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Factors influencing fleet manager adoption of electric vehicles

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ABSTRACT

Research has identified several reasons why fleet managers are good candidates to be electric vehicle (EV) early adopters such as their intense usage and high automobile purchase rates. This expectation is supported by a recent study which found that to 2013, governments and private companies were responsible for a majority of global EV purchases. Using content analysis of fleet manager interviews and pilot project reports, this study investigated 14 US and Dutch organizations that adopted EVs from 2010 to 2013 to determine which factors influenced their purchase decisions. In addition, it also analyzed the reasons why these same firms did or did not expand their EV fleets. Fleet managers identified testing new technologies as being the overarching driver of their initial adoption of EVs. Organizations also noted several influential but secondary factors including lowering their environmental impact, government grants, and improving the organization's public image. For organizations that decided to expand their EV fleets, the primary motivating rationales were firm-specific, including pursuing first-mover advantage, specialized operational capabilities, or a compelling business model.

Introduction

The IPCC (2012) noted that to avoid potentially catastrophic environmental, social, and economic consequences from climate change, there needs to be substantial decreases in greenhouse gas emissions (GHG), specifically in the energy production and transportation sectors. Electric vehicles (EVs) have been identified as one of the most promising technologies in the transportation sector to reduce GHG emissions in the post 2020 timeframe (IEA, 2013). However, there is a whole series of barriers that limits their emergence and wide-spread adoption including the development of new technologies, replacing support infrastructure, and auto manufacturer investment (Tran et al., 2013).

In addition, because EVs entail fairly dramatic operational and performance differences relative to the dominant internal combustion engine vehicle (ICEV) design, wide-spread adoption would also require adjustments in consumer understanding, heuristics, and automobility expectations (IEA, 2011). EVs differ from ICEVs in that they have a lower driving radius, lack of motor noise, lower vehicle emissions[1] and different refueling/charging requirements. The requisite changes in consumer beliefs toward a radical innovation such as EVs helps to explain why establishing a customer base is one of the main obstacles hindering their early adoption (Christensen, 1997). Through several factors including decreased battery costs and the installation of charging infrastructure, a customer base for EVs has emerged with 2012 global sales reaching approximately 113,000

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[1] This depends on power grid mix, speed and load conditions, and total miles driven (Hawkins et al., 2012).

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units (IEA, 2013). A majority of these EVs were purchased by governments and firms (Kumar, 2013), identifying the importance of organizations during the innovation's early adoption phase. For example, FedEx purchased 200 EVs (Scientific American, 2013), and the French government has been coordinating a plan to procure 50,000 of the automobiles for public and private organizations (IEA, 2013; Green.autoblog.com, 2010).

Researchers have identified several reasons why organizations are good candidates to be early EV adopters[2] including their high vehicle purchase rates, intense usage, (frequently) centralized refueling stations, and limited number of decision makers (Nesbitt and Sperling, 1998; IEA, 2011; Bobit, 2012; Dijk et al., 2013). Fleet managers also have a better comprehension of lifetime vehicle costs than do private households (Lane and Potter, 2007; Sovacool and Hirsh, 2009). Consequently, organizations are more likely to adopt vehicles that have high purchase costs but offer the potential of lower total ownership costs through reduced operating expenses.

Although studies have acknowledged organizations to be major adopters during EV market introduction (Kumar, 2013), research identifying factors that influence fleet manager purchase decisions was either conducted before the recent broad commercialization (Nesbitt and Sperling, 1998; Nesbitt and Sperling, 2001) or was not based on empirical data (IEA, 2013; Dijk et al., 2013). As such, the theory regarding fleet manager EV adoption should be updated now that the automobiles are available for sale and revealed consumer behavior (empirical data) can be analyzed. In that regard, this article centers around the following research question, *what were the important factors that influenced fleet managers' initial EV adoption?* An additional and related area for analysis is why organizations did or did not expand their EV fleets. Thus, a second research question is, *which factors determined whether or not organizations increased their EV fleets?* The purpose of this study is to develop testable hypotheses regarding the driving forces behind fleet manager EV adoption. It will also provide policy recommendations for achieving higher EV diffusion through encouragement of adoption by organizations.

Literature review

Innovation literature identifies several important theoretical concepts that are particularly relevant and influential to the emergence of EVs. These include the difficulty in transitioning from a locked-in dominant design and fundamental dynamics resisting the emergence of a radical innovation[3] such as EVs. Measures such as subsidies and education programs have been influential in encouraging the initial adoption of other eco-innovations such as compact fluorescent lamps (CFLs) and PV, but high levels of consumer uncertainty call into question how effective those factors would be for EVs.

ICEV lock-in

Since the rise of ICEVs as the dominant automobile design almost 100 years ago, industrial dynamics have functioned to lock-in the technology as an integral part of society's fabric, consequently erecting barriers that limit the development and adoption of competing innovations. Positive feedback through mechanisms such as learning-by-doing, economies of scale, and network externalities can serve to focus technological development along a particular path or trajectory (Dosi, 1982). In the case of ICEVs, this has led to steady improvements in several areas including fuel efficiency, performance, safety, and comfort (Abernathy and Utterback, 1978). In addition to such incremental improvements, many dominant designs experience a buildup of supporting elements as other industries develop complementary products and services (Arthur, 1989). During the past 100 years, ICEVs have become entrenched in the fabric of everyday life through factors such as improvements in engines, expansion of fueling stations, the creation of automobile standards, and the rise of inter-industry network dependencies (Unruh, 2000). Consequently, a very strong system or what Geels (2002) refers to as a socio-technical regime has developed around the ICEV. When a technology such as the ICEV becomes dominant through technological and institutional positive feedback mechanisms, it is referred to as lock-in (Arthur, 1989). Unlocking such dominant technologies is a difficult and lengthy affair (Unruh, 2002), requiring an emerging innovation, larger macro-level changes e.g. the rise of environmentalism, and a destabilization of the existing socio-technical regime (Geels and Schot, 2007).

EVs – the emergence of a radical eco-innovation

Innovations vary in their relationship to the incumbent technology. There is a sharp distinction between those that are based on existing knowledge (incremental) and those that require a new source of expertise (radical) (Anderson and Tushman, 1990). In that regard, EVs represent a radical innovation because they use a high-energy battery and electric motor instead of an internal combustion engine. According to Tushman and Anderson (1986), "Major technical change opens new worlds for a product class but requires niche occupants to deal with a considerable amount of ambiguity and uncertainty as they struggle to comprehend and master both the new technology and the new competitive environment" (p. 460). This uncertainty emerges because the extent that an innovation differs from the dominant design has an increasingly negative effect on a broad array of industrial dynamics including consumer willingness to pay, future profitability of a technology,

[2] As opposed to Rogers' 'early adopters' which constitute a clearly defined group of consumers with specific characteristics, this study uses the term in a more general way to identify the initial consumers that have purchased an EV.

[3] Following Rennings (2000), this article uses a broad definition of eco-innovations as the new concepts, behavior, products, and processes, which assist in the reduction of environmental impacts or the attainment of specified ecological sustainability goals.