Research paper

How many admirals does it take to change a light bulb? Organizational innovation, energy efficiency, and the United States Navy's battle over LED lighting

Nicholas Dew*, Kathryn Aten, Geraldo Ferrer

Graduate School of Business & Public Policy, Naval Postgraduate School, 1 University Circle, Monterey, CA 93943, United States

ABSTRACT

Energy policy research has highlighted systematic shortfalls in the adoption of new energy technologies owing to market failures and behavioral factors. However, less research has examined how organizational processes may block energy innovations. In this paper, we propose that a key organizational obstacle in the adoption of innovations may be the lack of a good justification for implementing a technology. In situations where there is no obviously correct answer regarding the adoption of an innovation, organizations put a premium on developing a justification that may be favorably received in the context of an organization's energy culture. Absent a favorable justification an organization may abandon a new technology, or delay implementing it until a suitable justification becomes available. We draw our insights about the role of justifications in organizations from a study of the U.S. Navy's decade-long attempt to justify LED lighting on its ships. LED lighting proponents in the Navy cycled through several justifications for the technology with little success. We conclude that a better appreciation of the organizational processes involved in justifying new energy investments is essential for the development of more effective energy policy.

Published by Elsevier Ltd.

1. Introduction

Many energy efficiency initiatives involve the adoption of something new, whether they are new behaviors and practices or new technologies and infrastructures. Much policy research has focused on the upstream development of new technologies perhaps implicitly assuming that free market processes and self-interest would drive subsequent adoption processes. However, adoption rates for new energy technologies have persistently lagged behind the predictions that cost-benefit analyses would suggest [1]. This has led researchers to focus on behavioral failures as one source of the shortfalls in investments in energy innovations [2–5]. While there has been important progress in understanding behavioral factors, significant gaps remain in our knowledge of barriers to the adoption of new energy technologies. One important gap is the organizational decision processes involved in the adoption of energy innovations, a topic on which scholars have recently called for more research [6].

The purpose of this paper is to take up the question, 'How do complex organizations make decisions about adopting energy innovations?' Influential parts of the literature still treat household and organizational decision-making about energy technologies as profit-maximizing cost-benefit calculi that, in principle, are highly prescriptive. However, for decades scholars have criticized the tendency to black-box organizational decision-making as an optimizing activity, indicating that this is descriptively inaccurate and may mislead policy making by creating flawed expectations regarding organizations' reaction to policy interventions [7]. Instead, scholars stress that, because of the inherent uncertainties involved in adopting innovations, organizational decisions about innovations are not at all straightforward [8]. Thus, in a comprehensive review of energy scholarship, Sovacool [9] calls for research that transcend "conventional techno-economic thinking" [10] to reinstate human decision making in its full social setting into studies of energy use. Specifically, Sovacool appeals for research that addresses the role of communication and culture in decisions about energy use, noting both the need to investigate what types of information influence energy users and how a group's cultural views and values influence its decisions about energy use.

To shed light on these questions, we analyze a particularly illuminating case: the U.S. Navy's attempts at adopting LED lamps on

* Corresponding author.
  E-mail addresses: ndew@NPS.edu (N. Dew), kjaten@nps.edu (K. Aten),
gferrer@nps.edu (G. Ferrer).

its ships [11]. The Navy started researching LED lamps in 2002. Yet, despite continuous effort by elements of the Navy that supported the adoption of this technology, as of 2015 approximately 90% of the total fleet lighting needs were still met by less-efficient incandescent and fluorescent lighting systems [12]. Given some inherent technical, safety and efficiency advantages of LED lighting, one might have reasonably expected it to be used more extensively than it is. Instead, the LED lighting case illustrates the obstacle course organizations may have to conquer in order to adopt a new technology.

Our study makes two contributions. First, our case research on the U.S. Navy provides an example of the justification phenomenon in organizations. Yin [13] argues that the identification of hitherto overlooked phenomena is one of the chief roles and strengths of case study research. We speculate that the phenomenon of justifications may have been ignored because it stands outside the boundaries of the techno-economic paradigm that dominates energy studies. The case of the U.S. Navy clarifies this concept. Second, we expect that the concept of justifications may be generally applicable across the organizational landscape because the social psychological theories upon which justification is based generalize to a wide range of organizations. These theories suggest that social accountability plays an important role in organizational decision making. Suitable justifications for choices therefore matter even more in organizations than they do for private choices [14,15]. Thus, we speculate that our analysis of justifications in the U.S. Navy may be relevant across a wide variety of organizational types, nationalities and situations.

We proceed as follows. In Section 2 we provide a condensed review of some previous literature that forms essential background for our study. Section 3 describes our research methods and provides background on technology adoption in the U.S. Navy. Section 4 narrates the four separate ways the Navy attempted to justify LED lighting adoption. In Section 5 we discuss our analysis and present results. In this section we also explain why previous literature does not adequately account for our findings (Section 5.3). Section 6 concludes by considering the implications of this study for policy debates.

2. Literature review

We take recent literature on energy cultures as the backdrop for our study [6]. This literature highlights the large number of factors that researchers have identified as affecting energy behaviors, such as microeconomic theory and behavioral economics. The energy cultures framework is particularly suited to our study because it was developed out of a desire to identify levers of change in energy systems [18]. Picking up a significant recent theme in the energy literature, it emphasizes that no single analytical approach tends to explain more than a small portion of energy behaviors or holds a monopoly on reliable policy interventions [19,9]. Instead, the framework suggests that it is important to consider the overall system in which difficult decisions about energy are embedded and produced. It posits three major groups of elements in energy systems: norms, practices and material culture. The energy culture of a specific household, organization or nation is defined as emerging from the interactions between these three elements [6]. The framework proposes that the components of an organizational energy culture may lock-in to an equilibrium arrangement, thus creating systematic barriers to adopting different energy behaviors. Changing the system equilibrium may require an external shock [20] or the diffusion of niche-internal factors that change the equilibrium from within [21].

In this paper, we build on the energy cultures framework by proposing that organizations search for suitable justifications for changing their energy behaviors. A justification is a defense or explanation of a particular course of action. It provides a rationale that seeks to satisfy oneself and probing from others about "Why am I (or why are we) doing this?" A significant body of research in decision theory has studied ways that individuals and groups make choices by constructing reasons that justify decisions both to themselves and to others [22,14,72]. Typically, in making choices individuals attempt to find a dominant option by framing and reframing an issue until an ascendant option is revealed. If they cannot find a dominant option, then they grudgingly engage in the more cognitively taxing process of considering trade-offs between alternatives in order to find a way of justifying one choice over another.

Scholars have argued that these reason-based decision-making processes are important to individuals but may be intensified in organizational settings because in these settings individuals owe justification to one another [23,15]. In order to maintain their social standing and not appear foolish in front of their audience, actors become even more conscious of the need to give persuasive justifications for why they propose one choice over another. Thus, owing to social dynamics, actors pay heightened attention to justifying choices by grounding them firmly in a convincing logic. Where possible, actors favor justifications that are easy to make to others, simple to describe, and noncontroversial [15].

Prior research has identified justifications as a key element in innovation adoption in organizations [24]. Why is this? Though often overlooked in techno-economic thinking, new ideas typically need the support of multiple organizational constituents to be adopted. It is well established in the organizations literature that only with support are new ideas able to overcome lock-in to the prevailing culture of an organization [25–28]. Thus, while the literature recognizes that innovation ideation is typically promoted by personal and small group factors, innovation adoption in organizations is influenced largely by socio-political factors such as participation in decision-making and the backing of organizational constituents. Kanter summarizes that, "The features of successful ideas have more to do with the likelihood of gathering political support than with the likelihood of the idea to produce results."([29]; p.186; quoted in [26]; p.1105).

In this organizational context, the process of adopting innovations is open to socio-political maneuvers focused on mobilizing sponsorship. Advocates and champions of innovations work to establish a coalition of constituents that are willing to make the necessary investments of attention, enthusiasm and social and political capital that are needed in order to see an idea through to adoption. Before making these investments, constituents need to be convinced that undertaking such efforts is justified [24]. Therefore advocates of innovations attempt to provide satisfying justifications for constituents.

The literature also provides some specific pointers to the nature of these justifications. Decision-making processes based on justifications deviate significantly from normative choice models. Even more than individuals, groups exhibit strong preferences for escaping debates about trade-offs because conflicting reasons are hard to evaluate and reconcile (Irwin & Davis, 1995). In some instances, dominance derives from prominent features of a choice. For example, Barber et al. [14] found that stock-picking clubs more strongly favored firms on Fortune's 'most admired' list than individuals making the same choice. The researchers proposed that this phenomenon occurred because clubs were more likely to pick stocks that were easy to justify to members. Relevance is another way advocates attempt to justify a proposed choice. Studies of issue-selling in organizations have found that issue sellers work hard to establish relevance by making linkages between their focal issue and other issues that their organization cares about [30]. In the absence of a dominant justification, actors resort to tallying rea-