealism positively correlate to early adapters of change. This supports both Covey's notions (2006) of the need for trust in an organization and Brafman and Beckstrom's work (2007) on explaining ideology in decentralized organizations. These ideas provide

utility managers with a framework from which they can conceptualize an organization that is more resilient, less bureaucratic, and more likely to meet the needs of their communities.

D. APPROACH

It follows that to develop a roadmap to assist utilities in developing resilient infrastructure organizations leadership will need buy-in from employees for the process. In an effort to develop that buy-in, organizations have recruited utility managers from around the country to assist in both understanding challenges and developing a process that move the industry closer to resilience. This study, therefore, adopts a qualitative approach of direct interviews with utility leaders to derive insights and judgments from a diverse group of experts. These individuals did not interact directly and supplied their evaluative thoughts independently, thereby avoiding groupthink or undue influence of dominating personalities. Through a series of questions, analysis, and feedback, the respondents supplied insights that validated the current environmental conditions under which utilities operate. These conditions included such issues as the characteristics of a resilient organization, the role of leadership, the skills required for leaders and the obstacles to change in the environment. Additionally, they provided insight into how utilities might adjust to meet the changing environmental conditions that became the foundation for the roadmap. Finally, participants reviewed the emergent theory to verify the path is one the industry might accept.

E. METHODOLOGY

The purpose of this research was to develop a roadmap for publicly owned utilities to develop resilient organizations that could adapt to environmental conditions. The stakeholders who might benefit from the research include such groups as utility managers, labor unions, policymakers, regulators, environmental groups and, most importantly, the utility's customers. The focus of the study was on publicly owned utilities within the United States to determine the perceived state of resilience based on a predetermined set of definitions.

The project was developed using a mixed research methodology focusing on a qualitative evaluation of the problem using Grounded Theory to develop an emergent theory based on the current literature and data gathered from the subjects. The research used complex adaptive system theory as the model to explain current conditions and used that theory to test proposed changes to determine their impact on current conditions. What was expected was that publicly owned utilities were not very resilient or adaptable to change and that the current level of constraints placed on an organization inhibited the ability to adapt or change. The research provided utilities with a model to develop organizational resilience by identifying the constraints to change and the skill set required to lead effective change.

Eight experts from various water utilities across the United States industry were provided an initial set of open-ended questions that provided the initial data set (see Table 3). Respondents were asked a series of demographic questions followed by several open-ended questions regarding the following issues.

- What does a resilient organization look like?
- What are the internal and external constraints to creating an adaptable organization?
- What set of skills and training will utility leadership need to manage change in their organization?

The subjects' answers became the dataset from which to begin to understand what was happening by reading and re-reading the textual database to discover categories, concepts and properties and their interrelationships or the variables of the dataset. The research then shifted to an open-ended interview of six participants to confirm the result of the initial questionnaire, and delve a little deeper into when utilities were at their best or highest level of resiliency and how that exceptional level would look when it became the norm (see Table 4). With the data provided by the subjects, an emergent theory emerged that fit this dataset. The research led to the emergent theory and proposed a strategy to achieve the goals and objectives that described that roadmap to resilience for utilities.

F. SUMMARY

Resiliency for utilities is more than just having a plan to handle disasters or developing redundant infrastructures. It requires utility management to develop an understanding of the environment they operate in and to mitigate risks using agile decision making to maneuver the utility through a changing world. It will require management to assess where they are today in relation to their organizational culture so that they can begin the process of changing organizational cultures to meet the demands in the environment.

The literature provides a number of points by which utility managers can measure their current level of organizational resilience along with a means to determine the organizational culture type using the transformational/transactional scale. Using this information, management can set a baseline and determine a direction to become a more resilient organization. The literature provides a number of means that managers can use to begin to shift organizational culture and to understand the means for managing both continual and episodic change.

To assess the current state of the industry, several current leaders in the industry were queried. The results of that inquiry are reported later in this paper.

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II. RESULTS

A. BACKGROUND

To provide some context for the results of the aforementioned survey, a review of the 2010 State of the Industry Report (SOTI) provided insights into key water industry issues. This report, prepared annually by the AWWA, described those issues that members felt may not be adequately addressed by current industry standards and tracked significant trends in areas of capital spending and emerging issues. The random survey sent via e-mail to more than 17,000 AWWA members had a response rate of about 15 percent. These respondents were predominately utility operators (53%), followed by utility service providers (consultants and vendors) (33%), with the remainder being individuals associated with professional organizations, academia and regulatory bodies. The design of the survey was respondent-led in terms of identifying issues, by not providing a list of potential responses but rather asking core questions that sought to elicit respondents' perspectives in their own words. The survey began with a general question on the current soundness of the industry on a 1–7 scale with seven being very sound and one being not sound at all. Once the general temperature of the industry was taken, the survey moved to three issue-orientated questions to get the respondent to identify specific concerns related to soundness and time (near-term issues, long-term issues and any issues inadequately addressed) (Mann & Runge, 2010).

Although over time, industry leaders had reported the industry improving, the results for the initial question on the survey in 2008 showed that leaders felt that improvement had flattened. This overall pattern may be the result of how members see the current strength of the industry. This reaction was clearly an indication of a perspective that was less positive than even three years ago. As members self-selected issues, categories coalesced around business factors, infrastructure, regulatory environment, source water, workforce, water treatment, consumers, macro factors, security, technology, energy water quality, industry leadership and wastewater issues.

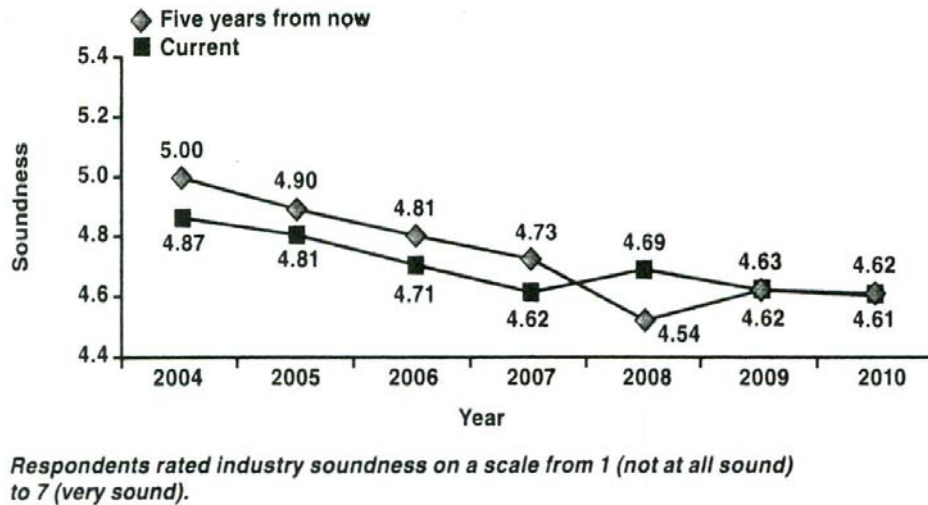


Figure 5. Soundness trend for U.S. water industry (From: Mann & Runge, 2010)

Of the all the issues highlighted in 2010, business factors, infrastructure, regulatory environment, source water and workforce issues were the most commonly indicated as near-term and long-term issues. These same issues also commonly showed up as inadequately addressed issues of concern. Business factors (including such items as funding for infrastructure replacement and rehabilitation, financial gaps between the cost of production and the rate the customer base will support, and the cost of regulation) has continued to be the number one concern for members since inception of the survey. Its importance expanded due to its close ties to both the number two issue (regulatory requirements) and the number three issue (infrastructure), as it concerns cost for these items in the face of shrinking revenue.

Infrastructure issues not only relate to cost concerns, but also to the issue of aging infrastructure. The reason little attention is paid to infrastructure is that the systems are underground and out of sight, thus making it difficult to attract the necessary resources and political support to rehabilitate. Regulatory compliance issues relate to both the cost associated with testing and treating at lower contaminate levels and those resources redirected away from addressing the issue of aging infrastructure or other key elements of industry operation. Members indicated a need for additional cost-benefit analysis and scientific underpinning for regulations to provide for safe water at a reasonable price.

Source water concerns are an ongoing issue due to cyclical drought and increased demand as populations that have shifted to the west over the past 50 years have affected availability and quality of source water. The magnitude of members' concerns on this issue has grown over time, and it is seen as being largely unaddressed. Workforce issues have become less important as many key utility personnel have put off retirement due to the economic downturn. This has given utilities some additional time to develop plans to develop staff to fill these critical positions. The expectation is that as the economy improves, these key individuals will leave the field with their corporate knowledge, which will affect the industry (Mann & Runge, 2010).

Respondents identified several other issues that influenced resources. The cost for treating water to standards continues to elevate in importance and will require examining a wider range of solutions beyond existing chemical treatment. The industry's ability to meet regulatory requirements for safe water treatment within the current model of treating every drop as if humans consumed it is not sustainable. The cost associated with providing water has not transferred to the ratepayer, thus creating a gap in revenue for utilities.

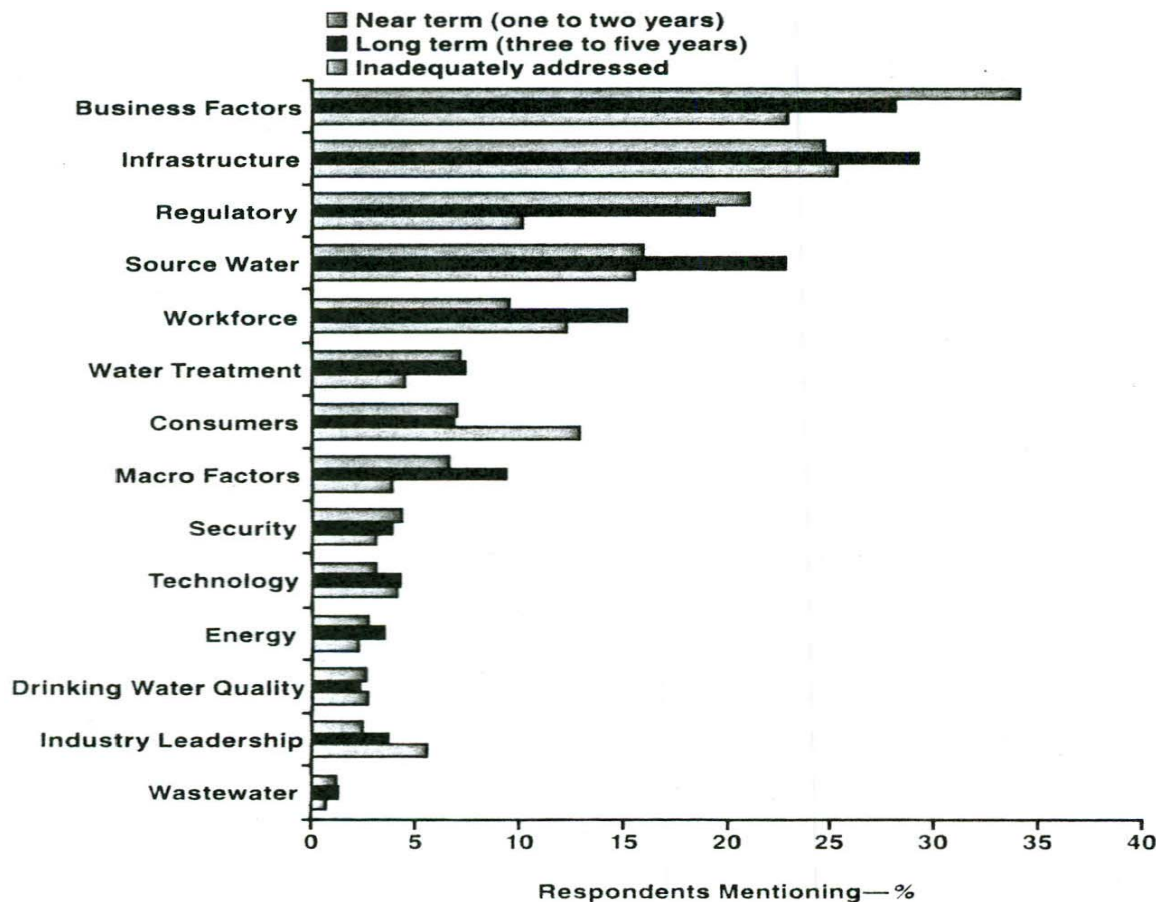


Figure 6. Summary of issues as cited by U.S. water industry respondents (From: (Mann & Runge, 2010))

The industry has traditionally been comfortable being a silent servant and has not engaged customers in discussion about the real cost of providing the service. This has led to the expectation by consumers that water is essentially a right and the cost must remain low. Utilities must engage their customer base to know them better so they can both provide the highest quality service at a reasonable rate and be able to acquire buy-in from ratepayers as costs change. Macro factors refer to those items like population growth or decline, demand, climate change or other issues outside the control of the industry. It is clear from the survey responses that utilities have differing understandings of their environmental conditions and a desire exists to have a coherent water resource strategy. Although utilities operate in the same ecosystem, each utility has a unique operational environment and water resource strategy. Leadership issues finished near the bottom of

the list of concerns, but inadequately addressed according to members. The members also confirmed that utility enterprises tend to lack a culture of innovation and creativity, are resistant to change, and are insular in nature (Mann & Runge, 2010).

Given these challenges of aging infrastructure, limited revenue streams, stressed water resources in some parts of the country, and uncertain workforce viability, it becomes clear that the current model of organizational structure and operating paradigm is not sustainable. It would seem that if the industry is going to meet its increasingly costly water service requirements, a different, or at least a revised, organizational model might be required to address the uncertainty in the environment. This new or different model is, in fact, developing resiliency within an organization and the industry and using the megacommunity approach to addresses the issues of cost with the customer base and regulators.

B. WHAT RESILIENCE LOOKS LIKE

In reviewing the responses to Question #1 (see Appendix, Table 7) the group categorized the issues around three themes or levels of behavior: governance, operational issues and organizational issues. Governance would include such items as how an organization was legally structured, how much impact elected officials have on the organizations decision making, legislation, and the rules or regulations that follow from that legislation.

The definition of resiliency for the purpose of Question #1 was the capability of an organization to maintain its functions and structures in the face of internal or external changing environmental conditions, and to respond positively to these changes, or when necessary, degrade gracefully consistent with its business interests and investment capacities.

Table 5. Written Questionnaire

Question #	Question
1	Please describe what a resilient utility looks like based on this definition?
2	Please compare and contrast your organizations level of resiliency to your description of Question #1.
3	What is the role of utility leadership in the development of resilient organizations?
4	What set of skills or training will be required for utility leadership to develop both resilient organizations and manage change to create those organizations?
5	What are the internal constraints to developing resilient organizations? Can they be overcome and if so, how?
6	What are the external constraints to developing resilient organizations? Can they be overcome and If so, how?

Issues identified that relate to governance include realistic rate development based on the true cost of treatment and distribution, asset repair and replacement governance free of political interference, and the limitations imposed by third-party regulations. Industry leaders seem to feel that there was increasing pressure on utilities to conform to political and regulatory requirements that limit the ability of management to operate as it sees fit. It would seem that a different management model might required to address the complex environment that these organization now exist in, but respondents provided little in terms of what that model might look like.

Operational issues are those items under the current control of management like plans, policies and employee development. Operational issues noted by the group include items, such as developing succession, robust asset management, and contingency planning, risk management and redundant systems. These are elements needed to develop flexible and adaptable organizations by modifying policies, procedures, work flow and employee skills/training in an effort to accomplish the mission. The group also spoke of the importance of employees and the need to provide an environment that supports and develops human resources. They specifically noted the need to keep their employees updated on changes, action plans, conflict resolution, continuing education and career advancement opportunities, benefits, and employee evaluation processes. To measure if staff was internalizing new norms and values and to improve trust in the organization, management needs to provide a conduit for communication in a physiologically safe

format. Regular employee attitude surveys are one method to accomplish these goals by providing the ability to trend answers to questions over time to note improvement or failure.

Organizational issues deal with how an organization was structured, its decision-making processes, leadership skills, organizational culture, and how it sees its place in the environment. The group in this context identified items such issues as the need for agility in decision making, empowering both management and employee decision making, careful planning, constructing wisely and operating efficiently. Accepting and understanding internal and external change are inevitable and planning to address those changes was the first step in developing adaptive behaviors. As one respondent noted, create and maintain a culture that was dynamic, constantly learning and adjusting to changing events.

In looking at these responses, it seems clear that the current top-down hierarchical model may not be the best choice for developing resilient organizations. It is also important to note that today's utilities, based on legislative requirements, are the norm, and simply eliminating the current model is not practical. There might be adjustments to that model that would allow an organization to improve its resiliency while retaining some form of the current bureaucratic model.

When looking at the responses to Question #2, it appears the group associates resiliency with the ability to recovery after an emergency, providing protection for existing resources, and developing a redundant system to ensure system viability (see Appendix, Table 8). They also feel that their organizations have developed as resilient utilities. They come to ideas due to using their own perceptions of what a resilient utility may look like. For those who concentrated on redundancy, that became the standard of a resilient utility. For others, the ability to make decisions in an agile manner became that standard, and for still others, having appropriate policies/procedures and plans in place was that indicator of a resilient utility. The point being that without some agreed upon framework of what organizational resiliency is, no starting point exists from which resiliency can be built into publicly owned utilities.

It was clear that an agreed upon definition is necessary if these organizations are to begin the process of moving toward an agreed upon goal. It was also clear that each utility starts from a very different place on the road to resilience, so any plan must take into account that reality. The roadmap then is an agreed upon set of goals that moves organizations toward resilient behaviors, not a defined set of steps down a particular path. Growing resilience in the industry is a continuous improvement process not a project. It is not so important what path a utility takes, but that they begin the journey.

Respondent answers to Question #3 indicate that they view the role of management as being one of direction setting, prioritization and human resource development (see Appendix, Table 9). Several people noted the need for leadership to set direction using vision and values to build a culture that supports resiliency. Leaders also need to champion both resiliency issues and change in general as part of their responsibility. They can accomplish this by what they focus their interest and organizational capital on, such as championing agile or flexible planning and investment processes, embracing technology, developing a culture that encourages employee participation, training and development, and insuring that effective emergency and contingency plans are in place and tested.

The group seems to indicate that, for at least some, these leadership qualities are an ideal type or something to strive towards, and not necessarily, the way the world is today. The question then becomes, “if this is not the way the world operates today, why not?” Moreover, how do utilities get to a point where utility leadership takes an active role in organizational development? It is safe to say that based on the previous discussions, utility managers feel they have limited control over the environment due to extensive regulation, labor agreements and political influences. As to the question of how to change that paradigm, that comes through organizational development, and that starts with leaders who have a skill set that allows them to lead change.

It seems clear from their responses that Gerstberger’s study of utility leadership appears to be valid where leaders in the industry are backward looking, reluctant to lead or to hold people accountable and refrained from monitoring the organization (Gromala & Gerstberger, 2010). They also note correctly how to change their current trajectory of

industry leadership toward a more transformational leadership culture. This indicates that not only was there some support in leadership for change but also that the foundation was understood within leadership of what it would take to shift organizational cultures. This was positive sign of understanding that a problem existed, but not necessarily knowing how best to address it, was an unexpected finding. It holds promise for a future solution and indicates leadership may be operating in the complex domain without having the tools to sense their location or have decision-making models to address the problem.

The respondents provided a list of skills and characteristics they felt were necessary in any utility leader. The characteristics noted (courage, bravery, personal resilience, honesty) flow directly out of Covey's four cores and 13 behaviors to build trust in any relationship (see Appendix, Table 10). The need to continue to build trusted relationships both within organizations and with outside stakeholders is a key skill for leaders. To develop that skill, it is necessary to be an effective communicator as noted by the respondents in their comments (persuasive, articulate, ability to develop buy-in, political finesse, ability to interact with a wide variety of people, collaborator). The group agreed that the ability to build trusted relationships through communication skills is necessary for effective utility leadership.

The group also spoke to the need for leaders to be visionary or forward looking with the ability to understand the environment, accept that change is a constant and adjust or adapt as needed. This requires a holistic view of the world and an ability to make decisions based on good data and with all stakeholders in mind with an understanding of what is possible or pragmatic. It also requires leaders to have the ability to function in a world of uncertainty and modify their behavior dependent on the domain or context they are in and provide the organization direction.

Organizational agility and flexibility are the goals in terms of decision making and developing organizational structure that allow those activities to occur. Leaders not only need to be team builders, they also must be team players and developers of talent to provide the next generation of utility leaders. Going back to Gerstberger, leaders need to think differently about the world they live in and refocus their effort on those things they can control. The focus should be on items, such as organizational structures, commitment

to employee safety, development and retention, team building, both with management and among employees, and developing strategic plans that outline mission, vision, values and long-term goals that set direction.

Respondents identified a number of internal constraints to change, organized around the ideas of governance, operations and organizational issues. The governance issues noted included such items as reduced revenue flow in an already tight economy, open records requirements, lack of flexibility in human resources and other regulatory requirements, and political influence (see Appendix, Table 11). Operational issues noted included such items as costs associated with unions and labor work rules, regulations, and long-term investments. Utility leaders have few tools to address the issues of governance and operational obstacles due to legal constraints. They can, however, through the megacommunity concept, begin to bring forth some of the issues that influence the whole of the community in an effort to garner understanding of the utility environment and seek the aid of stakeholders in response to that environment.

Some organizational issues noted included such items as the need for a dedicated individual to manage resiliency, complacency within the utility that leads to resistance to change, bureaucracies that foster mediocrity, and ambivalence. A general lack of communication and management commitment and creativity (thinking outside the box) seems to exist that restricts or eliminates the idea of continuous improvement. Internal organizational change is that sweet spot where utility leaders have the authority and ability to reshape their organization in a more resilient manner.

The respondents provided several ideas on how to overcome the internal obstacles that primarily revolve around the concept of trust. They speak of developing buy-in and empowering employees to action, having local communities take more responsibility or a larger role in the development and operation of their local utility. By working with employees and through key stakeholders to address utility issues (megacommunities), utility management must have a willingness to trust and give away some power. To allow for this shifting of power through trusted relationships, employee training and education needs to occur so they are prepared to make decisions in the field. In addition, another requirement is that utilities need the right people (skill set) in the right positions to create

an environment that desires innovation and change, along with a champion or dedicated leader to insure the success of the change process. Respondents noted clearly, if utilities are to overcome these obstacles, it will require top management commitment and guidance.

External constraints, to some degree, overlapped with the internal constraints based on how the individual respondent defined the particular obstacle. The group noted that ratepayers, or customers, were a major obstacle to achieving a reasonable rate for the service due to their expectation of low-cost service and the issue of non-payment for services (see Appendix, Table 12). The constraints noted by the group included the item of governance (regulators, political leadership, legislation and the rules that come from that process) along with an inability to grow the business geographically, logistics with other agencies and natural disasters. This fits with both existing research that utilities exist in a closed environment and the emergent theory that due to changing environmental conditions, utilities lack the ability to sense their environment and adapt to it when conditions change.

The respondents provided several suggestions for how to address these external obstacles that focus on communication to the community and key stakeholders and developing a multi-sensory organization engaged in its environment. The group noted the need to be as transparent as possible with the utilities daily activities, communicate, and educate the key stakeholders and the community on the utilities role and their environmental situation in an effort to garner support for change. The multi-sensory organization built on a flat organizational structure monitors the environment for many conditions. These include regulatory and legislative changes that may influence the utility, elected officials and candidates' agendas and their impact on the utility. Marketing the organization to existing and new customers to understand the customer base and provide them a reliable service at a reasonable price, use just in time inventory techniques and cross training staff to monitor operations and control cost.

C. EXPLORING THE POSSIBILITIES

After compiling the information from the initial questionnaire, the researcher provided respondents the data as a starting point for the discussion that occurred in the interview process. The interviews conducted were open ended and designed in one-hour blocks of time. Additional clarifications and substantive changes to the information was the goal of the interview process, and when time became a constraint, not all questions in the interview were completed. The following show the results from the six interviews conducted over a two-week period between November 22 and December 8, 2010.

Table 6. Interview Questions

Question #	Question
1	As you look at the criteria for resilient infrastructure organizations that the group put together, what are your initial reactions? Does the list spark any additional thoughts?
2	When you think about your organization, how important is reaching some level of resiliency. What would need to change to adjust that viewpoint?
3	Grouping the responses from the initial questionnaire into a couple of categories, operational issues, organizational structure and governance, talk to me a little about each in terms of which is critical or key, and how they may be interrelated in some respects.
4	In many ways, utilities are structured for the 19th century's industrial revolution with items like division of labor, interchangeable parts and management by direction. Can our current organizational structures support a 21st century world? In addition, what has to change if they are going to be successful? Alternatively, is there a better model?
5	What model would insure achievement of success as defined by greater resiliency?
6	In your opinion, what is the best method (e.g., regulation, self-driven) to drive resiliency throughout the industry? Who should lead this effort?
7	There is agreement that leadership within the organization is critical to this endeavor. In many cases, managers are not hired for their ability to lead change, but to maintain stability. How can anyone expect managers to understand change is necessary, but also effectively lead that process? Is there a need to change the paradigm for choosing leaders or possibly improve the training process?
8	Governance and regulation appear multiple times and fashions as an obstacle for success. Is it possible to put the entire stakeholder group in a room (mega-community) with the goal of creating an environment where utilizes can collaboratively develop the means to become resilient and flourish economically?
9	Regulation by its nature creates inflexibility that drives up costs and reduces resiliency; is there a better way to achieve the goals of regulators without creating a controlled environment where utilities are boxed in their decision-making options? What would that look like?

As respondents reviewed the answers from Question #1, two distinct paths occurred regarding the information provided. One group provided very specific ideas for developing resilience around operational issues (asset management plan, developing redundant infrastructure, tested emergency and continuity plans) and felt the need to hold onto those concepts and not place as much emphasis on other parts of the response (see Appendix, Table 13). In other words, they were comfortable with what they were doing to address the issue and were not prepared to move much beyond that level of action. The second group, although agreeing that the items listed were part of the resiliency discussion, noted in many cases that they were not practical due to current regulatory or political constraints. This met expectations, as the group comes from various parts of the country and represents very different utilities in size and scope.

There was also a reframing in Forrest Gump's terminology to "resiliency is as resiliency does." Meaning if an organization exists in an environment where episodic change can be catastrophic (think major disaster hurricane, earthquake, etc.), that organization has a higher probability that it will develop the necessary tools and make the required changes in the organization to address that risk. In other words, in areas with high demand and year-to-year changes in source water availability, the expectation may be an organization that adapts to those conditions. Until an organization experiences a situation where the need exists for adaptive behavior, it may appreciate (understand it intellectually) the need for this type behavior, but its ability to implement such actions under its current environmental conditions is limited. In parts of the country without that high probability of catastrophic loss, the need to develop a resilient organization is significantly less. To develop this type organization, there a consensus seems to exist that management supplies the vision, mission and values (basis for a strategic plan), and direction to employees to move the organization toward resilience. Several respondents noted that an organization must reward those behaviors that move it toward resilience and provide disincentives for mediocrity in the organization. A need on the part of utilities exists to hire/promote people who have an extended performance ceiling. A utility's ability to sense issues in its environment and define solutions in advance of a problem is the measure of resilience.

Respondents noted several negative elements revolving around political and structural issues. Politicians work on an election cycle timeline and that limits a utility's confidence in its ability to complete effective long-term planning. As political priorities change, the utility strategic plan in many cases must adjust to those changing priorities, and thereby, limiting the effectiveness of the plan. Leadership needs to be cognizant of that issue and address it accordingly. In many cases, smaller utilities may have an advantage in that they have fewer levels of bureaucracy to negotiate, and therefore, can be much more nimble in their decision making. While they may gain in nimble decision making, they lack the resources to act, which therefore, limits their resilience. Utility leaders must work within the boundaries of their governance that impacts the items noted in Question #1 in a negative manner, such as the following.

- The cost associated with redundancy makes it impractical for most utilities
- Succession planning is difficult under civil service rules
- Asset management plans are only as good as the organization ability to secure funding
- Governance and politics drive the bus, and leadership can only affect what it can control
- Strategic planning and technology are guidelines and need tempering in a cost conscious environment

The group noted that utility leaders must consider these items as they implement organizational change. No one correct way exists to organize and implement resiliency. Those utilities that exist in a more volatile environment are likely to develop methods to greater resiliency within the organization. Resiliency is not just about assets but rather a different way of seeing the world and adapting to it. An organization looking to improve resiliency should focus on revised strategic plans to include elements of resilience as it changes the organizational structure and operations.

Typically, this group of respondents had not used the term resilience to define the activities they currently associate with the continuity of operations and development of asset management plans or redundancy (See Appendix, Table 14). In other words, the group focused on physical infrastructure in any discussion about resilience. In some cases, they call it agility or process risk identification prior to developing mitigation

strategies to address that risk. Another way to look at the issue is as simple as having the flexibility to react to any situation in a timely manner (this removes the proactive requirement noted above and simply focuses on reacting quickly). One respondent noted that resiliency was the foundation of the organization and was defined by that organization focus on becoming a learning organization that adapted to a changing environment. In any case, the entire group of respondents framed the issue with the language of risk management that leads the author to the conclusion that an effective risk management program might be a precursor to the development of resiliency.

It seemed helpful that the group frame its responses by grouping similar items that affect its organizations. In all cases, governance was the element that was most rigid and unlikely to change because it was foundational, and in most cases, a bureaucratic structure was legally defined, and therefore, difficult to change. Organizational structure was the next element in which it was felt leadership could compensate for sub-optimal performance by adjusting the structure or culture of the organization, and in doing so, would change the operational composition of the firm (see Appendix, Table 15).

The group split somewhat on operational changes with one faction focusing on the process of organizational change while the other group focused on operational plans driving organizational change. The issue of culture was raised in the negative sense that when trying to change an organization, sub-groups with similar interests worked to provide roadblocks toward the desired goal. The more entrenched the bureaucracy, the more likely management would find groups resisting change. This follows Kelman's and Schein's notions regarding the difficulty associated with changing organizational cultures. The key element to understand from this question was that most respondents appeared adverse to strategic organizational change and looked more to changing the operational or tactical environment. This confirms Gerstberger's study in which he reports that utility leadership seems much more comfortable working within the confines of their technical expertise and not necessarily focusing on management issues (Gromala & Gerstberger, 2010).

There was universal agreement among respondents to the question of changing the bureaucratic model. It was stressed that in many cases, this model was dictated by legislation, and as the result of the business model (results oriented 24/7 processing), must remain stable while meeting regulated standards for performance with little flexibility. All responded that the model might not be optimum but was pliable enough to manipulate toward a less hierarchical and more flat structure that provided a psychologically safe environment for employees to make decisions at the lowest level possible (see Appendix, Table 16). They seemed to imply that an organization structured in a hierarchical, top-down manner to meet their regulated performance standards was adjustable in its internal culture. Several mentioned the need for strong leadership that sets, directs and follows through on plans. They noted utility leadership's decision-making palate was shrinking and that management's ability to influence the environment was limited regardless of the structure in place. Until the system reaches a crisis or the edge of chaos, real change is unlikely. The major point from this discussion was that bureaucracies were here to stay. That said, those structures can be manipulated to a more decentralized form to meet resiliency needs, and many utilities have already instituted some of these practices as the result of Total Quality Management or other management development programs. It was clear from the previous discussion, at least for today, that there was no better or more workable model for publicly owned critical infrastructure than the bureaucracy (See Appendix, Table 17).

On Question #6, there again was almost universal agreement as to how to present resiliency to the industry. A need existed for regulation to meet public health and safety standards, but the nature of regulation, besides being costly, did not foster resiliency. It was a one-size-fits-all process that allowed for little flexibility or deviation regardless of an organization's structure. The consensus of the group was that resiliency was best presented and implemented through the industry's professional groups that could champion the process to their members and provide guidance for individual utilities seeking to improve their resilience within the concept that each utility was unique and would look a little different (see Appendix, Table 18). This allows utilities to begin a continuous improvement process that develops resiliency in incremental steps and allows

each organization to remake itself within its own environment. The use of professional groups can be risky as was indicated, as these groups, in an attempt to please their entire membership, could provide a watered down solution that did not really address or solve any issues.

The group consensus for Question #7 was that existing professional groups (engineers and scientists) were the best qualified to be industry leaders as they possessed the technical skills required for professional licensure (see Appendix, Table 19). Traditional leadership has been backward looking to see what worked in the past as opposed to being innovative and creative. This was the result of the industry's requirements and its comfort zone. A consensus seems to exist among the group that management development programs on leading change are currently lacking. To get leaders to attend, it was felt that including these principals in the professional schools and creating programs at prestigious universities would be the best method to move the program forward. The dissenting opinion used the "Great Man" theory of leadership where conditions define leaders (FDR/Churchill in WWII or Lincoln during the Civil War) and how they manipulate the environment to achieve success. Although there are certainly historical examples, most change occurs not under crisis but through an adaptive process over time.

The group agreed that using the concept of a megacommunity, as discussed in Question #8, to address some of the fundamental issues facing utilities, such as pricing the cost of service and replacing an aging infrastructure and staff, was an option for the future. Like any organization, the key to success in this process was outlining needs or requirements within this community and then being able to articulate those needs to the group, while at the same time remaining open to a wide range of solutions (see Appendix, Table 20). Utilities using these concepts need to be patient, deliberate and seek to collaborate where possible. This will be a long and sometimes difficult process, but can achieve great results over time. No consensus occurred from the group on the effectiveness of this concept. Some have only used this concept on predominantly environmental issues with some degree of success while others find these large collaborative events to be less than successful, which resulted from the complexity of

these situations where everybody thinks they are in charge, and when everyone was in charge, no one was in charge. They make individuals and groups feel good about what they are involved in, but they tend not to accomplish much. This discussion indicates that where possible utility management can use this concept to build trust in community and with key stakeholders to have one more tool to address those wicked issues that face utilities.

The group came to a consensus on Question #9 and the issue of regulation and its necessity, but there was a need for utilities to engage in the legislative and regulatory process as early as possible to adjust the rules to create more flexibility for utilities (see Appendix, Table 21). Using a collaborative process among the agencies, utilities, professional groups and other stakeholders where smaller sub-groups allow individuals to have an opportunity to assist in the rule making process can improve compliance and help manage costs of regulation for the utilities, which insures that sound science is used and attempts made to keep politics out of the process. In other words, regulators can set the goals but leave the methodology to the utilities so that they can implement incremental change to address the issue in question in a cost-effective manner.

D. THE EMERGING THEORY

1. Resilience

Resilience in an organization is the ability to understand the environment, and through agile decision making, positively interact with that environment to strengthen the organization through adaptation.

Proposition #1–To understand an ever-changing set of environmental conditions, an organization must develop a normative behavior of continuous learning. The more focused an organization is on creating a high trust learning environment, the more resilient that organization.

Proposition #1a–The more educated employees are, the better sensors they become for understanding the environment.

Proposition #2—If an organization is to understand its environment and be agile in their decision making, they must employ all available sensors (human, technological and others). The greater the number of sensors employed to understand the environment, the greater the likelihood of a resilient organization.

Proposition #2a—To process the information received from all sensors, an organization will need a system or means to capture, analyze and interpret this information to make it usable for decision makers.

Proposition #3—Resilience requires agile decision making in a complex environment. Organizational structures that support and empower decision making at the lowest level possible, and that provide a framework to make those decisions, improve resiliency by allowing for flexibility in operations.

Proposition #3a—The more decentralized an organization, the greater its ability to adjust to rapidly changing environmental conditions. It follows then, that the higher normative behavior impacts decision making and the fewer rules used to accomplish tasks, the more resilient the organization.

Proposition #3b—Utilities exhibit the resilient behaviors of developing people and plans to address catastrophic failures that occur on a regular basis and many utilities have developed plans and made capital investments to address catastrophic failure. These behaviors allow the utilities to become more resilient. However, without changing the paradigm toward decentralization or adjusting the decision-making framework to acknowledge a complex environment, a high likelihood exists that when impacted, the organization will either not see the issue or be overcome by it before it can react.

Proposition #4—An effective risk management program may be a precursor for resilient behavior.

2. Organizational Change

As organizations developed over the last century, the bureaucratic model is used that sees the world as stable and predictable. In this system, managers can maneuver the levers of power in a deterministic planned way to achieve desired goals. System

performance occurs through optimizing the functional components while the bureaucracy ensures coordination and accountability. Little need exists to create resilience in such an organization as external elements are static and internal elements are controlled. Unfortunately, the world is more complex and in a state of constant flux requiring organizations to rethink their current management paradigm.

Proposition #1—The existing model for utilities and other hierarchical bureaucracies fails to account for rapidly changing environmental conditions, such as natural or intentional disasters and technology innovations. This model also fails to account for internal controls stifling innovation and creativity in the organization as such centralized bureaucracies are less flexible to change and have greater difficulty adjusting to changing environmental conditions.

Proposition #1a—Due to legislative constraints that are unlikely to change, the hierarchical bureaucracy will continue to be the model for most public agency utilities. It is incumbent upon managers to understand the need for flatter organizational structures and push power and decision making down to the lowest level possible.

Proposition #1b—Utilities can affect their level of resilience mostly through organizational change, and industry professional groups can assist them in that endeavor.

Proposition #2—An organization changes continuously through a process of interconnected individual agents entering and leaving the organization with new information and ideas that allows the organization to adapt to environmental conditions as it evolves.

Proposition #3—Episodic or leadership-driven change is necessary for organizational survival, as rapid changes in environmental conditions require an organization to set new direction. Foundational to this change is the need to adjust or change the tacit assumptions and values of the organization, as they no longer fit the environment.

Proposition #4–The higher the level of trusted relationships within an organization, the greater the likelihood that positive change will occur. People need to have a level of psychological safety in place to feel safe enough to experiment and attempt new ideas, which requires a high level of trust within the organization.

3. Leadership

Leaders can influence both continual and episodic change by what they focus on and whom they hire and fire.

Proposition# 1–Since continual change occurs as the result of the churn of people through the organization, and specific traits and values can improve the likelihood of an individual being a change agent, it is incumbent on leadership to ensure the people hired fit the organizational culture desired.

Proposition #2–To direct change, it is necessary to understand the current state of leadership culture within an organization. Using the assessment tool (Bass’s ODQ), an organization can determine their current leadership culture within the transformational-transactional types.

Proposition #3–Where a leader focuses attention is the place change will occur. It is imperative that leadership provide sufficient time and resources to complete the change process required to alter the tacit values and assumption necessary to build resilient behavior.

Proposition #4–Based on current studies of bureaucracies and utility leadership, a gap appears to exist in the skill set of utility leaders towards result-driven leadership.

Proposition #4a–Leadership in utilities will continue to originate from the existing professions, and therefore, a need exists to insure this group receives training and continuing education in the skills of managing change.

Proposition #4b–Utility leadership needs a framework from which it can interpret its complex environment and a decision-making model that provides a means forward.

4. Obstacles to Change

A number of internal and external obstacles exist for utility leaders that will need examination to move toward resilient enterprises.

Proposition #1–Utility managers have less control over external obstacles, such as regulators, political leaders, governance issues, etc. By working in a collaborative method with these key stakeholders and sharing the issues that affect the utility, it is possible to develop a shared response to those issues that positively benefit the utility.

Proposition #1a–Where there are clear and distinct ties to utility goals and objectives, it should participate in collaborative decision making.

Proposition #2–Utility managers can positively impact resiliency through organizational change using the behaviors of path-goal theory to lead to more transformational cultures and Covey's four cores and 13 behaviors to improving trust and adjusting both their organizational cultures and structures to meet their needs within the environment.

Proposition #2a–Trust is a two-way street and in those organizations with long histories of union activity, change may be more difficult. Management can create an environment where trusted relationships flourish and employees are hired that desire these relationships, but existing employees and their unions must be open to change if the organization is to alter its tacit assumptions. Open, honest, and transparent communication between management and union representation about the state of the utility and the need to change the current method of doing business is necessary.

E. RESPONDENTS' FINAL THOUGHTS

Respondents reviewed the initial emergent theory to provide their additions, subtractions and adjustments included in the second review above. The respondents supported the initial theory and provided clarity and substance to several propositions that improved the emergent theory. With this confirmation from industry leaders, the next step was to develop a strategy framework that utilities could employ to address the issues noted in the theory.

F. SUMMARY

Initially, this section focused on the 2010 State of the Industry (SOTI) survey conducted by the AWWA that documented the areas of concern for industry leaders and those areas that members saw as being inadequately addressed. Next, a series of questions requiring a written response went out to industry leaders focusing on the ideas of resiliency, leadership, cultural change and obstacles to change. Interviews conducted with a smaller group based on the information garnered from the first two elements improved the emergent theory and developed a framework that could provide utilities a roadmap toward resilience.

The SOTI survey documented the key concerns for decision makers and a variety of other items not adequately addressed by the industry revolving around sustainability and resilience. It would appear that industry leadership continues to have difficulty addressing these wicked problems year in and year out as they continue to score high on this annual survey, which resulted from these traditionally natural monopolies discovering their operational environment had become considerably more complex. Management educated using the Newtonian paradigms or operating in the simple and complex domains of the Cynefin framework are unprepared to address the non-causal world of the complex and chaotic domains.

The design of the written questionnaire focused on gathering some initial input from industry leaders about what a resilient organization looked like, what the role of leadership was in that process, what type of organizational culture was needed, and what the obstacles to change might be. Several interesting points were uncovered because of this process. When provided an ecological definition of resilience, industry leadership outlined most of the characteristics expected to be found in this type of organization, which indicated that they understood an organization as a CAS, even if they might not necessarily call it that. Using their notion of a resilient organization, they were able to provide a set of leadership characteristics and skills required to change an organizational culture and move the organization toward a particular set of goals. Many of the behaviors noted by the respondents were congruent with both House's path-goal behaviors and Bass's transformational leadership, which indicated that the proposed methodology

towards moving organizational cultures to a more resilient position was much more likely than previously thought. The group also was able to provide an extensive list of obstacles to change and a list of means to overcome those obstacles. The key findings were that regardless of how an organization seeks change, executive leadership must be committed to that change for the long haul and that many of the wicked problems that influence utilities require collaborative decision making with key stakeholders and employees. These findings indicated that the concept of the megacommunity discussed above could provide utilities a methodology to address these issues in a fashion that was not outside current utility leadership's comfort zone.

The final information gathering point was to interview several industry leaders in an attempt to flesh out the responses of the initial questionnaire and confirm the information as a test of the emergent theory. The group identified a couple of themes that refocused the emergent theory toward a more pragmatic and individual utility approach to the issues.

All utilities will start this process in different places, and therefore, must be flexible enough to adjust to their varying needs. The strategy must be pragmatic or primarily focused on those items that utilities can effectively change or adjust. They indicated there was little value in expending resources on items that for political or other reasons were not likely to occur.

To develop buy-in and support for this continuous improvement process, the industry's professional organizations seem to be the most efficient place to begin these discussions. There was agreement that if utilities were to address the wicked problems of the industry, they were going to have to look outside the industry to key stakeholders for assistance and to develop awareness of these problems. A significant need seems to exist to develop education and training programs for utility leaders and perspective for leaders that address the issues of organizational culture, CAS and leadership in a complex world.

III. DISCUSSION AND RECOMMENDATIONS

A. IMPLICATIONS OF THE EMERGENT THEORY

This paper offered several implications for utilities if the emergent theory were to be embraced. First, it requires that leadership and labor begin to see the world as a complex set of systems demanding changes in behavior from all parties. It means a change in the way utilities address major issues outside their immediate control that relinquishes some power to stakeholders outside the utility and employees within the organization. A new focus is needed on education and training to address the issues around living in a complex environment and developing multi-talented sensors to understand and proactively address that environment. Cultural change is required at some level to adjust the tacit assumptions of the organization and to foster resilient behaviors and develop transformational leadership cultures. Although the basic structure of a bureaucracy will continue to be the structure of these organizations, management needs to develop ways to push down decision making and develop teams as a means to organizational change. By fostering trusted relationships at all levels of the organization and with others outside the organization, the probability for real change improves. The roadmap reinforces the notion that utilities need a new way to see the world and seeks to provide a starting point to develop the skills necessary to navigate that complex world successfully.

B. ENVISIONING A NEW WAY OF THINKING

The purpose of this research has been to provide publicly owned utilities with a roadmap to grow a resilient organization that is customer focused, forward looking, multi-sensory, and learning organizations that seek to proactively address risks and cultivate opportunities within an environment that requires high reliability and quality service. Organizations that implement these elements will improve the customer's experience while lowering overall organizational costs and providing both a resilient and a financially sustainable organization. The elements noted below provide insight into how this type of organization looks and is measured.

- Level of organizational resistance to change
- Level of command and control bureaucracy
- Focus on technical skills
- Level of data driven decision-making
- Level of employee empowerment
- Level of transformational leadership
- Using a multi-sensory approach and framework to understand and adapt to the existing environment.

As a rule, most groups need some type of structure for growth and development. Over time, this structure becomes entrenched and resistant to change. That said, an organization that fails to adapt would either collapse or implode due to rapidly changing external environmental conditions or internal dissent. What kind of organizational structure lends itself to rapid adaptation to changing conditions? Such an organization is where decisions are made at the lowest level in which employees are empowered to make decisions and norms are aligned within the organization that drive behavior rather than policies, procedures and regulations. This type organization understands complexity and thrives in that environment through a shared sense of purpose and interests, where power sharing is the norm.

Understanding the level of resistance in an organization and bureaucratic entrenchment provides a baseline for understanding the type of organization being reviewed, which is either a centralized and less adaptive organization, or a decentralized and more adaptive organization. The more decentralized or adaptive the organization, the more likely the resistance to change will be minimal. Utilities insulated from environmental conditions through regulatory actions, political control, and legislative requirements have developed as classic centralized bureaucratic organizations. Their ability to adapt to changing environmental conditions puts them and their customers at risk for catastrophic failure when the organization moves into the complex or chaotic domains.

To develop a learning organization typical of decentralized structures, a holistic approach to training and education is required. Therefore, the need to know and understand the level and focus of existing learning experiences for employees is a key to determining the next steps to moving an organization from a technical focus to a more holistic approach to learning. Norwegian researchers Grotan, Storseth, Ro and Skjerve (2008) suggest that improvisation is the engine for developing resilience in organizations. Improvisation traditionally has been associated with how exceptions are handled in a continually changing environment. As they looked at how an organization might train people to be more adaptable, they focused on anticipation, attention and response. They suggest that by using scenario-based training where individuals are provided multiple responses and results to problems much like game playing, individuals are allowed to build these types of skills. It would seem that by engaging in a training effort that regularly tests an employee's to adapt to changing conditions would be a method that develops a staff with the agile decision-making skills necessary in a complex world (Grotan, Storseth, Ro, & Skjerve, 2008). How decision making occurs within the organization will also be critical in determining where an organization is in the process to develop an action plan to move it towards a more data-driven approach (Gonzalas, 2004). What is expected is an organization that uses the same technical focus used in decision making on technical issues in a holistic manner throughout all organizational decisions with a framework that provides understanding of the complex world in which its operate.

The levels of employee empowerment and transformational leadership are different sides of the same coin and provide insight into how open and structured a particular work environment is. This is important, again, in determining where an organization is and developing a working plan to move it towards a more agreed upon, norms driven organization, focused on providing employees the maximum amount of control over its work environment as possible (Weick & Quinn, 1999; Kelman, 2005). This element allows the organization to create a situation where employees and others become sensors within the environment that seeks out issues or risks and acts on them to mitigate the loss, and more importantly, provides the customer with an experience second to none. Leaders need a framework to understand their environment and the tools to

manage within those domains. The Cynefin framework provides leaders with a means to adapt organizational behavior while seeking innovation and opportunity in an uncertain environment.

Two key elements required for successful change are stakeholder identification and leadership development. Stakeholder identification insures that all parties who have a stake in the strategy have the opportunity to be part of that process that leads to a new organizational direction, and to provide those collaborative opportunities that lead to buy in for the new vision or direction. Having the right people at the table who have either the explicit authority within the organization or their particular group or the implicit ability to influence decision makers is key to insuring the strategy is balanced among the groups impacted and provides for champions to take it forward. (Gerencser et al., 2008)

Leadership direction and support are key elements for the successful development and implementation of any strategy. Leadership direction in this case refers to the ability to set the tone for effective organizational change by removing or limiting the barriers to effective communication and collaboration among the parties involved in the process. Leadership also needs to set the parameters for the group developing the strategy to insure the group focuses its resources in areas where the barriers to change are at least permeable. Leadership support refers to the need for leadership to both champion and develop champions for this organizational change strategy. It also includes supporting the decisions developed by the strategy team and enthusiastically moving those changes forward through the implementation process. Showing the organization the benefits of this change along with the results if the organization continues on its current path provides the framework for organizational change. Working with management and the team to create an environment of trust and support to empower employees in both decision making and implementation of the strategy sets the foundation for the new organizational mission, vision, and values.

C. DEFINING THE ROADMAP FOR SUCCESS

The roadmap for success does not refer to a step-by-step plan that a utility can follow to achieve resilience. One of the respondents in the study accurately indicated that

‘this is a process, not a program,” and as such, it begins with the understanding that each utility starts from its own unique point in that process. Utilities function in a wide range of environmental conditions, both internally and externally, so that no one path is available for all to take to achieve a more resilient organization. Since each utility starts from a different point in the process and lives in a different environment, it would be impossible to provide a one size-fit-all approach to this issue. This roadmap is an implementation strategy that each utility will develop based on its own environmental conditions with the purpose of adjusting the tacit assumptions of the organization to make it more adaptable in a complex world.

D. DEVELOPING AN IMPLEMENTATION STRATEGY

The design of the strategy framework is for utilities to implement this strategy individually, and as multiple utilities change behaviors, the desired effect of a paradigm shift from protection to resilience in the industry is achieved. One way to move this strategy forward is to work through the regulating agencies to develop law that will translate into rules and regulations. Creating new regulation fails to take into account each utility’s unique environment and its ability to address that environment with the agility required to create true resilience. Although rules and regulations create uniformity of action in relation to a specific set of issues in most cases, they prevent an organization from developing the skills necessary to create innovation. A better choice is to work through the utility’s various professional groups to develop buy-in and support for the strategy framework through its working committees. Once garnered, the professional group can push forward a strategy framework and provide support to utilities to begin the implementation process.

Currently, the focus at the federal government level is ensuring the critical infrastructure can respond to and recover from natural or man-made events quickly. This is certainly a key element of resilience, but it is too narrow a focus to grow a resilient organization as it fails to address the holistic nature of the environment in which utilities

operate. The design of the strategy framework is to develop buy-in and illicit ongoing support for developing resilient utilities from their professional groups and has three primary goals, which are described below.

The strategy framework or roadmap to grow resiliency in publicly owned utilities is a continuous improvement process where an organization uses the following model. Management must lead this process through their actions and words and take ownership of the process. The organization will begin by assessing its current level of resilience based on the criteria provided, and then develop a strategic plan to address the weaknesses noted and capitalize on its current strengths and any opportunities noted with the assistance of the materials provided by the professional organizations. Implementing its specifically designed strategic plan, its will adjust the organizational culture to enhance resiliency. Once implemented and in place, management will monitor and measure/test those changes to ensure the desired results are achieved. It is management's responsibility to review the process to insure adequacy and effectiveness, along with providing direction for future changes as needed. The process then begins anew to continue to move the organization forward incrementally toward greater resilience.

Goal #1—Each utility will need to complete an assessment across multiple criteria.

Objective #1—A resilient organization, one characterized by its agility in decision making and high level of understanding their environment. An organization that sets goals that allows individual units the autonomy to achieve the mission in a more decentralized, flatter organization is required. The organization will self-assess its level of centralization based on how closely it is modeled to a typical top-down bureaucratic system, the flatter the organization, the more likely it will be resilient.

Objective #2—A resilient organization, characterized by collaborative decision making with high levels of trusted relationships between individuals and groups, using Covey's summary of trust taxes and dividends can assess its current state of trusted relationships.

Objective #3—A resilient organization is a learning organization because to adapt, it is necessary to focus outward on the environment continually, understand what is

happening, and adjust the behavior based on those changes. An organization can review several concepts as means to measure its current focus on learning. These items consist of providing continuous learning opportunities including those outside the job requirements, using learning to reach goals, linking individual performance with organizational performance, fostering inquiry and dialogue in a safe environment that allows for risk taking, and embracing creative tension at the edge of chaos, continually aware of and interacting within its environment.

Objective #4—A resilient organization requires significant information about the environment from which to learn and make decisions. It is important to collect data on the utility and its environment, but an organization must also be able to use that information effectively. An organization can measure its effectiveness by reviewing how much it uses that data to drive decision making. Is it collecting the right data to make those decisions? Where are the data stored and how easy are they to access? An indicator of effectiveness would be the implementation of a business intelligence system.

Objective #5—A resilient organization exhibits a high level of transformational leadership. Using Bass's ODQ typology and tool, a utility can understand its current leadership style and develop a plan to move towards a more transformational style.

Objective #6—A resilient organization must be a forward-looking, multi-sensory organization if it is to interact with its environment effectively. In other words, it must be involved in its communities at multiple levels, working on issues that influence both the utility and other stakeholders in the community. A utility can measure effectiveness by how often and to what extent it participates in collaborative efforts within the community to solve issues that not only have a direct effect but also more indirectly affect the utility.

Objective #7—To understand the complex environment in which it lives and makes effective decisions, the organization needs to develop a framework for decision making. Using the Cynefin framework and path-goal theory will provide a utility not only an understanding, but also more importantly, a model to traverse the obstacles it faces in a complex world.

Objective #8–The purpose is ultimately to service customers with a very reliable high quality product at a reasonable cost. If an organization is to understand its environment, then utilities need to know their customers and employees better than anyone else does so that they can meet their expectations and exceed them. This attitude goes back to being a multi-sensory organization, and thus, utilities can measure effectiveness by how often they have customer contact and the satisfaction of the customer with that service, and through employee attitude surveys.

Goal #2–Develop a strategic plan using the assessment process defined above and other elements to move it toward long-term resilience. Each utility will be in a unique position related to its current level of resilient behaviors and environment.

Objective #1–Based on the assessment, redefine the organization’s mission, vision and values to determine where the organization needs to move to achieve a desired organizational culture end state.

Objective #2–The organization will need to complete a Strengths, Weakness, Opportunities and Threat (SWOT) analysis to garner an understanding of the current environmental conditions needed to factor into the strategic plan.

Objective #3–Write the strategic plan for the organization with action steps and measurements included to determine plan effectiveness.

Objective #4–Based on the strategic plan, develop the operational planning process that addresses issues unique to the industry or organization (e.g., continuity of operations, asset management, and succession).

Goal #3–Leadership will monitor and measure for success.

Objective #1–Monitor plan elements against defined measurements and adjust plan as needed.

Goal #4–Leadership will review plan effectiveness and set direction accordingly.

Objective #1–Review the plan’s effectiveness and provide direction for incremental changes needed to adjust for failures in the plan or changes in the environment.

Resilience by nature is a continuous improvement process; as the environment changes, organizations with nimble agility maneuver their way through complex environmental conditions with no need for strict top-down bureaucratic control because those decisions are data driven at the lowest possible level in the organization. This change can only happen in high trust environments where learning is continual by everyone in the group and collaboration, both within the group and with key stakeholders on issues, is the norm rather than the exception. This type of organizational change can occur both episodically and incrementally based on conditions, but the key element is that change is constant and it is up to utility management to handle that change to provide its communities with truly resilient organizations.

E. METRICS FOR SUCCESSFUL ORGANIZATIONAL CHANGE

Measuring success in this process occurs when norms and values change within the industry. Several elements are available for measuring how successful the process has become in improving resilient behaviors in the industry. Some measures used include the development of a common definition for resiliency that engrains itself in the language of the industry, flattening of bureaucratic organizations, and an increase in the empowerment of employees to make decisions. Using the ODQ, it is possible to assess and begin to shift from a more transactional to a transformational leadership style, an increased commitment by both management and employees to education, increased use of technology as a sensor, and as database use increases, the acceptance of business intelligence programs throughout the industry. To address issues outside the utility, an increase in the use of the megacommunity approach to address those wicked issues that face utilities to include allowing key stakeholders and customers, allows a much more impactful role in utility operation.

F. CONTRAST WITH THE CURRENT STATE OF AFFAIRS

Today, resiliency occurs in those organizations where a likelihood of a catastrophic failure from natural causes exists; thus, if an organization exists in the regions of the country where drought, hurricanes or earthquakes are likely, that utility probably has developed at least some level of resilient behavior. In those parts of the

country where this is less likely, utilities focus has been on other items. The reality is that utilities live in a complex, networked community and that this complexity is going to continue to increase over time; therefore, if utility managers fail to change the way they see the world or adjust their organizations accordingly, the likelihood for utility failure due to multiple, but not necessarily connected events, increases.

Current organizational structures and operational paradigms built on the Newtonian principles of the 19th century lock organizations into decision-making models that start from the premise that the world is static and controllable. In a world of complexity and continuous change, enterprises can be blindsided if they continue to use these models. A new way of thinking is required and that means that utility leaders and others will need instructions in new assessment and decision-making methods to implement change and shift the tacit assumptions and values in the industry. The organizational structures in place today developed at a different time, with different understandings of the world. Their ability to adapt to complex environments is limited, and therefore, poses at least some risk to an organization's ability to manage in this environment.

Based on the studies noted above, it seems clear that utility managers believe they have limited opportunities to change their organization to meet a changing environment. This attitude is likely true if they are trying to use traditional levers to meet complex issues of the day, and therefore, have tended to shy away from organizational change and kick that can down the road to the next leader. Unfortunately, the next leader will probably be from the same organization or discipline and lacks either the skills or willingness to tackle these challenges, and the problem continues. Leadership development is critical if the industry is to break this cycle; providing utility managers with the skills required to adapt to a complex environment is a major step in successfully growing resilience in utilities.

Publicly owned utilities have been comfortable in being the silent service no one thinks about unless there is a problem. This standing in the background has lead to a set of expectations on the part of customers and key stakeholders that the service provided comes at the lowest cost and without considering the system holistically. In other words,

the industry has been unwilling to promote the need for costly infrastructure upgrades and repairs due to political expediency and customer apathy. Utilities need to engage key stakeholders and customers in serious discussions related to the cost of the service and what people are willing to accept in terms of cost increases or service reductions.

Many utilities today already capture a large amount of data on both their systems and customers, that if properly managed, can aid in decision making at all levels of the organization. This concept requires the investment in business intelligence solutions to provide decision makers with an easy means to tap disparate databases to supply decision maker's accurate, timely and relevant information from which to make good decisions.

Today, most utilities focus on providing employees educational opportunities that directly relate to their job function, and while this should continue to insure a quality product, it is necessary for employees to stretch the intellectual capacity to create staff that looks outside the box and seeks innovation. To become a learning organization requires a commitment to the employees and an understanding that they may move on once educated, but while they are in-house, their creativity and innovation will make the organization more nimble and better prepared to deal with the environment.

G. NECESSITY OF CHANGE

If utilities continue on their current course, what does the future hold? Utilities will continue to make decisions in the simple and complex domains of the Cynefin framework using mechanistic practices even though they will be residing in the complex or possibly the chaotic domains. The decision made will be, at best, unsuccessful and costly, and at worst, catastrophic with an increased probability of utility failure. Not only do managers need to understand which domain they reside in so that they can choose the correct decision-making model, but they also need relevant, accurate data quickly to provide the context for those decisions as they experiment to find the emergent path. This may sound too radical for most organizations, but the fact is that incremental changes over time can result in major changes to the system, that is adaptation. If utility organizations fail to adapt to an increasingly complex world, the results for their communities will be both costly and possibly catastrophic. Now is the time to begin the

process of developing more resilient critical infrastructure organizations through leadership development, assessment, investment, incremental organizational change and development of learning organizations.

H. LIMITATIONS AND OPPORTUNITIES FOR ADDITIONAL RESEARCH

This thesis is a mash-up of a number of ideas taken from authors in academia and elsewhere that seeks to provide an initial set of theoretical propositions that lead to a strategy that provides a first attempt to build resilient behaviors in publicly owned utilities. As with any new idea, it awaits refinement and validation that would follow a pilot of this model into a publicly owned utility organization. This pilot is another means to improve the current strategy and make it viable for a wide variety of utilities to adopt, and would act as an initial baseline for future adopters and provide a historical baseline for the organization. The industry can also invite organizational comparisons to a sister utility or agency of comparable size and function to test the validity of the strategy against an organization that made no changes to culture over the same period. The results of this comparison would draw on the metrics noted previously and the employee attitude survey to determine the level of change between the organizations. Alternatively, a single organization piloting this strategy could compare itself against its original assessment over time to determine the impact of the new strategy in relation to previous resilient behavior experiences.

I. CONCLUSION

Utilities are complex adaptive systems that exist in an ever-interdependent networked world where uncertainty and complexity are the norm. Managers of these firms have been schooled in traditional management techniques that see the world as mechanistic and normally in equilibrium. The result is that most utility managers lack the skills and decision-making framework necessary to operate in any domain other than the simple/complicated context. For utility operations to be sustainable and prosper in the future, managers will need both a new skill set and decision-making framework. That new skill set starts with a different understanding of how the world operates with a focus on organizational development from the perspective that the organization is a complex

adaptive system. Change is the one constant in the world and managers can influence that change directly (episodic change) by adjusting the work environment to achieve a prescribed set of goals or through providing attractors (continuous change) by adjusting what they focus on and who is hired .

Utility leadership will need to assess the current level of resilient behaviors within the organization to provide a baseline from which leadership can develop a strategic plan to adjust the organizational culture and measure future success. The paper provides a series of variables (level of bureaucracy, transactional/transformational leadership styles, use of business intelligence) and the means to measure those variables to set the baseline of organizational resilience. Since every utility starts from a different place on the roadmap, once the assessment is completed, each utility will have a unique situation from which it can improve its resilient behaviors. The paper provides a series of methods to begin to adjust the organizational culture through management behaviors like House's Path-Goal management behaviors, Kelman's seeking political dissent for change, Covey's need for trust, Beckman's characteristics of a decentralized organization and others. Management's responsibility is to incorporate those behaviors into its organization that both fit the current culture and improve its level of resiliency from the original assessment.

Along with improving management's skills in adapting its organizational culture to this ever-changing environment, it also needs a means to sense the level of complexity in the environment. The paper discusses the concept of the Cynefin Framework that can provide managers the skills necessary to understanding the complexity of the world, but more importantly, it provides a decision-making model that can assist leaders in adjusting their behavior, and ultimately, its organization's path. Utility management can begin the process of growing resilient behaviors into its organization by using these tools, which in turn, provides its customers with sustainable utility operations.

Like a painter, each utility stands before a canvas that is incomplete with a palette of tools to finish the work. Without a framework from which to begin the process, it becomes difficult to know where to begin. The purpose of this research is to provide utility leaders with some context from which they can begin to understand the complex

environment they currently reside in and provide some additional tools for their palette to grow resiliency in their organization. The researcher hopes that by working through the industry's professional organizations, the industry can develop a pilot to test this theory, then adjust it as necessary and roll the process out to additional participating utilities, one at a time. Over time, he would expect to see a paradigm shift in the industry that more closely reflects the information in the CAS and cultural change literature and the insights of industry leadership that participated in this research. This is not to say that what utilities have done in the past in relation to becoming more resilient is wrong or unnecessary; rather, this research provides a new context and framework from which that foundation can be improved to address the new complex environmental conditions that each utility faces.

APPENDIX.

A. RESULTS OF INITIAL QUESTIONNAIRES

Resiliency, for the purpose of this discussion, is the capability of an organization to maintain its functions and structures in the face of internal or external changing environmental conditions, and to respond positively to these changes or when necessary degrade gracefully, consistent with its business interests and investment capacities.

Table 7. Response to Question #1 of Initial Questionnaire

Respondent #	Questions #1-Please describe in your mind what a publicly owned critical infrastructure resilient organization might look like based on this definition.
1	I would characterize a resilient critical infrastructure organization as one that would be flexible and adaptable by modifying policies, procedures, work flow and employee skills/training in order to accomplish the mission. As far as the question being related to publicly owned organizations, I think the “best practice” of resiliency would be the same regardless of ownership. The goal is the same despite there being different challenges in a public versus private organization.
2	The Utility’s main priority is, and always will be to provide safe and reliable water and sewer service. In order to do this, water and sewer rates have to be adequate to provide acceptable levels of service. It requires an extensive asset management program designed to sustain the existing infrastructure indefinitely.
3	One that is “hedged” in a variety of ways to permit changes in one direction or investment as circumstances may dictate. A resilient organization is one that has pushed power down decision making to the lowest levels reasonable with the goal to stimulate/support individuals taking ownership of their roles/responsibilities by using independent judgment.
4	Non-elected officials whom are protected from political interference by the nature of their appointments would govern this type organization. They operate independent of third party regulation of their business affairs. They are managed in accordance with business principals allowing them to collect the full price of their services. Their operations are managed by professionals empowered and encouraged to plan carefully, construct wisely and operate efficiently. Management has the capability of adjusting its expenses, especially its personnel expenses, as necessary to respond to changes in its operating environment. The organization must have created and must maintain a culture that is dynamic and constantly learning and adjusting to changing events

Respondent #	Questions #1-Please describe in your mind what a publicly owned critical infrastructure resilient organization might look like based on this definition.
5	Based upon this definition, a publicly owned, critical infrastructure resilient organization would utilize all facets of asset management planning to make sure the organization has planned for and prepared for challenges related to its physical infrastructure. Such as above ground facilities and below ground infrastructure; its personnel to make sure succession planning or bench strength has been considered and developed and the system is prepared for current and future regulatory challenges. Rate planning must also be conducted to ensure financial stability and affordability can be maintained while implementing any asset management plan.
6	Any public utility should be organized and built to sustain a catastrophic failure and still deliver vital services (perhaps at a reduced level) and be able to put the pieces back together in a short time. It should also be able to operate if the senior level managers become incapacitated for any reason. Redundancy should be built into the system, allowing services to be re-routed or delivered by backup systems.
7	The organization should have redundancy built in for its source, treatment and distribution of water. It should have a business impact analysis in order to develop a plan to create contingency plans for most situation
8	First, an upper management team that fully understands and accepts there will be change, both internal and external, requiring the organization to plan ahead as much as possible. The team would be dedicated to managing infrastructure, a governance structure that promotes financial viability and operational experience to manage risk effectively. The organization would look at all aspects of the operation and identify strengths, weaknesses, opportunities and threats (SWOT analysis) Based on the SWOT analysis, prepare action plans addressing the weaknesses, opportunities and threats while continuing to build on the strengths. A SWOT analysis will identify issues regarding the aging workforce, continuing the education, knowledge and skill sets of the employees, employee retention and turn-over, employee benefits and competitive wage surveys, customer satisfaction, expanding and marketing the organization, vehicle and equipment replacement, capital improvement recognition and funding, preventive maintenance programs from tools to office buildings and how the economy will effect these issues and what effect it will have on your current strengths. Organization would be planning for technological, legislative and regulatory changes that would affect the day-to-day operations. The organization would be involved in outreach programs, active in community events and organizations, and supporting designated local charities. The organization would also have employee events that would support team building and volunteering to assist the local community. Succession plans would be in place or being developed identifying key positions within the organization. Plans would include identifying the employees who succeed into key position with the employee receiving training and mentoring on a routine basis.

Respondent #	Questions #1-Please describe in your mind what a publicly owned critical infrastructure resilient organization might look like based on this definition.
	The organization would have a disaster recovery plan in case of a catastrophic emergency that would include having the ability to continue operating under adverse conditions. The ability to relocate essential personnel, supporting equipment and supplies if required would also be included in the plan. The organization would have a professional, hands-on, Human Resource department who understands their role and seeks to minimize or eliminate the organizations exposure to litigation concerning personnel issues. The organization would keep their employees updated on changes, action plans, conflict resolution, continuing education and career advancement opportunities, benefits, and employee evaluation processes. Management should create work environments that are conducive to job shadowing, cross training in appropriate situations, and emphasize the importance of beings able to multi-task. The organization would survey their employees on appropriate topics to keep in touch with employees and show the organization cares about the employees' opinion. The organization would provide additional benefits to their employees in the form of employee assistance programs (EAP), credit-counseling programs, voluntary benefits that provide specialized options to employees and an active wellness program that encourages and rewards employees to participate in staying fit both physically and mentally.

Table 8. Response to Question #2 of Initial Questionnaire

Respondent #	Question #2 -Please compare and contrast your organizations level of resiliency to your description of question #1?
1	In our organization, changes occur very slowly because of several factors. I think in general many people are not responsive to changes of any kind and that is a hindrance to resiliency in any organization. Some of the challenges that we are faced with include political interference and the fact that the bargaining unit carries a lot of weight with the city administration resulting in our managers being less effective
2	I believe that our organization is capable of enduring change, and that our current structure will continue to allow us to provide the levels of service that we desire.
3	Unfortunately, many of the earlier investments were made using a 30-year payback period and the accumulated amount of debt limits short-term flexibility.
4	The definition above describes our organization.
5	Our organization has completed one update to its asset management plan and has done a good job of addressing above ground infrastructure. We are doing a fair job with our below ground infrastructure, which will be a key component of our next update. We do a good job meeting regulatory challenges and do look towards developing staff to prepare for future leadership opportunities as some of our more long-term employees retire.
6	<u>Redundancy:</u> As a water and sewer provider the organization has developed a system of built-in redundancies for its water and sewer infrastructure. These include backup distribution reservoirs and aqueducts, backup electricity generation and mobile disinfection units. The organization maintains four Operations Control Centers to remotely manage and operate the system, which can back each other up in the event that one becomes unusable.

Respondent #	Question #2 -Please compare and contrast your organizations level of resiliency to your description of question #1?
	<u>Risk Reduction through Capital Planning</u> The organization ceased using chorine in its system several years ago, thereby eliminating the risk of leaks or damage. All rehabilitation and construction contracts carry a security and redundancy component designed around a rigid security specification designed to harden structures and protect them from harm. <u>Planning</u> The organization maintains over 160 individual emergency plans for facilities and specific incidents. In addition to facility failure plans, for example, there are plans to handle weather events, civil unrest, spills and things like a flu pandemic. These plans are updated and tested regularly. <u>Emergency Response Capability</u> The organization maintains an organic emergency response capability. A 24-person Emergency Service Unit (ESU) is trained and equipped to deal with intentional or accidental contamination, confined space rescue, HAZMAT and emergency boom deployment. They are equipped with a mobile emergency lab, boats, SCBAs and other personal protective equipment and dedicated emergency trucks. There are also 3 Emergency Operations Centers, one of which is a backup facility in the event that one of the others becomes unusable. <u>Security Technology</u> The organization system protected by extensive surveillance equipment including PTZ, thermal and infrared cameras, card access systems and intrusion detection. In addition, the MWRA has deployed a contaminant detection and warning system and established response and testing protocols. <u>Training</u> ESU members drill monthly. The organization does a yearly major field exercise, monthly tabletop exercises and extensive training throughout the year to maintain skills and awareness. <u>Cooperation</u> The organization relies on the State Police to provide security protection to its infrastructure and maintains close relationships with the Emergency Management Agency, the state Division of Fire Services and the Department of Conservation and Recreation (which manages the organizations watershed lands), as well as municipal fire departments.
7	We have redundancy as well as a business continuity plan to mitigate most unforeseen circumstances that could occur.
8	The organization is currently following the items listed in #1 or is in the process of improving our existing items or developing new ones . We do not speak of identifying our strengths, weaknesses, opportunities and threats as a SWOT analysis, but these issues are discussed at our weekly staff meetings. The executive directors, divisional directors and our environmental communications director attend these staff meetings. Our threats are more related to drought conditions, flooding, regulatory changes, legislative changes, delinquent or non-payment from our customers as opposed to direct competition from another authority. We are fortunate to work for an organization that makes financial and asset decisions with an eye toward long-term sustainability. Revenue targets are set to meet operational needs as well as to provide reasonable reinvestment to renew infrastructure while remaining affordable for our customers.

Table 9. Response to Question #3 of Initial Questionnaire

Respondent #	Question #3-What is the role of utility leadership in the development of resilient organizations?
1	Part of the role of the leadership is to develop employees, policies and procedures to allow the utility to be positioned properly for any events that might occur. Certainly, this group needs to be a champion for attaining and improving organizational resiliency. The charge must be led from the top.
2	Utility leaders must plan appropriately and prepare for future changes to keep the utility running efficiently. Leaders must be willing to encourage change and get employee buy-in to improve the resiliency of their operation.
3	To advocate for agility in plan and investment and to do so typically with policy and regulatory bodies focused on their own short term, personal interests.
4	Utility leadership is completely responsible for creating a resilient organization. While the institutional constraints of governance and business regulation may mitigate against this being a simple task, leadership is still responsible for finding paths around these types of obstructions. Logical governance and the lack of regulation do not guarantee that the organization will become resilient. The leadership must understand what has to be done and be willing to build a system and a corporate culture that can make it work.
5	Utility leadership must create a culture that encourages employees to contribute towards this effort. Additionally, it must prioritize all facets of asset management and support the necessary funding to implement components of the plan. Items such as employee training and development, embracing technology and developing long-range plans must be a leadership priority.
6	In a word, critical. Senior management must treat resiliency initiatives seriously and provide support for capital spending, organization and training. There has to be a buy-in, not only by senior managers, but also by other constituencies, including regulators, unions and customers.
7	It is critical that they have a holistic view of the utility. They take each part of the utility and combine their needs to develop a program/policy ensuring the resiliency of the utility to serve their customers.
8	The culture or personality of an organization is a direct reflection of the leadership. To achieve and maintain a resilient organization, management must lead by example and support the items listed in #1. Leaders are found throughout all levels of an organization. They bring employee together to avoid problems and develop proactive solutions. Leaders anticipate risks and ensure the systems are in place to manage the risks. Leaders provide vision for the organization and facilitate change.

Table 10. Response to Question #4 of Initial Questionnaire

Respondent #	Question #4-What set of skills or training will be required for utility leadership to develop both resilient organizations and manage change to create those organizations?
1	The skills that are required are not unlike those needed by an athletic coach. Certainly, the ability to interact with many different types of people effectively is an invaluable trait. The ability to view things as an organizational "whole" and to use an interdisciplinary approach to setting goals and determining direction is necessary.
2	Leadership skills would be essential. Willingness to accept change, plan accordingly, remain efficient, and get buy-in from employees would be essential.

Respondent #	Question #4-What set of skills or training will be required for utility leadership to develop both resilient organizations and manage change to create those organizations?
3	Creativity Bravery Personal resilience, Articulate, Persuasive capability A visionary with pragmatic leanings.
4	Skills and training are only a piece of the challenge. The personalities of the leadership team will probably be the most important. If this team cannot work well together, all the training and skills available will not help. Additionally, someone must have a vision of what the organization should look like and how it should behave. Important skill sets would include, planning, financial management, very good HR skills, communications, and political finesse.
5	The desire and ability to identify industry leaders in this area must exist. Benchmarking will be a critical component of this effort. Utility leadership must also prioritize this effort, communicate this priority to its personnel, and make sure through strategic planning efforts that this objective is achieved.
6	Leadership needs to view their role in a broader context than just providing a service to customers or ratepayers. In order to do that they need to understand things like incident command and work through emergency scenarios that is not politicized to make the agency come out on top all of the time. Many utility leaders sometimes view a service interruption or systemic failure only within the confines of the utility itself. In most, if not all, cases the problems affect many other constituencies and services that need protection. This extends far beyond the public affairs arms of the utility and spill over into governmental and regulatory agencies and emergency service providers. Senior leadership has to devote time to training and planning themselves and become part of the solution.
7	To be resilient today one must manage for performance, for growth and for adaptation. We must look ahead to try to identify possible disruptions and test theories that are assumed would ensure resiliency against them. Cross-training employees can achieve this, along with building in redundancy and back-up capacity. These will help ensure some flexibility. Work with suppliers and their networks to see if they have worked on a plan to be more resilient in the face of an unforeseen disruption so they can provide you with what you need to keep operating. Continued operations/service improvement is necessary. From discussion and tabletop exercises through full-scale exercises and training will help ensure constant and consistent improvements are implemented. If utility leadership shows that it is committed to its employees the buy-in will be there.
8	Skill sets and management training are very important in order to develop a resilient organization and to manage change. The critical part of this issue is the forming of a true management team that has dedicated work ethic, believes and fully supports the issues in #1 and that it will benefit both the organization and themselves, is willing to accept change within their own work environment, accepts unplanned assignments as a challenge, and communicates with each other. The team must be willing to agree to disagree and be able to solve problems based on what is best for the organization, not what is best for an individual or group of individuals. The team needs to be inquisitive and have a desire to learn new things. They must be willing to interface with other organizations and make time for continual training. Every organization will have problems, conflicts, growing pains and challenges. What sets a resilient organization apart from other organizations is how they solve these issues, what did they learn from

Respondent #	Question #4-What set of skills or training will be required for utility leadership to develop both resilient organizations and manage change to create those organizations?
	those situations, and how do they prevent it from happening again. How fast does an organization, division, department bounce back from a missed opportunity or a set back?

Table 11. Response to Question #5 of Initial Questionnaire

Respondent #	Question #5-What are the internal constraints to developing a resilient organization? Can they be overcome? If so how?
1	Some of the constraints include political interference and the bargaining unit contractual obligations. The bargaining unit agreement in and of itself is not an issue, but rather the interpretation of specifics which is done without adequate regard given to the utility. The management negotiators are more concerned with the impact to the city. While these issues may seem insurmountable, I believe they nonetheless can be overcome. It requires an ongoing exchange to educate the parties of the utility business and its importance. Demonstrating how one size does not fit all.
2	Resistance to change. Strengthening resiliency would require change. Change would likely cost money initially. In this economy, this could be a challenge. This can be overcome by first obtaining buy-in from everyone involved, as I mentioned earlier. Showing how efficiencies can be increased would be helpful.
3	Unions, long term investments, regulators being easily manipulated to create rules that result in draining public coffers, Human Resources departments, rules requiring "transparency" in government that are now being used to create hysteria and misinformation as opposed to informing the public, short term political agendas, the need for flexibility not being recognized. How? Sheesh. Sometimes things simply need to blow up and be reformed. Government may be one of them. Government always needs a "burning platform" for the bureaucracy to feel as if they have cover to "act." Without it, stasis and ambivalence reigns. In other words, no one feels empowered to act at the risk of losing one's job. Philosophically, it will take a return of the people to a role of responsibility---a direction that the current powers, both federally and in the state of California, are not pursuing. Rather, the bigger governments are taking larger and larger roles and diminishing local roles---so the people move further and further away from any control.
4	Governance is probably the biggest. Hard to overcome without a change of charter. Organization is also a constraint. This can be changed by a determined leader. People are the key; if the people are not capable or in the wrong job or of the wrong skill set or personality for their job, the effort will fail. That is why a non-union environment is so important. Sometimes you just have to let folks go. That takes guts and a willingness to be unpopular, particularly in the short term.
5	In the current tight regulatory and tough economic climate where utilities must continually have to do more with less, it is very difficult to spend critical resources to develop plans that go beyond managing basic infrastructure assets and at the same time meet the challenges related to unfunded mandates such as the Disinfection By Product Rule. I think it will take time to overcome these challenges and this must be completed in small incremental steps. Utilizing an asset management process towards identifying needed changes and gradually incorporating these changes in to updates to the plan is the best way to make progress. I do not believe these challenges/constraints will ever be truly overcome. We will have to work to move towards becoming a resilient organization with each plan update. This sounds more like a process and not a project.

Respondent #	Question #5-What are the internal constraints to developing a resilient organization? Can they be overcome? If so how?
6	Many times these constraints are financial. Using capital projects to fund resilience however mitigates these objections. In some cases there is resistance due to the fact that managers either believe that bad things are never going to happen or that the planning and training to manage them are not worth the effort. This is kind of like driving about without a spare tire. Education, awareness and training help. As will developing national standards for resiliency.
7	Time, a dedicated person to train and money are constraints. If resiliency is made a priority, it will be accomplished. People, time and money will be allocated
8	• Not having commitment and support from top management on issues. • Management members not being able to see “the big picture,” only what benefits their own job management responsibilities. • Lack of communication throughout the organization • High turnover rate of employees causing management members to be continuously training and not having quality time to analyze what is causing the turn over. • Management members not being able to think “outside the box” or being creative, not willing to accept new responsibilities, not understanding the importance of teamwork, succession planning, outreach programs and the importance of encouraging employees to continue their education or learning a new skill set. • People in management typically hire people like themselves. • Management not setting realistic goals and objectives. • Not providing employees the proper tools, equipment, and/or technology to accomplish their job responsibilities. • Inconsistent conflict resolution. How to overcome • Total commitment from the management team

Table 12. Response to Question #6 of Initial Questionnaire

Respondent #	Question #6-What are the external constraints to developing resilient organizations? Can they be overcome? If so how?
1	The primary external constraint would be funding, which is determined by the Public Utilities Commission in our case. By presenting a thorough description of our requirements and the benefit to our customers funding can be obtained; although, it may not be instantaneous or sufficient for a total solution.
2	Money could also be considered an external constraint. In our organization, the City’s general fund is barely adequate to provide basic services. This makes it difficult for the utility to spend the money necessary to provide superior services. This requires us to pursue other methods for improving service. With good records and accounting methods, our utility can justify most of what is necessary to operate resiliently.
3	No response
4	Governance again, if it is defined externally. Union environment–hard to change Business regulation by an outside regulator–hard to change. Contracts with customers can be restricting, but can be adjusted over time.
5	External constraints include regulators, customers that we serve and as mentioned earlier financial constraints. I am not sure if they can be totally overcome. Certainly excellent communication is critical towards helping with this effort.

Respondent #	Question #6-What are the external constraints to developing resilient organizations? Can they be overcome? If so how?
6	The answer above applies, but with a different twist. Consumers, ratepayers, taxpayers and strapped government agencies view redundancy projects in particular as wasteful and unneeded. Education and transparency can help.
7	Logistics with other agencies can be a constraint. If all parties involved regard it as important than it will be accomplished.
8	• Economy • Regulatory issues • Legislative changes • Drought and/or flooding • Delinquent or non-payment from our customers • Inability to expand into new geographic markets to increase customer base. • Premium increases including liability, workers compensation, property insurance employee benefits, increases in electric and gas rates. • Elected officials who have different agendas opposing the organization's goals and objectives including reorganization, privatization, adding additional responsibilities to the organization without allocating proper funding or resources. How to overcome • Adjust to economic swings, both up and down by keeping the organization "lean and mean" (flat) to avoid layoffs, unnecessary overhead and overtime. • Use cross-trained employees to avoid having to hire for every new position. • Quick inventory turnover (just in time) • During down economic periods, employee bonuses instead of yearly wage increases. • Stay involved in new regulatory and legislative proposals and lobby for changes that help the organization. • Stay involved and knowledgeable of local and state political candidates and their plans that could affect the organization of they are elected. • Develop plans to protect facilities from flood and severe weather conditions. • Drought plans including alternative water resources, water usage restrictions plans, conservation awareness through outreach programs, capturing the released water from wastewater facilities and recycle back into the reservoirs. • Market your organization to surrounding counties, municipalities, towns by showing the benefits of regional cooperation, reduction of cost and overhead, combining resources. • Have a strong safety, wellness and risk management programs to minimize premium increases. • Conduct energy efficiency audits to eliminate unnecessary electric, gas and water usage.

B. RESULTS INTERVIEW QUESTIONS

Table 13. Response to Interview Question #1

Respondent #	Question # 1-As you look at the criteria for resilient infrastructure organizations that the group put together what are your initial reactions? Does the list spark any additional thoughts?
1	Reviewed the answers from others and wished he would have come up with some of those, as a whole he felt the answers provided made sense and was in agreement. He believes in building resiliency through redundancy and, where that is not possible due to cost seek alternative measures to mitigate the risk. We all, to some degree, work for elected officials who work on an election cycle timeline rather than the longer term needed, in most cases, to have an effective organization. It takes a great deal of political will and capital to develop redundant systems particularly in tough economic times, but failure to do so leaves single points of failure that can negatively impact the communities served and tarnish the reputation of the utility. In their case they have hundreds of miles of aqueducts and watershed to protect, there is a constant pressure to allow people to use the resources, but in doing so they open them up to an unnecessary exposure. It is difficult not to bend to the political will and open these sites, but to date they have been able to maintain the security at these sites.
2	Was glad he got to see what others had stated in their questionnaires; specifically the idea of a robust assets management plan he felt was important. In his utility they generally run a piece of equipment until it no longer runs, he felt managing that through an asset management program would improve resiliency. He also felt that we must find a means to develop a realistic rate structure that balances the needs of the community against the ever-increasing cost of production. This creates a situation where capital improvement projects get put on hold and infrastructure continues to age with the hope that nothing happens (risk management). Asked if issues of structure or regulation impact these issues? It is kind of a two edged sword, it may be better to bring people in from the outside at a high level to initiate change, but that has to be done carefully so that expectations are managed and employees see real change . If no change occurs or if expectations are unmet, then the ability to get buy in down the road is limited. Hiring from within allows people from the organization who know the culture to adjust or change the organization incrementally and maybe receive greater acceptance, but they may avoid those hard problems or fail to see them due to their organization biases. The notion of embracing technology was problematic for him based on the idea that not all utilities have the funding and expertise to implement technology. This may drive smaller utilities to connect to a larger utility that in turn simply shifts those costs to the larger utility. If they transfer the connection costs to the smaller utilities customers, it becomes cost prohibitive for them. Therefore, the cost of technology and in some cases the regulation that is associated with it has to be considered if we are going to maintain reasonable rates for consumers.
3	In reviewing the answers from question number 1: all good points, but the notion of resilience is as resilience does make some sense. The main issue is that utilities have to have the legal ability to operate in a flexible manner. In many cases, it is a governance issue where people in power are only focused on the here and now and do not look past the next election cycle for utilities managing in an ever-changing environment. This lack of forward looking and acting can be deadly.

Respondent #	Question # 1-As you look at the criteria for resilient infrastructure organizations that the group put together what are your initial reactions? Does the list spark any additional thoughts?
	Along with having the right governance, it is just as important to have the right people in place to adapt to the environment. They will provide the foundation of the organization and management needs to supply the will and vision to guide them. In many cases depending on the situation smaller organizations have an advantage in that they can react more quickly as they have few people involved in the decision making process. Until an organization experiences a situation where there is a need for an adaptive resilient organization, they may appreciate (understand it intellectually) the need for that type behavior, but their ability to implement it is limited until they are put in a similar situation. (Learning organization?) Example : current economic downturn where many organizations who have high capacity have seen demand dry up or major water user leave or close their facilities and the corresponding dramatic fall in revenue creates a situation where they are forced to rethink their environment and make changes, some better than others. Many of the utilities in the west where water capacity varies sometimes dramatically year to year have developed means to address these issues because failure to do so would result in catastrophic failure. If you want to develop a resilient organization you have to reward behavior that gets you to that point; many of the utilities living under the year to year changes in capacity have developed those processes (or adapted to the environment). Resiliency issues can be driven by events (loss of major customers, weather etc...) or they can occur incrementally over time (aging infrastructure, loss of institutional knowledge etc...) a utility's ability to sense these issues and define solutions in advance of the problem is a measure of resilience. (pro-active)
4	Reviewed the list had nothing to add felt it was an all-encompassing list. Also stated after reviewing the list he was not as confident in his utility's level of resilience. Asked how so, he did not have a good answer just felt like there might be items that they have not looked at close enough.
5	Finds the list complete; has no addition, but feels some of the statements may not be real world practical. For their utility, resiliency is driven off the assets management plans and he believes that this is an excellent tool that any utility can implement to begin the organizational planning process. They are highly regulated and governed by a six member boards appointed by executive leadership at the county level. They are also regulated by the PSC and because of these obstacles; many of the criteria mentioned may not be realistic for them. They place great emphasis on their asset management plan that acts as a lynchpin for all of their planning regarding resiliency as they use it to seek improvement in both creating redundant infrastructure and security. He does not see a better or correct means of governance and/or regulation; there is always the tension between providing an appropriate revenue stream to the utility and the cost to the consumer. The PSC allows them to apply for annual rate increases to cover the ever-expanding cost of producing water, but not necessarily to provide additional resources to grow or better protect the utility. You have to work within the boundaries that each utility lives in; it is not so much a matter of what kind of governance as much as how you deal with it.

Respondent #	Question # 1-As you look at the criteria for resilient infrastructure organizations that the group put together what are your initial reactions? Does the list spark any additional thoughts?
6	Some characteristics or elements are simply not politically palatable. There is a lack of balance to reality examples: • Redundancy makes sense, but has a high cost and long investment payback making it difficult to justify. • Succession planning also makes sense, but how do you balance that with civil service requirements and long term planning. • A robust asset management plan is only as good as your ability to secure funding to implement it. • Realistic rate development structure is needed, but in the current political climate it simply is unlikely to occur. • Governance and politics drive the bus; you only have the ability to change what is in your immediate control. • Limiting regulation would be great, but not likely until you change the model. • In that unions dominate if you want staff to be part of the learning environment that's going to increase cost to make it happen. Water/electric utilities exist in a more volatile environment than at any time before in history. This requires a different way of thinking and understanding resiliency; to be truly resilient, utility leaders have to be squeezed outside their comfort zone to action. If you're current environment is such that this isn't the norm, than your ability to rapidly adapt to a changing environment will be limited. • Embracing technology is good, but being on the bleeding edge is a recipe for disaster in a cost conscious environment. • Strategic plans can provide guidelines and are, to some degree, inflexible, but in environments with constant flux and transition the probability that the plan will fail at some level is relatively high. How do you cover the situation when it is not part of the plan or was based on assumptions that were incorrect? • There is a need to hire people that are three levels above the "Peter Principle" (in a hierarchy eventually, members are promoted to a position at which they are no longer competent. Peter's Corollary states, "in time, every post tends to be occupied by an employee who is incompetent to carry out their duties" and adds that "work is accomplished by those employees who have not yet reached their level of incompetence) so as to be able to move the organization forward. • People behave in their own self-interest; we need better rewards for excellence and disincentives for mediocrity within organizations.

Table 14. Response to Interview Question #2

Respondent #	Question # 2- When you think about your organization how important is reaching some level of resiliency? What would need to change to adjust that viewpoint?
1	The utility talks about resiliency all the time and designs systems and infrastructure to be redundant (back-up the back-ups) They have three sets of aqueduct tunnels along with several above ground water sheds to store water that run along a seventy mile route west from Boston. They have continued to maintain and provide preventive maintenance to this infrastructure even though it hasn't been used for decades. In one case in the recent past they needed to activate that infrastructure because of issues elsewhere in the system, because they had planned for this event and maintained the infrastructure they were able to continue operation. The caveat to this advanced redundancy is that it is very expensive and many utilities simply do not have the resources to implement such a system.
2	A resilient, robust operation is one that has managed risks and developed mitigation strategies to address those risks such as back up power, emergency and contingency policies, procedures cross training of staff, and IT plans to insure the continual ability to provide payment processing and recovery operations in a reasonable amount of time. (Resiliency tied to continuity of operations) Asked about issues such as aging infrastructure or replacing an aging workforce as resiliency issues? Not currently considered as part of this process but an issue, they have had multiple retirements that have created a loss of institutional knowledge. Their current solution is hiring these people back as consultants and although this has addressed the situation in the short run, they have not, to date, determined how best to address the root cause of the issue. The HR department is working on some methodology to try and capture this institutional knowledge to limit these issues in the future.
3	In his utility resilience is not discussed as a separate topic but rather is foundational to the organization. There is a focus on being a learning organization that consistently seeks to reevaluate its current environment in order to adapt as needed. When situation occur there is an event review to determine root causes and seek solutions that can be implemented to insure the issue does not reoccur. There is a focus on planning at all levels and that requires open honest communication among and from the management team that seems to work well for this group. Example: For many years, the utility experienced a growth rate near 15%; as the current economic conditions moved that growth to almost 0%, the organization shifted gears to control costs while holding water rates steady. As conditions have recently improved slightly, they have been able to adjust their operating environment too accordingly. Many of the utilities in the region have come under intense pressure and have not been nearly as successful at succeeding during the downturn.
4	Resilience does not come up as a separate line item in meetings or conversations. He defines resiliency as having the flexibility to react to situations in a timely manner and felt that the organizational tie to city government assisted in that endeavor and felt many private organizations without those ties would be less resilient. Asked him to expound on that, He felt that the relationship existed within city government due to working together (road projects etc...) on coordinated projects. In the case of emergency services, you at least have some familiarity that private industry may not get because of the relationship.

Respondent #	Question # 2- When you think about your organization how important is reaching some level of resiliency? What would need to change to adjust that viewpoint?
5	This is the first time he has used the term resiliency to address these issues. Recent events like, the electrical black out on the east coast, 9/11 etc... have raised the bar of expectations around utility performance. This has directed the utility to conduct vulnerability assessments and to change its asset management planning focus to provide more resources to address security, redundancy and resiliency issues. The asset management plan (AMP) is a twenty year document that they continue to expand to include other components of their infrastructure (above ground first now moving to below ground) as a result of changing expectations. For example, this has lead to additional emergency generation capability to their key pumping sites in an effort to provide service in the event of electric loss. There is also a regulatory and IT component of this planning that seeks to look into the future in an attempt to determine how technology or new regulation may affect the utility and to develop a mitigation strategy to address those issues on the horizon. In their current rate case they have to address the issue of the Tea Party constituency who not only want to keep rates low but also want the utility to take a much more aggressive stance on regulation that impacts the utility and community (less is better). Two years ago there was no one pushing back on too much regulation; the utility has to find a way to adapt to this new environmental condition.
6	They don't call it resiliency rather they call it agility or the process of being identified as a risk in advance and putting in place mitigation strategies to address the risk. Resiliency for them is more to do with the process of recovery after an incident.

Respondent #	Question # 3-We can group the responses from the initial questionnaire into a couple of categories, operational issues, organizational structure and governance. Talk to me a little about each category in terms of which is critical and how they may be interrelated in some respects?
1	They have sought to develop plans for every contingency and when asked why they spend the time and money to develop those plans. The answer is simply the time to think about what you need to do to manage a particular situation is not during the event, but rather before the event when multiple contingencies can be considered to provide a better solution to problems. In the example above they had a plan in place that dealt with just the issue they were experiencing, because they had considered the issue and planned for it they were able to not only activate the dormant infrastructure, but also to provide a solution to the primary issue that was resolved within twelve hours. The key to planning is to get everyone involved in the process collaborating to develop a finished product that will not only work, but also provide the buy in for action from the different departments should an event occur. The internal culture of the organization has a huge impact on the effectiveness of planning. People tend to build communities of interest or factions within the organization that can provide roadblocks to success through either damaging action or inaction. In his opinion the older an organization is, the more likely that there will be factions and that they will work to achieve their only agenda at the expense of the whole. This really becomes a leadership issue getting the differing fraction to work toward a common goal: he tells the story of George Patton asking his commanders to push spaghetti across the table; it can't be done rather you need to pull the spaghetti or lead it to achieve success.

Respondent #	Question # 3-We can group the responses from the initial questionnaire into a couple of categories, operational issues, organizational structure and governance. Talk to me a little about each category in terms of which is critical and how they may be interrelated in some respects?
2	As we talked about the categories of governance, operation and organizational issues from question #1 he felt that their organization was fairly self-sufficient and that governance issues were not a major concern. That said, he still finds there are times when he can't explain why the utility might make a particular decision when the only answer seems to be making the powers that be in the political arena happy.
3	The notion of three categories of issues (governance, organizational structure and operational) seemed made sense to him. Governance is the foundational structure of the organization, in most cases it has been legally defined and therefore too rigid to change unless there is a pressing need from the political side to spin off the organization and run it more as a business. Allowing decisions to be made outside the political process to increase speed and focus on the business eliminating the restraints that come with belonging to a government entity. Organizational structure is the next element where he felt that leadership could compensate for sub optimal governance by adjusting the structure of the organization and the operation element that follows from that change. In other words, leadership can define the vision, supply the resources and guide the process to change in an effort to make up for any deficiencies that occur due to restrictive governance
4	Operational plans were the key element of the three to assuring continuous operation as they provide information on what and how we are to complete our work. Organizational structure and governance are tied together with operational procedures, as you need all elements to run a successful organization. Plans have key role because, in many cases, those documents must be supplied to regulators.
5	The utility needs to focus on those issues they can control (operational and to some degree organizational) and leave the governance and legal changes alone. It is critical to success and where you don't have the skill set in-house, use those organizations (emergency services) with those skills to assist you in development and implementation of plans. They work collaboratively with these groups through their safety and security director who sets up training and develops testing mechanisms to ensure plan success. They use the engineering department to develop the cost for the elements in the asset management plan, with the financial group determining budget numbers to place behind the various projects. They have also spent significant resources on developing specific policies and procedures for the various groups to address most issues they face. If you can get the authorities behind the AMP, you have the ability to suffer those hic-ups in the revenue stream by prioritizing what you can get done in a particular year with the funding available. The plan is also beneficial in that it provides you the necessary justification for projects and should additional revenue be required, it can be explained to the board in terms of completing an investment through the plan.

Respondent #	Question # 3-We can group the responses from the initial questionnaire into a couple of categories, operational issues, organizational structure and governance. Talk to me a little about each category in terms of which is critical and how they may be interrelated in some respects?
6	From an organizational perspective, numerous state and federal agencies kick in during a crisis where other groups (first responders) take charge of a situation and the organization's focus is toward recovery and supporting the community. Operationally they push decision making to the lowest level possible within prescribed guidelines so employees can act in a manner congruent with the utility. If you were at Katrina, the initial response went very well; once the rule making authorities took control and the rules became critical, the process broke down. Example: During the earthquake in the late 80's, the control center for the utility was cut off from senior management within three days 95% of the customers had been restored, once senior management could again direct operations a different set of goals was articulated and the last 5% of customers took over three weeks to be restored. Governance is no more than the process of determining who is in charge. Politics has extended itself so deep into utility organizations that in many cases they have become disabled. No structure change can what people continue to determine is the course for their government (elections have consequences).

Table 16. Response to Interview Question #4

Respondent #	Question # 4-In many ways we are currently structured for the 19 th century's industrial revolution; with items like division of labor, interchangeable parts and management by direction can our current organizational structures support a 21 st century world? And if so what has to change if they are going to be successful? Or do we need a different model?
1	In discussing the use of 19th century models for organization, his initial point was that early in the century labor was cheap, you could have a large staff to do a variety of tasks that today are no longer completed or preventive maintenance has been pushed to longer periods between the maintenance because of the increased cost of labor. The result has been that infrastructure has not been maintained as well as it should have been. In many cases utilities have been forced to either scale back maintenance or outsource portions of the work, this makes sense if it is completed at a lower cost than could have been done by in-house staff, but that is not always the case. You also lose skilled positions over time that you have no choice but to contract out for those services. When asked about the rigidity of bureaucratic organizations, he told the story of WWI European generals from France, UK and Italy who used a very top down bureaucratic model where all decisions had to be approved; this led to mass casualties and by 1917 mutinies in many units. The Germans by contrast used a distributed system of decision making, pushing down to the lowest levels possible which allowed them to react much more successfully than the allies. The point being that a rigid top down structure where placeholders exist to move paper or make decisions is doomed in an ever-changing environment. That said, bureaucracy may be required to meet the legal requirements for the utility, but organizational structure can be designed to be flat and flexible.
2	He felt that bureaucracies can work, but it depends on leadership and the willingness and/or ability to accept new ideas or ways to accomplish things. If top management takes my way or the highway attitude it doesn't really matter what the organizational structure is, its unlikely innovation will flourish in that environment. When employees make

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	suggestions that are not implemented, they need to be told why it didn't occur and thanked for their input (this creates transparency and the environment where people will provide ideas) When asked how organizational structure may limit personal and organization development, he felt that it was more of a time constraint issue rather than one of organizational structure. At this point, the focus is on directing the workforce to complete what needs to be accomplished and there is not much time for anything else. They get those training issues required by regulation completed and that is about it. Was it a staffing issue or a refocusing of resources issue? In his opinion, it was not an issue of more people, but more likely a refocusing of resources and potentially a lack of expertise. Refocusing of resources requires leadership make a decision that those issues take priority over some of the day to day activities now being completed. Expertise refers to the issue that the utility may not have the internal staff expertise to develop or execute a program that includes both personal and organizational development. Again, this becomes a leadership issue in that they set the direction and control the resources necessary to make these types of changes. He also felt it important to look for people in the hiring process that are independent thinkers and with the expected turnover of staff during the next several years due to an aging workforce it would be a good time to manage this type of change with new people.
3	The utility business by definition is a result-oriented process that leaves no room for error and must be stable to provide service 24/7 meeting the regulated standards for performance with little flexibility. Someone must be ultimately responsible and that person directs or delegates that responsibility to others to insure performance is achieved. The objectives need to be met whether that is a very flat organizational structure or one more hierarchal. The key rather is to push decision making down to the lowest level possible, provide an environment where people are not afraid to make decisions (emotional safety) and provide them a vision about where the organization is going and how we plan to get there. The model of a bureaucracy may be required in order to meet the requirements of the regulated performance standards, but that organization can also be (Decentralized) in its internal culture and way it manages change. You have to have people that are flexible (team players) regardless of the model if you are to be successful in managing changes in a changing environment. • Trust your people • Reward them when they are correct • Back them when they are wrong
4	The current bureaucratic structure meets the needs of the organization and community and may be required due to the nature of the function, but there is room for improvement. That improvement can be directed through change at the organizational level to achieve a more flat organization.
5	He would suggest that the high level of bureaucracy would have to change at some point because it appears to be unsustainable at this point. In this organization, the issue is not internal but rather with the regulatory agencies that they work with who have very specific rules that are drawn from legislation and have very little flexibility. As an

Respondent #	Question # 4-In many ways we are currently structured for the 19 th century's industrial revolution; with items like division of labor, interchangeable parts and management by direction can our current organizational structures support a 21 st century world? And if so what has to change if they are going to be successful? Or do we need a different model?
	example for rate increases, the PSC likes to do a test case where they use a year to determine if the increase is justifiable by looking backward and this puts the utility a year behind in revenue. He also believes that this situation will not change anytime soon He does not see this as an internally issue as management as they have some control of the operational system in place. The bureaucracy still exists but they set the policy and procedures and have the authority to act which they have delegated to lower levels to get the work done as efficiently as possible. As a result the operation of the utility is less top down or bureaucratic as top level managers seldom get involved in the day to day activities of staff other than ensuring appropriate resources are in place. He feels they have a fairly progressive utility as it relates to employees' empowerment and satisfaction.
6	Our current structures do not allow us to operate effectively in a 21st century world of global interdependence where economic changes around the world can influence an organization's ability to succeed at their core mission. The best you can hope for is to partially influence the environment, not manage or controls it. People continue to see issues through a very narrow lens as interest groups and others create a zero sum game where utilities have little influence on policy makers and therefore are unable to negotiate the environment. It means that the decisions utility leaders can influence continue to shrink so that long-term investments and programs are avoided or pushed down the road. In other words, utility managers live in a world where their ability to influence the environment is limited with structures that are not likely to change until there is a crisis that requires change for the community to survive. Change is inevitable and it will occur on its own timeline; a structure that allows organizations to remain flexible while maintaining political credibility is important. We need to achieve a balance between providing a service at a reasonable cost and promoting a wide variety of agendas that have little to do with providing that service. Water in California is very political, in Southern CA, 20 million people have to import all their water from other sources. So there is a tension between geographic areas, different interest groups (development, environmentalist etc...) where 17 federal, 20 state and over 40 other interest group all have a different vision for the water shed and few are willing to make concessions based on their ideology. Change will occur when the system is in crisis.

Table 17. Response to Interview Question #5

Respondent #	Question # 5-If we need a different model what would be the best method to insure we achieve success as defined by greater resiliency?
1	N/A
2	N/A
3	N/A
4	N/A
5	N/A
6	N/A

Table 18. Response to Interview Question #6

Respondent #	Question # 6-In your opinion what is the best method (regulation, self driven etc...) to drive resiliency throughout the industry? Who should lead this effort?
1	There is a general need to maintain regulation for the sake of public health issues but the problem with regulations is that they are generally a cookie cutter one-size fits all approach. That simply does not take into account the differences in systems, communities and local environmental conditions that exist. This limits the flexibility that organizations have to determine how best to meet the needs of their communities which in the long term hurts resilience. Any program developed out of research would be better served coming from the industry's professional organizations so that utilities can modify them to meet their needs. There needs to be a political realization that other groups with varying agendas may attempt to hijack the resiliency issue and try to turn it to their own benefit. If a program comes from this, make it inclusive so as to limit regulators' work (play into their laziness) and they may accept it as is with little change
2	If we can develop a roadmap for greater resiliency, he felt that it should be presented and driven not by regulation, but rather through existing industry organizations. That way organizations can implement the program at their own pace and change the design to fit their particular needs while still improving the resiliency of the whole.
3	People in the water business are professional and do the job correctly without regard to the State. The regulations are in place to insure safe water to testable public health levels and insure the public safety. Most programs to improve the operation of utilities (climate change) have been driven through the industry's professional organizations. The difference obviously is that legislated regulation leaves no flexibility and everyone must do it to the same level. Programs pushed by professional organizations allow utilities to modify their behavior in increments as they have funding or time and supply the expertise needed by the utilities in these matters.
4	If this program is to be driven by anyone, the professional organizations are the best choice, as they will allow utilities to structure the program to their needs. No additional regulations!
5	There is a role for both the professional organizations and regulators. The program should be driven through the professional organizations where the difference between organizations can be built into the program. These organizations can also supply resources to those smaller utilities that may not have the expertise to manage some of these changes, but in those areas where an issue must be addressed, regulators may have a role in ensuring organizations do at least the minimum.
6	Do not really like either to manage the process. Regulation is wasteful, costly and inefficient; but the professional organizations, in an attempt to please all of their members, provided a watered down solution that does not really address or solve any issues. I think if it can come through communities so it can be developed for that area it will be most effective, not a one size fits all approach.

Table 19. Response to Interview Question #7

Respondent #	Question # 7-I think we can all agree that leadership within the organization is critical to this endeavor. In many cases, managers are not hired for their ability to lead change, but to maintain stability. How then can anyone expect managers to not only understand change is necessary, but to effectively lead that process? Do we need to change the paradigm for choosing leaders or possibly improve the training process?
1	In many cases you get the leader you get as a result of political appointment rather than specific qualifications. As a result, the big challenge is to modify the leadership through training and education. In a perfect world, if you can get major educational institutions (JFK school of public policy etc...) to take up the issue and provide the location and curriculum, it will be much easier to get senior leaders to attend.
2	It is critical for leadership to walk the talk. Stability is the goal, but if an organization remains static and fails to learn and grow, it will eventually lead to a change event. We need to understand that change needs to be incremental and the reason clearly defined to limit people's fear or anxiety regarding the change. We need to empower employees to make decisions at the lowest level possible and think about procedures as guidelines as we cannot write down ever-possible condition that may occur, people need to be able to think on their feet. There needs to be a free flow of information so people have the information necessary to make good decisions and we need to collect that institutional knowledge on paper so that it can be shared. In many cases information has been hoarded in the past as a means of establishing power and control; this needs to change.
3	Leadership in the industry has always been very conservative (it has been made up in large part by engineers) who want to use what they know works and therefore tend to look backwards to past to see what has worked before because it probably will work in the future. Interviewee was training as a business planner and has a focus more attuned to looking forward and innovating. Training may help get good leaders to set the example for the organization or to model the behavior that will be expected. The issue is that organizational culture will be a natural restrictor to change, so if you train some staff as change agents in the organization without top management support (resources etc...) it will be difficult for these folks to make change in that culture. If they are trained internally that will accentuate the problem as they will internalize the existing organizational culture. You can find some very adaptable organizations (5%) within AWWA lead by intelligent people who are in positions where resilience is a requirement for them to succeed. Its leadership's responsibility to work to create that internal environment where innovation and openness flourish within the governance structure that exists. There is a need to educate political leaders on the issues experienced by utilities with the goal of changing the focus to a long time continuum as opposed to an election cycle.
4	He does not believe we need a paradigm shift regarding who should be leaders, rather professional development of leaders, particularly in change management may be very useful for utilities. These programs are best driven by AWWA and other professional organization, but universities could build these skill sets in professional schools' curriculum. It should be noted that for most of the leadership positions a professional degree is required so it would make sense to have those skills included in the curriculum.

5	You need an identification process to choose leaders and also a set of policies to insure continuity . His experience with management development programs is that they tend to be too theoretical and don't provide the practical steps to accomplish the task desired. He strongly believes that developing an asset management plan and then using that through the planning process is the key to developing resiliency . Leadership needs to develop and articulate a vision for the organization and then take incremental steps to move that organization in the desired direction . The skill list noted previous provide a solid base for any leader to accomplish this goal.
6	Leaders rise up under great chaos : currently we are like a frog in the kettle on the stove with the water temperature slowly rising. I think there needs to be a significant crisis (frog dies) before any major change due to the complete fractionalization that has occurred within communities. The inability to come together as a group and compromise when needed has taken us down a path where there is not enough motion to take us down any one path so we stand still and hope for change or direction. Combine this with the restrictive regulatory and political climate and you have inaction .

Table 20. Response to Interview Question #8

Respondent #	Question # 8-Governance and regulation appears multiple times and fashions as an obstacle for success. Is it possible by putting the entire stakeholder group in a room (mega community) with the goal of creating an environment where critical infrastructure organizations can both become resilient and flourish economically? Will it happen?
1	He is cynical about the concept of the mega community in a sense because you give a great number of people or group veto power or at least the power to slow the decision making process . While he agrees that getting a small number of key people in the same room, working on limited issues can be very successful. With a larger group the number of agendas increase along with expectations that, if are not met, can create long-term resistance long into the future.
2	The notion of using a mega community to discuss critical issues that affect the utility such as rate schedules has been used by the utility when talking about protecting the watershed . All key stakeholders were engaged in this process to develop plans to address the utility's goal for development in and around the watershed. This model may be effective to address the issues of resiliency that influence the entire community .
3	This organization has focused on regional items particularly watershed issues concerning sewage dumping levels of treated water and saltwater intrusion into existing wells. As a utility, the key to success in this process is developing your needs or requirements and being able to articulate those needs to the group, while at the same time remaining open to a wide range of solutions . You need to be patient, deliberate and seek to collaborate where possible. This will be a long and sometime difficult process, but can achieve great results over time . In many cases it is also helpful to move the process along if you have a third party regulator or others who are requiring a change that forces the group to come to a consensus.
4	His organization uses the mega community ideas significantly particularly around environmental issues that affect the region . They have never tried it with something like resiliency issues, but he felt that maybe a way to smooth the road with stakeholders as they get a better understanding of the issues facing utilities .
5	They have not used the mega-community format in dealing with the various stakeholders on any issues. They have been involved in collaborative efforts on rate cases: "informal conference" that brings together utility leadership, regulators, the AG office etc... To offer suggestions on how to address issues and set the ground rules for system operations.

Respondent #	Question # 8-Governance and regulation appears multiple times and fashions as an obstacle for success. Is it possible by putting the entire stakeholder group in a room (mega community) with the goal of creating an environment where critical infrastructure organizations can both become resilient and flourish economically? Will it happen?
	These collaborative efforts are always the most effective means of addressing issues and eliminating the confusion or misunderstanding that happens when you have a written question based process.
6	In California, we have mega communities everywhere and for everything; the problem is they are blurred in the hum of complexity and everybody thinks they are in charge and when everyone is in charge, no one is in charge. They make individuals and groups feel good about what they are involved in, but they tend not to accomplish much.

Table 21. Response to Interview Question #9

Respondent #	Question # 9-Regulation by its nature creates inflexibility which drive up costs and reduces resiliency; is there a better way to achieve the goals of regulators without creating a controlled environment where utilities are boxed in their decision making options? What would that look like?
1	To some degree, this is the nature of the beast, but it can be managed by talking to all key stakeholders and coming to a common understanding of the situation. You want to develop buy in from those in the emergency service community well before you have a crisis so that you can say to this group that in the event of A we will be doing B, C and D and request their reaction to make sure everyone is on the same page. It is about developing and maintaining relationships with those key stakeholders and insuring that an active line of communication is open
2	Regulators need to garner the input for utilities prior to writing rules. Just because we now have a device that can measure to a specific level does not mean we need to lower the level if it's not a public health or safety issue. By forcing utilities to spend money testing systems that don't markedly improve public health, we waste resources that could be better spent in other areas of utility management.
3	N/A
4	Does not believe we can make significant changes in how we are regulated, the rules are the rules and does not see any reason why the regulatory community would want to give up their existing power and control.
5	The organization has begun using a similar process to one described above where they gather stakeholders together before rules are written to get industry's concerns addressed prior to final rules being issued. This collaborative process between the agency, utilities, professional organizations and other stakeholders where individuals have an opportunity to assist in the rule making process has improved compliance and managed costs for the utility's so it's a win-win-win for everyone. Insure that we are using sound science and try to keep the politics out of the process
6	Absolutely, regulators can set the goals but leave the methodology to the utilities so that they can implement incremental change over time to address the issues. This will continue to be an issue as term limits have now been passed in CA and the timeline for elected officials to solve issues has become fixed. That being the case, it is likely that they will not only force hard timelines, but set more specific methodologies to point to success.

Respondent #	Additional Comments
1	The most important issue as it relates to resiliency is we need to inform and educate the public on the importance of resiliency, what a resilient organization looks like and why it is in their interest to ensure their local utility is resilient. In doing so we have at least the opportunity to make our case for rate increases as necessary to upgrade or enhance infrastructure to better serve the community. Without that component of public awareness, it will be very difficult for utilities to find the funding required completing many of the back-up or redundancy projects.
2	Leadership drives resiliency and this creates a conundrum for utilities that need to have people in leadership positions that understand the technical nature of the function, but in doing so you place people who may not have the managerial skills necessary to create the conditions for resiliency to flourish. If you can create a management, team that can work together and has the required skills and vision then organizational change can occur and focus can shift. Even hiring people from the outside may not be the answer if they come with the same set of values from their discipline and are unwilling or unable to work in a team.
3	N/A
4	- No additional comments- covered the significant issues around this issue - Key for him the development of a professional development curriculum for utility leaders
5	Asking the right questions no further responses
6	None

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