

Title

Public transport operators' technological choices of zero-emission buses:
Stakeholders' perspectives

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Summary

This paper aims to examine the influence of stakeholders on the technological decisions made by bus operators during their transition to renewable energy. This study uses Shareholder Primacy Theory as the theoretical foundation. However, it may be insufficient to explain why firms make different technological choices within similar contexts. Therefore, this study also employs Stakeholder Theory and integrates elements of Resource Dependence Theory. This research adopts a matched-pairs case study approach, focusing on two major bus operators that have made different zero-emission technological choices within the same city in the UK at the same time. Qualitative data was collected using various methods, and full pattern matching method is used for case analysis. Findings add nuance to the definition of 'salient' stakeholders and explaining their various impacts on firm decisions, enriching Stakeholder Theory. The research also provides insights into particular firms' interpretation, assessment and balancing of stakeholder interests, contributing to the stakeholder management literature.

Keywords: Technological Choices; Shareholder Primacy Theory; Stakeholder Theory; Resource Dependence Theory; Sustainability; Zero-Emission Transport.

Introduction

Technological choice is one of the key strategic decisions of a company, which may profoundly influence the capital investment and long-term competitiveness and consequently the long-term objectives of the company. In the public transport industry, the adoption of zero-emission buses has become a major trend. Therefore, the focus of this study is on how different stakeholders influence the technological choices of operators in the sustainable bus transition. Shareholder Primacy Theory (SPT) is chosen as the theoretical basis for this research, as it emphasizes shareholder interests, but other stakeholders' interests may be compromised as a result, which in turn may damage the company's reputation and value. Therefore, this study employs stakeholder perspectives, by revealing the influence of salient stakeholders and stakeholder conflicts of interest in the decisions, to enrich Stakeholder Theory (ST) and claims to contribute practical suggestions and insights for policymakers and industry participants.

There are three reasons why investigating this topic is crucial: the urgency of sustainability, the practical and theoretical gaps in existing research.

Firstly, sustainable development is a global agenda that has attracted mounting policy and research attention worldwide. In the UK, transportation is the largest greenhouse gas emitter that accounts for 27% of total emissions (GOV.UK, 2021). Considering that the transport industry is a major contributor to carbon emissions that threatens the environment, accelerating the adoption of zero-emission vehicles in the industry is deemed essential to achieving a sustainable future. Through analyzing the influencing factors of bus operators' technological choices from a stakeholder perspective, this study may help policymakers to more effectively understand and promote sustainable development strategies in the transport sector to meet the net zero emissions target set by the UK government for 2050 (Moura et al., 2020; GOV.UK, 2022). It may also provide experience and references for other countries/cities to promote development in sustainable public transport.

Secondly, current research on how various companies in similar contexts make different technological choices is still lacking. This study investigates the decision-making factors of two bus operators in the same city when choosing between Battery Electric Vehicles (BEVs), primarily powered by electricity, and Hydrogen Electric Vehicles (HEVs), primarily driven by hydrogen energy. Each type has unique technological advantages and constraints, as detailed in Appendix 1. While existing research proposes that beyond technological attributes, factors such as financial constraints, policies and regulations, and social pressures may influence bus operators' choices (Foster and Rosenzweig, 2010), but fails to specify why companies make different decisions in similar contextualization. ST suggests different stakeholders may exert varying influences on corporate decisions (Laplume et al., 2008). By taking stakeholders' perspectives, this study fills the practical gap by revealing the unique reasons why two operators in a similar contextualization make different choices.

Thirdly, despite many years of study, there are still theoretical gaps in ST that need to be addressed. This paper specifically focuses on stakeholder salience and balancing conflicting interest claims. Regarding stakeholder salience, current research recognizes legitimacy, power, and urgency as generic dimensions (Mitchell et al., 1997). However, applying these umbrella terms in practice to determine which stakeholder has greater legitimacy, more power or more urgency may pose challenges, as stakeholder salience varies by industry (Fineman and Clarke, 1996), and these umbrella terms may not fully cover the nuanced

differences and complexity of real-world scenarios (Eesley and Lenox, 2006). Therefore, it is essential to differentiate stakeholder salience in specific situations (Eesley and Lenox, 2006). This study seeks to devise sub-measures, inspired by Resource Dependence Theory (RDT), to better understand and compare the impact of salient stakeholders in the transport sector.

Regarding balancing conflicting interest claims, existing research still has gaps in how firms can balance and resolve interest conflicts and engage with stakeholders to achieve sustainable development (Wheeler et al., 1997; Reynolds et al., 2006; Laplume et al., 2008). Jensen (2002) proposed treating the maximization of the firm's long-term value as a shared goal for all stakeholders, but this approach may not consider the heterogeneity of stakeholders who may have different influences and value claims in the firm's technological choices. Reynolds et al. (2006) examined the balance of stakeholder interests based on resource divisibility and relative stakeholder saliency, but the study participants were only low and middle managers, ignoring other salient stakeholder perspectives such as top management, suppliers, government, and customers. Moreover, the vignettes used in their study may not accurately reflect the actual complexity and dynamics within the organization. Particularly in the public transport industry, business activities may involve wider stakeholders such as government, passengers, suppliers and communities. Therefore, this study aims to examine how, in the focal context, operators balance and resolve stakeholder conflicts and promote stakeholder engagement more carefully to prevent negative impacts on the business and achieve sustainable development.

Although it may be challenging to draw general conclusions as different industries rely on different resources (Laplume et al., 2008), this study makes valuable contributions to filling existing gaps in ST. It may achieve a balance between cost-effectiveness, environmental protection, and social welfare benefits (Jakhar et al., 2019).

Based on these gaps, this paper proposes potential research questions

Research Question 1: What factors influence the different technological choices made by various firms within similar contexts?

Research Question 2: How do stakeholders influence these different choices, considering their varying interests and salience?

Literature Review

Shareholder Primacy as the theoretical base

This section elucidates the rationale behind employing SPT as the theoretical foundation for this study, and the reasons underpinning Stakeholder Theory's role as the primary theory. SPT, from a legal perspective, promotes the maximization of shareholder interests on the grounds that they are the company's owners and the residual claimants (Lewis and Carlos, 2022). This implies that a company, when making strategic decisions, should prioritize shareholder interests, a practice that may potentially undermine the interests of other stakeholders.

ST highlights that neglecting stakeholders' interests may harm a company's reputation and value, thereby inhibiting the potential for shareholder interest maximization. By attending to

the interests of stakeholders, a company may bolster its reputation and value, thereby enhancing shareholder value in the long run (Barney, 2018). As such, the influence of stakeholders is integral to this study.

Stakeholder Theory with Resource Dependence Theory

ST still has limitations, including salient stakeholders' influence and balancing their interests (Frooman, 1999). By investigating the application of ST in a specific industry and drawing insights from RDT, this paper offers a fresh perspective. It enriches the understanding and applicability of stakeholder salience and interest conflict resolution in the public transportation sector. Ultimately, this study claims to broaden the scope of ST and bridges existing gaps.

Regarding stakeholder salience, RDT emphasizes continual external resource dependence for organizations (Pfeffer and Salancik, 1978), advocating for companies to consider external factors and establish reliable external resource dependence (Dai and Si, 2018). The author argues that for those stakeholders who provide key resources, companies may see them as salient stakeholders in their technological choices, which may enrich Mitchell's three dimensions (Driscoll and Starik, 2004). In addition, the salient stakeholder may vary from industry to industry, and in this study the authors focus only on the salient stakeholder in the area of public transport sustainability. This may address the low validity of overly broad research on salient stakeholders' definition and identification (Eesley and Lenox, 2006). During the interviews, the author raised questions about how salient stakeholders are identified and how they influence firms' choices. Through the methods employed in this study, the paper aims to enrich Mitchell's three generic dimensions of stakeholder salience.

Regarding balancing stakeholders' interests, existing research has gaps in addressing how to balance interests and engage with stakeholders. It also lacks a clear framework for making choices to balance competition between stakeholders (Kaler, 2006). Shareholder-dominated companies may damage long-term interests by pursuing short-term profits like dismissing workers, polluting the environment or damaging local communities (Ioannou and Serafeim, 2012). However, over-emphasis on stakeholders' interests and power may also threaten the business. The company may ignore competitive threats and market pressures, distracting them from their operations and ultimately leading to failure (Walker and Marr, 2001). To balance conflicting interests from stakeholders, companies may need to identify critical resources. This study utilizes RDT to investigate company's dependence on resources and role in balancing stakeholder interests. Additionally, the study explores practical ways companies can engage with stakeholders when faced with difficulties in balancing competing interests. Through examining the experiences of companies, this research aims to refine gaps in ST theory related to resolving conflicts and engaging with stakeholders.

Research Methodology

Research Design

Informed by interpretivism (Saunders et al., 2009; Bhattacharjee, 2012), this study employs the full pattern matching and matched-pairs case studies methods respectively. Full pattern matching enables comparison of case results with preliminary theoretical ideas, finding

consistencies and inconsistencies to gain a deeper understanding of both theoretical and observational realms. On the other hand, the matched-pairs case study approach allows for a direct comparison of two companies that have made distinct technological choices within similar contexts, aiming to explain the different choices between the cases. These methods are explained in detail in the following sections.

Full pattern matching operates through the comparison of theoretical and observational realms, but does not extend to hypothesis testing. The theoretical realm, derived from extant theories, results in the formation of a theoretical pattern. Conversely, the observational realm arises from data obtained through observations, interviews, and other sources, leading to the creation of an observed pattern (Trochim and Donnelly, 2001; Sinkovics, 2018). This study constructs the observed pattern using the matched pairs case study method, a process that will be further elucidated subsequently. The final stage involves evaluating the consistency or inconsistency between the theoretical predictions and the findings from the case studies.

Drawing inspiration from the "Eisenhardt Method" (Eisenhardt, 2021; Buck, 2011), this paper specifically employs a matched-pairs case study approach to establish the observed pattern. Case studies enable the examination of links between events rather than just the frequency of their occurrence and are applicable to the interpretation and in-depth analysis of phenomena (Eisenhardt, 1989). The matched-pairs case study approach may help the researcher to control and match variables of two related or similar cases, minimizing the interference of other influencing factors, allowing the author to focus on the case study and draw rich conclusions and new insights (Eisenhardt, 2021).

This paper investigates matched-pairs (Eisenhardt, 1991) of two representative large bus operators in one UK city, for three reasons. Firstly, one city holds constant certain contextual variables, such as city size, local community culture, topography, climate and economic development level and so forth. Secondly, two large-size bus operators are selected, both with multiple operating routes and years of operating experience in the target city. This may ensure that variables like company size, familiarity with the local market and so forth, are consistent. Thirdly, this research is studied over the same time period to avoid the results being differentially affected by the time factor. By controlling these variables, the author may reduce the interference of external factors and obtain a rich description and credibility from this study (DiBenigno and Kellogg, 2014; Eisenhardt, 2021).

Specifically, this paper selects Aquenton (pseudonyms are used to protect the privacy of the two bus operators), a city with a significant advantage in hydrogen technology, as the research site. The local government has set targets and allocated funds to develop hydrogen energy to achieve industrial transformation, reduce dependence on fossil fuels, and create a low-carbon city. Aquenton has two main bus companies, Forward Bus (stands for forward-looking) and Summit Bus (stands for professionalism), each operating over 20 bus routes. However, they have chosen different bus technologies for the transition to zero-emission buses. Forward Bus prefers operating HEVs, while Summit Bus favors BEVs. This study uses a paired case study with two representative cases to draw reliable conclusions.

In summary, this research begins with the development of preliminary ideas drawn from existing research, thereby forming the theoretical pattern underpinning this study (Trochim and Donnelly, 2001; Yin, 2014; Sinkovics, 2018). Following this, the matched pairs case study method is employed to compare and analyze the two selected cases, forming the

observed pattern. Finally, a pattern matching comparison is conducted between the observed and theoretical patterns, followed by an analysis of the results. The primary focus of this study is on theory building as opposed to theory testing.

Data Collection

In this research, qualitative data is collected to accommodate the complexity of social science research and to avoid oversimplification of social phenomena into isolated variables (Flick, 2018; Welch et al., 2022). To mitigate the potential subjectivity of qualitative data (Goertz and Mahoney, 2012), the study employs three data collection methods and triangulation (Gioia et al., 2013).

Firstly, the primary data collection method is semi-structured interviews with relevant stakeholders, including managers from the two case companies, bus suppliers, and industry organizations and so forth. The author contacted relevant stakeholders related to the two cases through an alumni network, friends, and emails, and expanded the scope of the interviews through snowball sampling. Interviewing different stakeholders allows the author to cross-validate the answers from different interviewees, ensuring the accuracy of the results and avoiding bias (Yin, 2014).

Secondly, this study used a large number of existing documents and literature, including Foresight Bus's and Summit Bus's company reports, public transport and sustainability industry reports, Aquenton council reports and plans, meeting minutes and internal documents, passenger research literature, and more. These documents cover various stakeholders' decisions, communications, and other related content. The materials may help obtain more comprehensive data and enrich the study results (Yin, 2014). Additionally, the data may also be used to conduct triangulation to increase the validity and reliability of the research findings (Gioia et al., 2013).

Thirdly, this study also employed observation and fieldwork notes. To broaden the scope of data collection, the author conducted firsthand observations in Aquenton and visited bus manufacturers' factories to communicate with their staff. The author also rode the buses of two operators personally as a passenger (one of the stakeholders). These methods may enrich the data and provide more contextual information for a comprehensive understanding of the research topic (Saunders et al., 2009; Yin, 2014; Welch et al., 2022).

In summary, this research collected qualitative data through semi-structured interviews, existing documents, and observation and fieldwork notes. By controlling variables and conducting triangulation, the author aims to derive accurate and comprehensive findings, drawing rich, but contextualized, conclusions and new insights from the study, based on thematic analysis applied to qualitative data.

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Appendix

Appendix 1: Comparison between BEV and HEV.

	Benefits	Issues
BEV	• A mature and safe technology (Neubauer et al., 2012). • Lower BEV cost than the HEV (Kim et al., 2021).	• Slow charging speeds (Offer et al., 2010). • Pollution of the environment if the batteries are powered by fossil fuel electricity generation (Bose, 2010). • The production of lithium batteries may damage the environment (Aral and Vecchio-Sadus, 2008).
HEV	• Short refuelling time (Offer et al., 2010). • Long driving range (Lipman et al., 2018). • The clean energy of hydrogen itself (Stern, 2018).	• Safety issues with hydrogen storage and refuelling (Najjar, 2013). • Supply issues with hydrogen fuel and fuelling stations (Lipman et al., 2018).

Source: The author

Appendix 2: Factors influencing the technological choices of companies.

First level	Second level	Explanation/ description
Technology	Reliability of Technology	Whether the new technology can provide consistent and reliable performance;
	Maturity of Supply chain	Whether the supplier can provide stable bus or energy supplies;
	Other technological elements	Technology life cycle
		Economies of scale
Finance	Revenue	The potential revenue impact of adopting the new technology on the business; including return on investment; subsidies or funding; new customers attracted by the new technology, etc.
	Cost	The potential cost of adopting new technology on the business; including the company's financial burden, initial investment or operating costs, etc.

Pressure	Social pressures	For companies' reputations, they may be influenced by social pressure from environmental organizations, communities or customers, etc.
	Regulatory pressures	For the companies' legitimacy, they may need to comply with regulations or rules.
	Competitive pressures	For the companies' competitive advantages, competitor products may influence their technological choices.
Company's strategy	Integrability	Whether the new technology can be integrated into the business;
	Strategy alignment	Whether the new technology is aligned with the company's strategy.

Source: the author (Shehabuddeen et al., 2006; Foster and Rosenzweig, 2010)