

## Adoption of Smart Grid Technologies by Electrical Utilities: Factors Influencing Organizational Innovation in a Regulated Environment

Funded by:

NSF Grant: SES-1231192

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### Overview

Electrical utilities in the U.S. face a challenging future, marked by the need to modernize an inefficient, deteriorating infrastructure based on obsolete technology, and public resistance to location of new generation and transmission facilities. There is a great deal of interest in adopting smart grid technologies to improve the quality, reliability and efficiency of electricity supply, enable greater use of distributed alternative energy sources and reduce the need for new transmission lines. The smart grid allows utilities to better manage supply and demand, while giving customers real-time usage information and the ability to adjust consumption in response to pricing. The smart grid is touted as a key strategy for reducing the environmental impacts of electricity production and use, and several states have mandated smart grid development. Yet this innovation presents major organizational and technical challenges to utilities, which operate in a highly-regulated environment and are subject to pressure from a number of interest groups. The lack of consensus on infrastructure configurations, communications and control protocols and standards create risk and uncertainty. Future costs and benefits are difficult to predict, and some early trials have engendered strong public opposition. As a result, utilities have been slow to commit to widespread adoption.

## Objectives

The objectives of the research are to advance knowledge and provide insights to business and government decision makers by answering following questions: (1) What internal and external factors determine the motivation and willingness of utility companies to develop and deploy smart grid innovations? (2) How do organizations in a regulated environment respond to innovation opportunities and challenges? (3) What policy changes would be required to overcome obstacles to the adoption of socially desirable innovations?

## Methods

The research involves qualitative case study and quantitative survey work. Comparative case studies were carried out on utilities that differ in terms of important organizational characteristics and operate in different state regulatory regimes in order to study the impacts of organizational and environmental factors on smart grid adoption. Based on findings from the case studies, and on a set of individual interviews paired with web surveys, a large survey of U.S. utility companies was developed to test hypotheses about the factors influencing smart grid adoption and implementation.

## Intellectual merits

The research advances knowledge of organizational innovation in response to promising but potentially disruptive technologies in an important organizational context: the regulated monopoly. Smart grid innovation includes a complex set of technologies, whose adoption and integration involves a diverse and interrelated mix of technical, organizational and policy issues. The research develops and tests a model to predict smart grid adoption, and also provides a baseline data set that can be used in future research. The results will contribute to the fields of organizational science, innovation studies, information systems, public policy, economics, and management.

## Broader impacts

The creation of a smart electricity grid has the potential to dramatically reduce the environmental impacts of electricity production and use, improve the reliability and security of the U.S. electricity supply, and create a platform for new business and technology development. The study provides insights into the changes that need to occur before a cleaner, more reliable and intelligent electrical infrastructure can be put in place. These insights provide guidance for utility companies, their suppliers and customers, and for policy makers and regulators.