EVS30 Symposium
Stuttgart, Germany, October 9 - 11, 2017

Electric Vehicle Procurement Decisions in Fleets: Results of a Case Study in South-West Germany

Daniel Guth[1*], Joachim Globisch[2], Axel Ensslen[1], Patrick Jochem[1], Elisabeth Dütschke[2], Wolf Fichtner[1]

[1]*Karlsruhe Service Research Institute (KSRI) at the Karlsruhe Institute of Technology, Kaiserstrasse 89, Karlsruhe, 76133, Germany* [2]*Fraunhofer Institute for Systems and Innovation Research (ISI), Breslauer Strasse 48, Karlsruhe, 76139, Germany* [*]*Corresponding Author, E-mail: daniel.guth@student.kit.edu*

Summary

In order to increase the market share of electric vehicles (EV) in Germany, further insights on actors and structures of EV specific procurement decisions for fleets are necessary. Our analysis focuses on vehicles registered by companies/organizations as they dominate new vehicle registrations in Germany. The following question is examined empirically: Which departments influence EV procurement decisions in small and medium-sized enterprises (SME), in large-scale enterprises (LSE) and in public organizations (PO) and what are the differences compared to these departments' influences on internal combustion engine vehicles (ICEV) procurement decisions? Our results show that EV procurement decisions of organizations in South-West Germany are decisively influenced by upper management levels and partly by organizations' fleet management departments. In small and medium-sized enterprises sales- and public relations departments have a major influence on EV procurement decisions. These findings are important for stakeholders interested in selling EVs or in designing policies that are more effective in influencing organizations' decision making concerning future EV procurement decisions.

Keywords: Consumers, EV (electric vehicle), Fleet, Marketing, Sales

1 Introduction

Global emissions projections clearly show that rising greenhouse gas emissions in the transport sector need to be copiously reduced for achieving significant climate change mitigation targets [1]. Due to rising vehicle registrations on the global level efficiency gains of conventional drivetrain technologies (the main contributor to greenhouse gas emissions in transport) could not reverse the trend of increasing greenhouse gas emissions so far [2]. In order to significantly reduce greenhouse gas emissions within the transportation sector, the electrification of individual road transport by substituting internal combustion engine vehicles (ICEV) with electric vehicles (EV) and additionally decarbonizing the energy system seems promising. The German federal government intends to increase the share of EVs and to establish Germany as the worldwide leading market and leading supplier of EVs [3]. This strategy is supposed to secure the leading position in automotive construction with the jobs related, domestic value added as well as corresponding export opportunities. Furthermore, this strategy reduces dependencies on oil imports, consumption of fossil resources and reduces local emissions in cities [3].

As EV registrations are still low, increasing the knowledge on EV procurement decisions seems indispensable in order to develop strategies to increase EV sales numbers. Developing a better understanding of organizational fleets' procurement decisions especially plays a key role in increasing EV market shares as 60 percent of all new vehicle registrations are made by organizations [4], [5]. The time of ownership of vehicles purchased by organizations is much shorter than the time of ownership of vehicles purchased by the private sector. Many of the vehicles newly registered by organizations are sold to private households via the used car market [5], [6], [7], [8]. In addition to that, vehicles used in organizational fleets possess characteristics that make them suitable for being replaced by EV [9], [10]. These characteristics include comparatively high mileages and high usage frequencies [5]. Additionally, it is likely that in addition to EVs ICEVs are available in fleets. These can be used if specific trips need to be made that exceed the technical possibilities of current EVs [5], [10], [11], [12].
EV procurement decisions follow an adoption process. Literature distinguishes between three phases: (i) Initiation phase of innovation adoption, (ii) decision phase within the innovation adoption process and (iii) the adoption decision's implementation phase [13], [14], [15]. This work has its focus on (ii) the decision phase. The following aspects are considered: (i) Reviewing EV specific characteristics, (ii) importance of actors and structures within an organization concerning EV procurement decisions and (iii) identification of organizations where EV procurement is particularly likely [15]. Quantitative studies evaluating EV specific characteristics are available in literature (e.g. [16], [17]). Studies identifying organizations which are likely to procure EVs also exist (e.g. [18]). However, there is a need for quantitative research concerning importance of actors and structures within organizations during EV procurement decision phases.
By looking at organizations and their role as consumers, sales strategies can be derived from the results. We propose a classification of organizations that is derived from a B2B marketing typology of organizational customers. We divide organizations into private enterprises und public organizations (PO) [19]. Dependencies between the size of companies and their procurement procedures exist [20]. Therefore, we split private enterprises into small and medium-sized enterprises (SME) and large scale enterprises (LSE).
This article investigates the following research question: Which departments influence EV procurement decisions in small and medium-sized enterprises (SME), in large-scale enterprises (LSE) and in public organizations (PO) and what are the differences compared to these departments' influences on ICEV procurement decisions?
To answer this research question we analyze survey data on different departments' influences on revealed EV and ICEV procurement decisions and evaluate reasons for and against purchasing EVs.

2 Overview on data and methods

Section 2.1 provides an overview on the data used before corresponding data collection and analytical methods are described in section 2.2.

2.1 Data

The data used in this study was collected in an online survey in the research project Get eReady carried out in South-West Germany between 2013 and 2016. The objective of this project was to determine critical success factors of EVs in fleets. A large-scale fleet trial including 109 organizations and 327 EVs was set up in order to analyze whether appropriate sales activities for EVs, charging services, charging infrastructure, consulting activities and an adequate compensation of expenses lead to an accelerated market diffusion of EVs [21]. The organizations participated in the project between 7 and 27 months, 16 months on average. They received a monthly compensation of expenses for participating of up to 500 Euros net per full electric vehicle (BEV) or range extended electric vehicle (REEV), and 350 Euros net per plug-in hybrid electric vehicle (PHEV) [22]. Fleet managers of all 109 participating organizations completed two surveys. 16 % of the organizations are categorized as PO. 68 % of the organizations are categorized as SME and 17 % as LSE. To distinguish between SME and LSE, the number of 250 employees is used according to a simplified form of the definition by the European Commission [23].
The fleet managers and decision makers in the participating organizations are on average 45 years old (SD=12), predominantly male (about 85 %) and highly educated. On average, the respondents have been employed for 16 years in their organizations (SD=12) and have 10 years of experience (SD=10) with fleet management activities on average [22]. See [21] for further information about the scope and dataset of the project Get eReady.

2.2 Methods

Data collection

The following question was asked to find out about departments existing within the participating organizations: 'Which of the following special departments are available in your organization?' *(Q1)*. The respondents were asked to select from the following list: fleet management, financial controlling, sales, public relations, human resource, purchasing and facility management.

The following question was asked to measure the influence of different departments on organizations' EV and ICEV procurement decisions: 'How high is the influence of the following persons, bodies or departments in the decision to procure EVs / ICEVs?' *(Q2 & Q3)*. Depending on whether the respondent stated a particular department would be existing, a selection of the different departments above mentioned complemented by 'organizational management' was provided for evaluation. In addition, an open text field was provided to list other influencing organizational bodies beyond the departments listed. The respondents provided information on the departments' influence on a six-point scale ranging between 1 ('no influence') and 6 ('great influence').

Additionally, priorities and reasons for and against procuring EVs were gathered by the following questions. First the question 'What factors influence your organization's EV procurement decision?' was asked. Then the survey participants were asked to provide information on organizations' motivations for positive and negative EV procurement decisions by evaluating the 14 items shown in Table 1 *(Q4)*. An item represents an associated advantage or an associated disadvantage concerning EV procurements. We therefore get priorities of reasons influencing EV procurements. Associated advantages are marked with (+), disadvantages with (-) (Table 1).

Table 1: Items concerning organizations' motivations to procure EV

Statement ('Decisive factors regarding EV procurement decision of my organization include …')	**Abbreviated version**
'... whether the employee motivation is thereby increased.'	(+) Increase of employee motivation
'…whether the climate is thereby protected.'	(+) Climate protection
'…whether traffic noise is prevented.'	(+) Prevention of traffic noise
'... whether local air pollution is prevented.'	(+) Prevention of local air pollution
'... whether my organization can improve its image.'	(+) Improvement of organization's image
'... whether my organization can secure experience-based advantages in the field of e-mobility.'	(+) Experience-based advantages in e-mobility
'... whether my own work becomes more interesting.'	(+) Own work becomes more interesting
'... whether the fleet management becomes more complex.'	(-) More complex fleet management
'... whether the mobility of employees is thereby restricted.'	(-) Restriction of employee mobility
'... whether this results in a reduction of the vehicle's reliability.'	(-) Reduction in vehicle reliability
'... whether this results in a reduction of road safety.'	(-) Reduction of road safety
'... whether this leads to negative reactions of fleet vehicle users.'	(-) Negative reactions from users
'... whether overall costs for vehicles increase.'	(-) Overall vehicle cost
'... whether comfort is thereby reduced.'	(-) Reduction of comfort

Note: 1 corresponds to 'Does not apply at all', 2 to 'Does largely not apply', 3 to 'Does rather not apply', 4 to 'Does rather apply', 5 to 'Does largely apply' and 6 to 'Does completely apply'.

Data analysis

Q1: In order to determine statistically significant differences concerning the existence of specific departments in SME, PO and LSE, pairwise χ^2-tests for independence are carried out for all departments analyzed. Using this test allows analyzing whether two nominally-scaled variables are independent from one another. In our case this means that we compare whether two groups differ significantly concerning the existence of a specific department. In order to assess the strengths of significant test results, effect sizes are calculated. Contingency coefficients (ϕ-coefficients) are chosen to determine effect sizes [24], [25], [26].

Q2: Ordinal-scaled data was provided by the fleet managers answering the question on different bodies' or departments' influence on EV procurement decisions. Nonparametric Kruskal-Wallis tests are applied to determine whether differences between SME, PO and LSE concerning influences of different departments

on EV procurement decisions are statistically significant. This test is based on the idea of sorting ordinal data. The measured values are replaced by ranks. The calculations for the statistical tests are then based on these rankings. If Kruskal-Wallis test results are significant, answers provided by at least two of the three groups differ significantly. Three pairwise post-hoc Mann-Whitney-U tests are then applied to find out between which of the three values significant differences are observable. As post-hoc tests are multiple tests, significance levels need to be adjusted. This approach is called error correction and is carried out according to Dunn and Bonferroni [24], [25], [26]. Post-hoc tests determine which groups differ. Corresponding effect sizes of post-hoc tests are calculated. Correlation coefficients are used as an approximation for the effect sizes of test results [26].
Q3: We test for differences between different organizational departments' influences on ICEV and EV procurement decision. Due to the nonparametric paired sample setting Wilcoxon signed-rank tests are applied [26]. Just like the other two nonparametric tests applied, this test also transforms the measured values to ranks. Correlation coefficients are used as an approximation for effect sizes. Cohen (1992) provides the following interpretations: 0.1 corresponds to a weak effect, 0.3 to a moderate effect and 0.5 to a strong effect [26], [27].
Q4: We provide descriptive statistics regarding reasons for and against EV procurements. Kruskal-Wallis tests are applied to analyze potential differences between the three organization types considered.

3 Results

In this section answers to the questions Q1-Q4 are provided.
Q1: Table 2 provides an overview on the differences observed concerning departments existing in the three organization types.

Table 2: Significant χ^2-test results for two groups per organizational body

Compared groups	*Test statistic (χ^2 value)*	*Significance level*	*Effect size (ϕ-coefficient)*	*Interpretation effect size*
Test results for fleet management				
SME & LSE	21.701	***	0.49	strong
SME & PO	5.216	*	0.24	moderate
LSE & PO	4.062	*	0.34	moderate
Test results for sales				
SME & LSE	6.755	**	0.27	moderate
SME & PO	5.879	*	0.25	moderate
PO & LSE	15.352	***	0.66	strong
Test results for financial controlling				
SME & LSE	9.948	**	0.33	moderate
SME & PO	0.013	ns	0.01	weak
PO & LSE	7.441	**	0.46	strong
Test results for purchasing				
SME & LSE	11.206	**	0.35	moderate
SME & PO	1.857	ns	0.14	weak
LSE & PO	3.367	*	0.31	moderate
Test results for public relations				
SME & LSE	11.206	**	0.35	moderate
SME & PO	0.885	ns	0.10	weak
LSE & PO	4.575	*	0.36	moderate
Test results for human resources				
SME & LSE	8.252	**	0.30	moderate
SME & PO	8.966	**	0.31	moderate
LSE & PO	0.004	ns	0.01	weak
Test results for facility management				
SME & LSE	7.724	**	0.29	moderate
SME & PO	28.237	***	0.55	strong
LSE & PO	1.457	ns	0.20	weak

Note: *** p<.001 ** p<.01 * p<.05 ns not significant

While sales and human resource departments are most common in SME, fleet management and facility management only exist in every fourth SME. In LSE, specialized departments exist for almost every field of work. For instance, 90 % of LSE have departments for public relations, purchasing, sales and financial controlling. In PO results vary. On the one hand, most of the PO have specialized departments for facility management (78 %) and human resources (88 %). On the other hand, only 22 % of the PO have specialized sales departments. Departments for public relations, financial controlling and fleet management exist in approximately every other PO. χ^2-tests showed that significant differences can be observed concerning the existence of specialized departments in different types of organizations. The share of special departments for human resources, facility management and fleet management is significantly higher in PO than in SME. LSE have a significantly higher share of special departments for public relations, purchasing, sales, financial controlling and fleet management than PO. All significant test results have moderate to strong effect sizes (Table 2).

Q2: Figure 1 provides information on average influences on EV procurement decisions of different organization types' (SME, PO and LSE) departments. Table 3 provides detailed information on pairwise post-hoc Mann-Whitney-U tests of those departments showing significant Kruskal-Wallis-Test results. In all organization types, i.e. SME, PO, and LSE, organization management has the highest influence on EV procurement decisions.

Table 3: Significant post-hoc test results concerning departments' influences on EV procurement decisions

Compared groups	*Test statistic (z-value)*	*Significance level*	*Adjusted p-value (Dunn, Bonferroni)*	*Effect size (correlation coefficient)*	*Interpretation effect size*
Test results for organization management					
SME & LSE	3.92	***	0.000	0.42	moderate
SME & PO	2.96	**	0.009	0.31	moderate
LSE & PO	0.82	ns	1.000	0.14	weak
Test results for sales					
SME & LSE	3.34	**	0.002	0.50	strong
SME & PO	2.05	ns	0.122	0.35	moderate
LSE & PO	-0.06	ns	1.000	0.01	weak
Test results for financial controlling					
SME & LSE	3.34	**	0.003	0.55	strong
SME & PO	0.80	ns	1.000	0.14	weak
LSE & PO	1.81	ns	0.212	0.39	moderate
Test results for public relations					
SME & LSE	2.81	*	0.015	0.46	moderate
SME & PO	4.58	*	0.021	0.82	strong
LSE & PO	-0.06	ns	1.000	0.01	weak

Note: *** p<.001 ** p<.01 * p<.05 ns not significant

The influence of organization management in LSE and PO is high (4.7 and 5.4). However, it is significantly higher in SME (5.9) (Figure 1). In all three types of organizations, the fleet management has the second highest influence on EV procurement decisions. Regarding departments with the third highest influence, the following differences are observable. In SME sales departments have the third highest influence with a moderate to strong influence (3.6). SME sales departments' influences are significantly higher than sales' departments influence in LSE. In LSE public relations departments have the third highest influence on EV procurement decisions with a comparably weak score of 2.0. Purchasing departments of PO have the third highest influence. Hence, influence is also in the weak to middle range (2.7). Much lower influences of departments with the third highest influence compared to departments with the second highest influence can be observed (see Figure 1). In general, in SME more departments have a medium to high influence on EV procurement decisions than in LSE and PO. For instance, influences on procurement decisions of financial controlling departments are significantly higher in SME than in LSE. In addition, public relations departments of SME (3.7) have a medium to high influence. Their influence is thus significantly higher than the influences of public relation departments in PO and LSE. In LSE and PO EV procurement decisions are made by the upper management and fleet management, other departments have

only minor roles (see Figure 1). Table 3 shows that all of the significant test results have moderate to strong effect sizes.

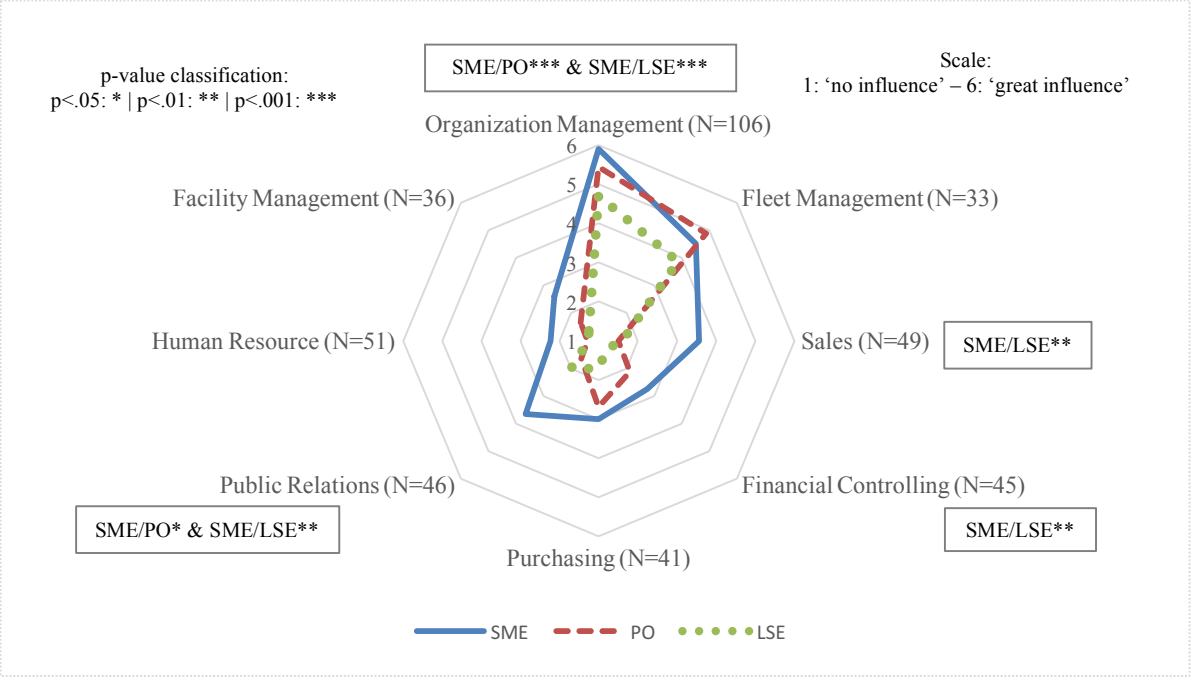

Figure 1: Degree of influence regarding EV procurement decisions

Q3: Compared to EV procurement decisions organization management has a significantly lower influence on ICEV purchase decisions in all three types of organizations (Table 4). Furthermore, public relations departments seem to have a higher influence on EV procurement decisions than on procurement decisions of ICEV (see Table 4). Fleet management departments' influence on EV procurement decisions is significantly lower than fleet management departments' influence on ICEV procurement decisions. However, differences are not significant for the following departments: sales, financial controlling, purchasing, human resource and facility management.

Table 4: Organization departments' influences on ICEV and EV procurement decisions

	EV Procurement			*ICEV Procurement*			*Test results concerning departments' influence on EV and ICEV procurement decisions*			
	N	*M*	*SD*	*N*	*M*	*SD*	*Test statistic (z-value)*	*Signi-ficance level*	*Effect size (correlation coefficient)*	*Interpretation effect size*
Organization management	106	5.63	0.99	57	4.85	1.51	5.93	***	0.80	strong
Fleet management	33	4.33	1.71	26	4.50	1.33	2.03	*	0.77	strong
Sales	49	2.80	1.95	33	2.73	1.68	1.83	ns	0.46	moderate
Financial controlling	45	2.18	1.45	34	2.38	1.58	1.18	ns	0.32	moderate
Purchasing	41	2.49	1.94	29	2.59	1.57	1.61	ns	0.46	moderate
Public relations	46	2.76	1.80	27	1.89	1.22	3.09	**	0.89	strong
Human resources	51	1.69	1.29	36	1.86	1.17	1.85	ns	0.48	moderate
Facility management	36	1.92	1.50	24	1.75	1.11	0.81	ns	0.36	moderate

Note: *** p<.001 ** p<.01 * p<.05 ns not significant

Q4: Regarding priorities concerning reasons for procuring EV or not all items were on average at least evaluated as 'Does rather apply' by respondents of all organization types (see Table 5). The only item that was on average rated as 'Does rather not apply' or less, was the item 'own work becomes more interesting'. The items 'improvement of the organization's image', 'climate protection', 'overall vehicle costs', 'prevention of local air pollution', 'experience-based advantages of e-mobility' and 'restriction of employee mobility' were rated highest by SME, all being on average rated as 'largely correct' (Table 5). The items 'improvement of the organization's image', 'prevention of local air pollution' and 'climate protection' were on average rated as 'Does largely apply' by PO and therefore achieved comparably high ratings. In addition, 'prevention of traffic noise' was on average also rated as 'Does largely apply' by PO and was so rated comparably high within this group. The following items received the average rating of 'Does largely apply', the highest scores by LSE: 'overall vehicle cost', 'climate protection', 'improving the organization's image', 'prevention of local air pollution' and 'restriction of employee mobility' (see Table 5). However, differences observed between the three types of organizations are not statistically significant.

Table 5: Respondents' evaluations of statements concerning reasons for and against EV procurement decisions

Statement	SME			PO			LSE		
	N	M	SD	N	M	SD	N	M	SD
(+) Increase of employee motivation	67	4.48	1.13	17	3.65	1.38	14	4.43	1.02
(+) Climate protection	68	4.75	1.14	17	5.35	0.49	14	4.71	0.99
(+) Prevention of traffic noise	67	4.21	1.45	15	5.20	0.68	14	4.14	0.95
(+) Prevention of local air pollution	69	4.65	1.37	17	5.29	0.69	14	4.50	1.16
(+) Improvement of organization's image	67	5.03	0.94	17	5.12	0.78	15	4.60	0.91
(+) Experience-based advantages in e-mobility	68	4.51	1.19	17	3.88	1.32	14	4.36	1.22
(+) Own work becomes more interesting	66	3.36	1.38	17	2.76	1.03	15	3.33	1.50
(-) More complex fleet management	68	4.22	1.12	17	4.00	1.41	13	3.85	1.07
(-) Restriction of employee mobility	68	4.63	1.29	16	4.44	1.15	14	4.64	1.15
(-) Reduction in vehicle reliability	68	4.41	1.53	17	4.47	1.07	14	4.43	1.56
(-) Reduction of road safety	68	4.47	1.48	17	4.47	1.18	14	4.71	1.68
(-) Negative reactions from users	68	4.01	1.48	17	4.06	1.03	14	4.21	1.19
(-) Overall vehicle cost	67	4.66	1.31	16	4.69	1.35	15	4.60	1.24
(-) Reduction of comfort	68	3.59	1.30	17	3.71	1.05	14	3.43	1.16

Note: 1 corresponds to 'Does not apply at all', 2 to 'Does largely not apply', 3 to 'Does rather not apply', 4 to 'Does rather apply', 5 to 'Does largely apply' and 6 to 'Does completely apply'. (+) marks an associated advantage of the EV procurement and (-) marks and associated disadvantage of the EV procurement.

4 Discussion

In this section we discuss our findings and provide practical implications (section 4.1). Then we present limitations regarding methods and data used (section 4.2).

4.1 Findings

The influence of organizations' departments on EV procurement decisions differ between SME, PO and LSE. Knowledge on these differences is relevant to policy makers and sales departments of EV manufacturers because these stakeholders might want to develop strategies in order to increase EV sales. Results indicate that currently organizational departments influencing EV procurement decisions are different from those making the procurement decisions for ICEVs.

The following observations can be made regarding influences of different departments: Across all organization types, top management levels decisively influence EV procurement decisions. This result is further supported by the fact that upper organizational management levels influence EV procurement decisions more than procurement decisions of ICEVs. ICEV procurement might be rather a standardized

process managed and carried out by specific departments responsible for vehicle procurements. In contrast to this, EV procurement seems to be an upper management issue, which has not been delegated to specific departments yet. The fact that most organizations procured EV for the first time might be the reason for the higher management involvement.
Fleet management departments – if they exist – have the second highest influence on EV procurement decisions in all three organization types. Hence, in addition to the upper organization management, fleet management needs to be convinced of EV procurement specific advantages. Further departments are involved in EV procurements of SME: Sales, public relations and financial controlling. These departments only exist in approximately half of the SME in our sample. Nonetheless, if existing, they have a relatively high influence on EV procurement decisions. Contrarily, in PO and LSE the majority of organizations within the sample (except for sales in PO) have specialized departments for sales, public relations and financial controlling. However, influences on EV procurement decisions of these departments are barely observable.
The increased influence of sales and public relations in SME could indicate that the positive public image of EVs is a motivating factor for positive EV procurement decisions particularly in SME.
Another important observation derived from Figure 1 is that purchasing departments have only moderate influences on first EV procurement decisions. This is particularly the case for LSE. More than 90 percent of LSE have purchasing departments. However, corresponding influences are almost nonexistent. In SME and PO, purchasing departments have at least moderate influences on EV procurements. However, not even every second SME and only two out of three PO have purchasing departments. Thus, the statement of "moderate influence" must be weakened. This result is quite remarkable, as purchasing departments are formally responsible for procurements within organizations. Table 6 briefly summarizes our findings concerning communication strategies and presents arguments to convince organizations to procure EVs. Organization-specific arguments that are part of these strategies should stress the associated benefits of EV procurements (marked with (+)) or encounter associated disadvantages (marked with (-)).

Table 6: Recommended strategies with arguments to convince organizations to procure EV

	Organization type	*Organization's target departments*	*Arguments (Sorted according to descending importance per organization type)*
Strategy 1	SME	Organization management, Fleet management, Sales, PR, Controlling	(+) Improvement of organization's image, (+) Climate protection, (-) Overall vehicle cost, (+) Prevention of local air pollution, (-) Restrictions of the employee mobility, (+) Experience-based advantages in e-mobility
Strategy 2	PO & LSE	Organization management, Fleet management	PO: (+) Climate protection, (+) Prevention of local air pollution, (+) Prevention of traffic noise, (+) Improvement of organization's image
			LSE: (-) Reduction of road safety, (+) Climate protection, (-) Restrictions of the employee mobility, (-) Overall vehicle cost, (+) Improvement of organization's image

4.2 Methods, data and limitations

We analyzed a sample of 109 organizations who had procured at least one EV. To discuss limitations of methods and data applied, the quality criteria objectivity, reliability and validity are discussed [19].
Objectivity limitations in online surveys are usually comparably small compared to e.g. interviews. They may result from different operating systems or browser settings leading to different visualizations of questions and scales [28]. As we performed various test trials with different browsers and operating systems, this impairment is small to non-existent in our case.
Surveys without the presence of interviewers including online surveys can lead to reliability reductions because the motivation and discipline without interviewers can be low [28]. The possibility of reduced motivation was also given in our case by the fact that the investigated organizations were contractually obligated to participate in the survey. However, the fact that we interviewed an early adopter sample

opposes this effect, as we experienced that early adopters are often motivated to tell others about their experiences. In addition to that, the survey we created is very user-friendly. The monthly financial compensation [22] for the present economic disadvantages of EV could have additionally increased the motivation of participating and therefore could have increased the quality of our sample.
Regarding validity, representativeness claims need to be clarified. As the survey data used was collected from an early adopter sample, we do not expect representativeness for organizations in South-West Germany. The main reason for studying early EV adopters and not a representative sample permitted to collect information on revealed preferences of organizations who purchased EV and to analyze decisions that were already carried out. With this approach we reduce the discrepancy between verbal statements and actual customer behavior. The potential for strategic biases are low in our work as it is unlikely that interviewees were able to achieve a more favorable outcome through incorrect statements [19]. The hypothetical bias also seems to be negligible [19]. When responding to the questions, our interviewees referred to their real experiences concerning EV procurement decision carried out. The responses are thus free from hypothetical behavior distortions that could occur when the respondents would not have been involved in the organizations' EV procurement decisions.

5 Conclusion and outlook

EV adoption decisions of organizations play a decisive role in accelerating EV market uptake i.a. due to the fact that 60 percent of all new vehicle registrations are made by organizations. In addition, there is a need for research regarding quantitative studies on the importance of organizational actors and structures in EV adoption decision processes. Our results show that differences can be observed between different organization types' and their departments' influences on EV procurement decisions.
On the one hand, for the majority of our sample's organizations classified as SME, specialized bodies or departments for many fields of work do not exist. In order to increase EV sales numbers in such SME, the upper management needs to be convinced of EV specific advantages. On the other hand, in SME with specialized departments, these have a moderate to strong influence on EV procurement decisions. Fleet management in particular needs to be convinced of EV specific advantages. These results are consistent with findings indicating that procurement decisions for EVs are currently mainly made in larger teams with persons working in different departments with a strong influence of the top management [5].
In contrast, in almost every LSE, specialized departments for the different fields of work investigated exist. However, only fleet management departments were relevant in EV procurement decisions in addition to the organization management. Strategies intending to increase EV sales could focus on convincing these two organizational bodies of EV specific advantages. This is approximately in line with [5]. According to the results of this study EV specific procurement decisions are made by higher management levels, not by the department typically responsible. This can be explained by the novelty of the good and the increased need for a longer and strategic time horizon [5].
Conclusions regarding EV procurement decisions of PO are to some extent similar to the conclusions derived for LSE. Likewise, upper organization management has the highest influence on EV procurement decisions. At the same time, fleet management, which exists in half of the whole sample's organizations, has a strong influence on EV procurement decisions in PO. Sales, human resources and public relations have only little influence on EV procurement decisions in PO analogous to LSE.
The main conclusion of our study is that in the current market phase, for all types of organizations, the organization management and in some cases the fleet management are to be targeted to support the diffusion of EVs into organizational fleets. An additional way to convince SME of EV procurements seems to be to emphasize the positive public image of EVs. Overall, the results can be interpreted in a way that EV procurement is currently not a standard procedure of organizational procurement. Thus, strategies to make them part of the standard vehicle portfolio are needed.
Future work could focus on evaluating communication channels and contents to convince relevant persons and departments of EVs. Furthermore, the way of interaction could be focused on, e.g. which entity initiates the process of procuring an EV and which entities have the role of being potential show stoppers. Furthermore, future work needs to analyze non-adopter organizations to reveal reasons and organizational players that prevent organizations from procuring EV. Such results could then be used to further improve strategies that have been developed in this work to convince more organizations to procure EVs.

Acknowledgements

This publication has been written in the context of the research projects *Get eReady* and *Profilregion Mobilitätssysteme Karlsruhe*. The *Get eReady* project was funded by the German Federal Ministery of Economics and Energy (BMWI) under the promotion sign 16SBW020E. The *Profilregion Mobilitätssysteme Karlsruhe* is funded by the Ministry of Science, Research and the Arts Baden-Württemberg (MWK), the Ministry of Economic Affairs, Employment and Housing Baden-Württemberg (WM) and as a national High Performance Center by the Fraunhofer-Gesellschaft.

References

[1] O. Edenhofer et. Al., *Mitigation of climate change: Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, ISBN: 978-1-107-65481-5, New York: Cambridge Univ. Press, 2014

[2] A. Peters, C. Doll, F. Kley, M. Möckel, P. Plötz, A. Sauer, W. Schade, A. Thielmann, M. Wietschel & C. Zanker, *Konzepte der Elektromobilität und deren Bedeutung für Wirtschaft, Gesellschaft und Umwelt*, Deutscher Bundestag, Büro für Technikfolgen-Abschätzung -TAB-, Berlin; Fraunhofer-Institut für System- und Innovationsforschung -ISI-, Karlsruhe, 2014

[3] *BMBF*, https://www.bmbf.de/files/programm_elektromobilitaet.pdf, accessed on 2016-11-27

[4] *KBA*, https://www.kba.de/SharedDocs/Publikationen/DE/Statistik/Fahrzeuge/FZ/2013/fz14_2013_pdf.pdf?__blob=publicationFile&v=4, accessed on 2017-06-27

[5] K. Nesbitt, D. Sperling, *Fleet purchase behavior: decision processes and implications for new vehicle technologies and fuels,* Transportation Research Part C: Emerging Technologies, ISSN 0968-090X, 9(2001), 297-318

[6] T. Gnann, P. Plötz, F. Zischler, & M. Wietschel, *Elektromobilität im Personenwirtschaftsverkehr: Eine Potenzialanalyse*, Working Paper on Sustainability and Innovation, Fraunhofer ISI, S7(2012)

[7] *DAT, https://www.dat.de/fileadmin/user_upload/DAT-Report_2013_kfz-betrieb.pdf*, accessed on 2017-06-26

[8] P. Plötz, T. Gnann, A. Kühn & M. Wietschel, *Markthochlaufszenarien für Elektrofahrzeuge: Studie im Auftrag der acatech – Deutsche Akademie der Technikwissenschaften und der Arbeitsgruppe 7 der Nationalen Plattform Elektromobilität (NPE*), Fraunhofer ISI, 2013

[9] J. Globisch, U. Schneider & E. Dütschke, *Acceptance of electric vehicles by commercial users in the electric mobility pilot regions in Germany*, European Council for an Energy-Efficient Economy (ECEEE), Summer Study proceedings, (2013), 973–983

[10] T. Ketelaer, T. Kaschub, P. Jochem & W. Fichtner, *The potential of carbon dioxide emission reductions in German commercial transport by electric vehicles*, International Journal of Environmental Science and Technology, ISSN 1735-1472, 11.8 (2014), 2169-2184

[11] *Nationale-Plattform-Elektromobilität*, http://nationale-plattform-elektromobilitaet.de/fileadmin/user_upload/Redaktion/NPE_Fortschrittsbericht_2014_Barrierefrei.pdf, accessed on 2016-11-27

[12] T. Gnann, T, *Market diffusion of plug-in electric vehicles and their charging infrastructure*, Dissertation, ISBN: 978-3-8396-0933-0, Stuttgart, Fraunhofer-Verlag, 2015

[13] T. Kollmann, *Das dynamische Phasenmodell zur Akzeptanz bei technologischen Nutzungsgütern und-systemen*, Akzeptanz innovativer Nutzungsgüter und –systeme, Neue betriebswirtschaftliche Forschung, DOI 10.1007/978-3-663-09235-3_3, 239(1998). 73-162

[14] M. A. Hameed, S. Counsell & S. Swift, A conceptual model for the process of IT innovation adoption in organizations, Journal of Engineering and Technology Management, 29.3 (2012), 358–390

[15] J. Globisch, *Elektrofahrzeuge in gewerblichen Fuhrparks: Was beeinflusst die Adoption durch Organisationen?,* Dissertation, Karlsruher Institut für Technologie, forthcoming

[16] A. Ensslen, N. Kühl, C. Stryja, P. Jochem, *Methods to Identify Users' Needs and Decision Mechanisms for the Adoption of Electric Vehicles*, Proceedings of EVS29 Symposium, 2016

[17] M. Koetse, A. Hoen, *Preferences for alternative fuel vehicles of company car drivers*. Resource and Energy Economics, ISSN 0928-7655, 37(2014), 279–301

[18] K. Nesbitt, *An Organizational Approach to Understanding the Incorporation of Innovative Technologies into the Fleet Vehicle Market with Direct Application to Alternative Fuel Vehicles*, Dissertation, University of California, Davis, 1996

[19] C. Homburg, *Marketingmanagement: Strategie - Instrumente - Umsetzung – Unternehmensführung*, ISBN: 978-3-658-13655-0, Wiesbaden, Springer Gabler, 2017

[20] S. Mürling S., K.-I.Voigt , C. Baccarella, C. Scheiner, *Besonderheiten in der Vermarktung von Industriegütern mit Fokus auf das Buying-Center-Konzept,* International Marketing Trends Conference, 2012

[21] B. Sachs, L. Ungerer, P. Jochem, A. Ensslen, W. Fichtner, J. Globisch, P. Plötz, T. Georg, *Betreibermodell Elektro-Flotten in Stuttgart – Get e-Ready : FuE-Programm „Schaufenster Elektromobilität" der Bundesregierung: gemeinsamer Abschlussbericht,* doi:10.2314/GBV:873380274, 2016

[22] A. Ensslen, T. Gnann, J. Globisch, P. Plötz, P. Jochem, & W. Fichtner, *Willingness to Pay for E-Mobility Services: A Case Study from Germany*, Proceedings of Karlsruhe Service Summit, 2016

[23] *Eur-lex.Europa,* http://eur-lex.europa.eu/legal-content/DE/TXT/PDF/?uri=CELEX:32003H0361&qid=1498517225442&from=en, accessed on 2017-06-26

[24] J. Hartung, B. Elpelt, K.-H. Klösener, *Statistik: Lehr- und Handbuch der angewandten Statistik*, ISBN 978-3-486-59028-9, München, Oldenbourg, 2009

[25] J. Bortz, C. Schuster, *Statistik für Human- und Sozialwissenschaftler: mit 163 Tabellen*, ISBN 978-3-642-12769-4, Berlin; Heidelberg, Springer, 2010

[26] *Methodenberatung.uzh*, http://www.methodenberatung.uzh.ch/de/datenanalyse/unterschiede/zentral/kruskal.html#21, accessed on 2017-06-29

[27] J. Cohen, *A power primer*, Psychological bulletin, ISSN 1913-4126, 112.1 (1992), 155.

[28] A. Theobald, *Das World Wide Web als Befragungsinstrument*, ISBN: 3-8244-7296-1, Wiesbaden, Gabler, 2000

Authors

Daniel Guth is a student research assistant at Karlsruhe Service Research Institute (KSRI). He received his bachelor's degree in industrial engineering from Karlsruhe Institute of Technology (KIT) and wrote his bachelor thesis about electric vehicle procurement decisions in fleets. Currently, he is studying for his master's degree in industrial engineering at KIT. His major fields of studies are energy economics and marketing.

Joachim Globisch is a research associate in the Competence Center Energy Technology and Energy Systems at Fraunhofer ISI since April 2012. He currently finishes his PhD-thesis that deals with the adoption of electric vehicles by commercial fleets. In general he is interested in questions concerning the transformation of the energy system and alternative forms of mobility.

Axel Ensslen is a research assistant at the French-German Institute for Environmental Research and a member of the Transport and Energy research group at the Chair of Energy Economics at KIT since 2011. He studied industrial engineering at KIT and the Ecole Nationale Supérieure des Mines de Nancy. His research activities focus on socio-economic aspects of electric mobility.

Patrick Jochem is a research group leader at the KIT-IIP, -DFIU, -KSRI, and Chair of Energy Economics. In 2009, he received his PhD in transport economics form KIT. He studied economics at the universities of Bayreuth, Mannheim and Heidelberg in Germany. His research interests are in the fields of electric mobility and ecological economics.

Elisabeth Dütschke: Studies of psychology, business administration and marketing at TU Darmstadt and RWTH Aachen; graduation (Diplom-Psychologin) in 2004; research associate at RWTH Aachen; research associate and lecturer at Universität Konstanz; PhD in 2010 from the Universität Konstanz (summa cum laude / award from Südwest Metall); further work experience in consulting of private and public organizations and journalism. Since June 2009 at the Fraunhofer ISI / Karlsruhe as senior scientist and project leader.

Wolf Fichtner is director of the Institute for Industrial Production and the French-German Institute for Environmental Research. He is full professor and holder of the Chair of Energy Economics at KIT. His main areas of research are energy system modelling and the techno-economic analysis of energy technologies.