

## **The electric distribution utility business is a Complex Adaptive System**

The concept of a Complex Adaptive System (CAS) arose in the mid-1980s. Acknowledgement that an electric utility is a CAS happened many years ago. No big deal. What is a big deal is that utility people continue to work in a linear thinking mode based on "the whole is equal to the sum of its parts" reductionist thinking. As an example, the "voice of the customer" is treated as an independent part rather than an agent of a CAS willing and able to disrupt other agents. So what used to be a simple process to upgrade meters can now create a customer revolt and force some utilities to reluctantly offer an opt-out program to retain old analog meters. As novel agents like DG, DER, EV, Solar, Smart Homes are added to the CAS, the number of new risk relationships will rise astronomically. The cumulative impacts are huge including questioning whether electric utilities should maintain the traditional cost recovery business model.

The 20th century solution was to increase control, add more rules, and "try harder". Not wise in today's turbulent times full of uncertainty and ambiguity. Instead we must go beyond Reductionism and introduce another paradigm based on Complexity & Chaos science. A sense-making model that helps us to understand a CAS is the Cynefin Framework. This model combines the "ordered side" of Reductionism with the "unordered side" of Complexity and Chaos. It encompasses cause & effect relationships that can vary from obvious to no way to determine.

In a complex adaptive system, unexpected events can mysteriously occur. Surprises that hit the system with a major negative impact are coined "Black Swans." From a knowledge management perspective, we as linear thinkers dealt with "known knowns" and "knowable unknowns". In a CAS we expand the KM universe and include unknowables and unimaginables such as Black Swans. We don't know what they are, how big, by when, but we somehow must be prepared for their arrival. Another aspect is the "Butterfly effect" where small changes can lead to huge outcomes. As we learned, one customer complaint can lead to a class revolt.

In a CAS, the language shifts from business transformation to business evolution. A transformation has defined end goals, typically forecasts based on known trends. However, unless one has control or overwhelming influence on agent behaviour in the CAS, making long-term predictions is a fool's game. In addition, the practice of extrapolating trends to produce future scenarios for strategy purposes excludes unknowables and unimaginables by definition.

Taking a non-linear view also means looking at risk differently. Linear thinkers are familiar with the Gaussian bell curve or normal distribution. But most relationships in the real world follow the Pareto 80/20 principle (power law distribution). Bottom line: Black Swans will occur more frequently.

### **Implications for the electric utility**

At the strategic planning level, place less emphasis on creating and defining an ideal future end state that must be achieved. Apply a naturalistic approach by grounding oneself in the Now and conducting safe-to-fail experiments with a project management discipline. Base your next strategic move on how the immediate future emerges. Carefully watch small differences since they can lead to huge impacts (Butterfly effect). On the positive side, a serendipitous opportunity may come out of no where. It could be a picture of a future that is better, brighter, and more sustainable than the artificial future end state we dreamed up as idealistic linear thinkers.

Efforts to harden grid assets and perform regular maintenance (e.g., vegetation management) should carry on to build Robustness. But that's not enough. A key CAS strategy is to add resilience. By Resilience, we mean building the capability for the early detection of Black Swans and executing fast recovery when a disaster does occur. A third capability is early exploitation. Resilience is often associated with the ability to bounce back. Early exploitation is the creative capability to bounce to a better state rather than back to the original position. Plus leverage any serendipity that emerges.

At the operational level, the workforce needs to be prepared to handle unknowables and unimaginables. For engineers, the concept of emergent design makes more sense. In contrast to lean efficiency efforts, system and crew slack is necessary for fast recovery. Sharing risk with CAS manufacturers and vendors to develop prototypes and run safe-to-fail experiments is a plausible form of collaboration. "Tried and proven" is augmented by "constant beta mode". In a CAS, no one does it alone.

The world has changed. Executives, managers, and engineers who learn how to absorb complexity and work in a CAS are better equipped to pioneer their electric utilities towards an uncertain yet exciting future.

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