



AMERICAN MARKETING  
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# 2020 AMA Winter Academic Conference

Consumers and Firms in a Global World

February 14-16 | San Diego, CA

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## PROCEEDINGS

Volume 31

Editors:

Bryan Lukas, University of Manchester

O.C. Ferrell, Auburn University

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# “All That Glitters Is Not Gold”: Performance of EV-Charging Infrastructure from a European User Perspective

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**Keywords:** *e-mobility, charging, user experience, cluster analysis*

**Description:** *We take an exploratory look at performance types of charging services with a user experience study and 401 evaluated charging stations for electric vehicles across Europe, showing that there are still clear potentials to improve the customer and user orientation, especially concerning transparency of charging costs, barrier-free accessibility, and the visibility of the charging stations.*

## EXTENDED ABSTRACT

### Research Question

Climate change, air pollution and urbanization have been around for decades as subjects of scientific discussion. Among others, the development of sustainable mobility solutions is recognized as a potential action field to contribute to solving these problems (Banister 2011). For some time now, the car manufactures have been announcing a massive turnaround towards Electric Vehicles (EV) (Augenstein et al. 2015). Structural changes in global markets but also disruptive incidents, such as the diesel crisis, might be forcing companies like VW to come up with more than 80 EV models by 2030 (Carmagazine 2019). The question remains, whether Europe is ready for an “electric road revolution”? Particularly the charging infrastructure for EV’s is considered to play a significant role when it comes to technology acceptance by consumers (Biresselioglu et al. 2018). But how powerful is the charging infrastructure in Europe from the perspective of EV users? How convenient is the charging process? How transparent are the charging costs? How do users evaluate more general environmental factors that are important to them, such as safety, lighting conditions, and traffic load at the charging station? With this

study, we take an exploratory look at which performance-types of charging services exist in European markets.

### Method and Data

We conducted a User Experience study with 12 evaluation teams assessing charging stations across Europe, using either a BMW i3, Opel Ampera, VW eGolf or Mercedes B-class e-version, with their AC type 2 and Combined Charging System (CCS) charging options covering technically over 70% of available charging stations in Europe. Overall, 442 charging stations have been investigated in Germany, France, Austria, Italy, and the Netherlands. The assessment of single charging stations has been executed by the driver teams using a standardized evaluation-checklist. The checklist was developed based on literature and existing studies (Philipsen et al. 2015, Philipsen et al. 2016, Will et al. 2016, Zhang et al. 2017, Zhang et al. 2018), as well as qualitative interviews with seven charging experts from the companies ABB, EnBW, Daimler, and Bosch. It contained questions regarding general geographic factors, the infrastructure of the charging station, the charging environment, the charging process, the payment process, and support (three to seven

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questions per theme). After cleaning the data from missing values and outliers, the final dataset contained  $n = 401$  evaluated charging stations. We used a cluster analysis to examine the data, based on the cluster variables “light conditions,” “safety,” and “traffic load” (Sauer 2019).

### **Summary of Findings**

We found a cluster solution with  $k = 2$  clusters based on elbow plots (Kaufman and Rousseeuw 2005). Cluster 1 ( $n = 233$ ) mainly consists of charging stations located in the district center/city district. These charging points typically have an obvious signage and barrier-free access, whereby the costs for the charging process are not directly visible at the charging point. Both the usability of operating instructions and the light conditions as well as the safety and traffic load at the charging location range between “very good” and “good.” Cluster 2 ( $n = 168$ ) mostly covers charging stations in the city center/city ring. These charging stations usually do not have any obvious signs and the costs to be paid are not clearly indicated. The criterion of barrier-free accessibility provides a mixed picture: About 50% of the charging stations in this group are barrier-free, whereas the remaining half do not meet this criterion. Overall, the light conditions are “good” in this group. However, the charging stations in cluster 2 have performed below average compared to the overall sample as far as the usability of operating instructions, safety and traffic load is concerned.

### **Key Contributions**

Our study shows that there are still clear potentials for manufacturers of charging infrastructure as well as service providers to improve the customer and user orientation of their offers, especially concerning transparency of charging costs, barrier-free accessibility, and the visibility of the charging stations. Therefore, we are confident that with its findings, this study makes an important contribution to academic literature on charging infrastructure (Philipsen et al. 2015, Philipsen et al. 2016, Will et al. 2016, Zhang et al. 2017, Zhang et al. 2018) from the perspective of the users. It is the first research taking an exploratory look at which performance-types of charging services do exist on European markets—with charging stations in cluster 1 already achieving quite satisfactory results on most factors, and room for improvement on the above mentioned issues for most charging stations in cluster 2. It provides important implications for managerial practice by highlighting these key issues, which should be solved in order to improve the convenience of the charging process for the user and thus to further increase the acceptance of this, with respect to climate change and air pollution, potentially crucial technology.

*References are available on request.*