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

White spots in business and IT: An explorative study for e-mobility services

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Executive Summary

E-mobility services are important enablers for the success of electric vehicles. In contrast to conventional mobility where there is an ecosystem consisting of the vehicle and complementary services which has been built up and improved over decades, the ecosystem for e-mobility is far less advanced and still in its infancy. In order to get on the sustainable path to success on the steadily growing e-mobility market innovative ideas are necessary which are not covered by existing service offerings. This paper therefore describes a study that explores opportunities for innovative e-mobility service business models through a systematic analysis. In addition, each e-mobility service depends on IT support. Therefore, IT standardization is an important issue to build up more complex services on top of basic services and further advance the e-mobility ecosystem. Consequently, this paper presents results from a survey conducted with 27 e-mobility experts to identify necessary standardization gaps in the context of e-mobility services. The paper contributes to the existing body of knowledge by proposing a structured, repeatable method for identifying innovative business models and by offering insights in study results. Furthermore, gaps in the standardization of IT infrastructure important for the provision of existing e-mobility are illustrated.

1 Motivation

Even though the German Government aims for Germany to be the international lead market for electric mobility (e-mobility) until 2020, the diffusion of electric vehicles is still behind its expectations [1]. It seems as technically mature electric vehicles are not enough on their own to promote e-mobility to a broad audience. Looking at conventional mobility based on the traditional combustion engines, it can be seen as a complex ecosystem which contains a product that is linked to a multitude of services (gas stations, insurances, maintenance…) [2]. This ecosystem was built up and improved over decades to the point that drivers don't have to worry about their mobility when using a car. However, this is not the case with e-mobility. To attract e-mobility to a broader audience, an ecosystem for electric vehicles has to be built up that will help potential consumers to overcome their concerns of a lower driving convenience. The most prevalent concerns such as insecurity about the actual driving range or the fear that the utilization of an electric vehicle is more expensive and complex compared to those of conventional vehicles must be tackled to persuade potential consumers to buy or use an electric vehicle [3]. The consumer expectation of equal or even higher driving comfort with electric vehicles requires e-mobility actors to extend existing car-related services and to provide innovative

offerings. Setting up a new mobility system and developing such innovative services requires to identify unexplored fields which are not yet covered by current service offerings. Therefore, the first goal of this paper is to identify "white spots" in the current e-mobility service market, i.e. to identify business models that have a high innovative potential to support the attractiveness of the e-mobility ecosystem. In addition, according to Busse et al. [4] the provision of an e-mobility service often requires a comprehensive IT architecture which makes e-mobility services to IT-based services. IT-systems and interfaces, therefore, play an important role for the mutual exchange and success of the business model and its underlying IT of the correspondent service. One requirement for the development and provision of IT-based services is the foundation in standardized communication and platform formats that enable a consistent basis for service applications. Standardized IT communication formats allow an easy and fast integration of new IT-based services in existing and fast growing market structures as it is the case of e-mobility. As a result, this paper aims to identify and propose yet uncovered communication standardization gaps of IT-based e-mobility services to improve the interplay of existing e-mobility services and to facilitate the integration of new businesses in the market.

2 Business model white spots

First, potential white spots out of a business view are analyzed. Within section 2.1, the methodological approach of finding business model white spots in the field of e-mobility are described. In section 2.2, a selection of the most promising ideas is presented. Those are then evaluated according to their degree of innovation, depending on experts' opinions.

2.1 Methodology

A systematic analysis of existing business models is conducted to identify white spots in the e-mobility services landscape. The analysis is based on the e-mobility service framework proposed in Stryja et al. [5]. The framework enables the holistic description of e-mobility business models considering the specific components and characteristics of e-mobility services, e.g. their value proposition or key resources.

The analysis systematically searches for new, meaningful combinations of these components with the aim of finding new e-mobility services that are not provided today. In this study, the focus is set upon the three central components of the business model being *value proposition*, *key resource* and *key activity,* as depicted in figure 1. This focus is important to handle the complexity of the analysis as it increases drastically with each component ($O(n^2)$).

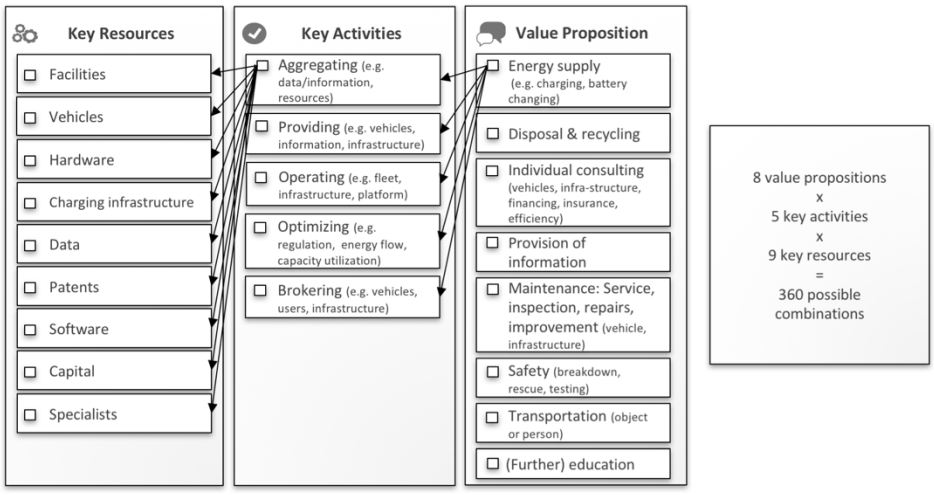

Figure 1: Methodology of business model white spot analysis, based in the e-mobility business model framework

To find unexplored business models, first all characteristics of all three components are combined with each other in a matrix which then contains 360 combinations in total. In the next step, all combinations are checked

through predefined questions concerning their meaningfulness and innovation potential in an expert workshop.

2.2 Selected results

The results of the white spot analysis are several ideas concerning different topics of e-mobility, whereby the top 10 of the most interesting white spots are described in this section ordered according to their value proposition. These results are also depicted in figure 2.

Several white spots can be found related to the value proposition *transport*. For example, as a service provider, it would be possible to act as a "*Uber-Broker"* and therefor to consolidate existing ride-sharing and taxi services digitally and to propose the individual best service to the customer depending on the service's current capacity utilization and the customer's desired destination. Another possible white spot within the area of transport is the "*PoolYourCar"* service, which allows an individual to provide his or her own car to a car pool—e.g. of the same manufacturer—and can then lend it to other individuals when he or she is not using it. This model allows to generate revenue when the car would otherwise not be used. Another example is the service "*ChargingWarranty"*, which allows drivers of electric vehicles to charge their car in a convenient way, precisely the use of charging stations across all operators—independent of their charging contracts. The payment could be made by using standard payment methods—e.g. credit card or PayPal. Another interesting white spot, which we consider rather a research impulse than a service, is the definition of *rules for the future of autonomous (electric) driving*. What happens to the bus, taxi and train drivers, if the future mobility will be characterized by self-driving cars? What safety regulations will be necessary? All these questions have to be clarified.

Three innovative approaches to new services are also discovered concerning the value proposition *maintenance*. One white spot could be the "*PredictivePartFailure"*. In this approach, the vehicle automatically recognizes, by means of sensor data patterns, that a part will soon fail and reports this to the driver. This is possible since fewer parts are installed in a car due to the electrification of the drivetrain and, in addition, a large number of sensors continuously generate measurements ("Internet of Things"). In combination with the white spot "*SmartCarAppointment"*, where the vehicle independently schedules necessary appointments in the workshop in coordination with the owner's calendar, the result is an all-round solution that reduces the driver's cognitive and time-consuming effort. In the event of a breakdown, the vehicle could be supplied and repaired quickly by another autonomous vehicle with the necessary spare parts through the service "*AutonomousRemoteMaintenance"*. This is possible by the automatic exchange of measurements concerning the error.

With regard to the value proposition of *individual consulting*, a service could be conceived, which would utilize data from various sources, e.g., the energy supplier, the Internet of Things, the electric car and other consumption data sources in order to offer an individualized electricity tariff called "*myTariff"*.

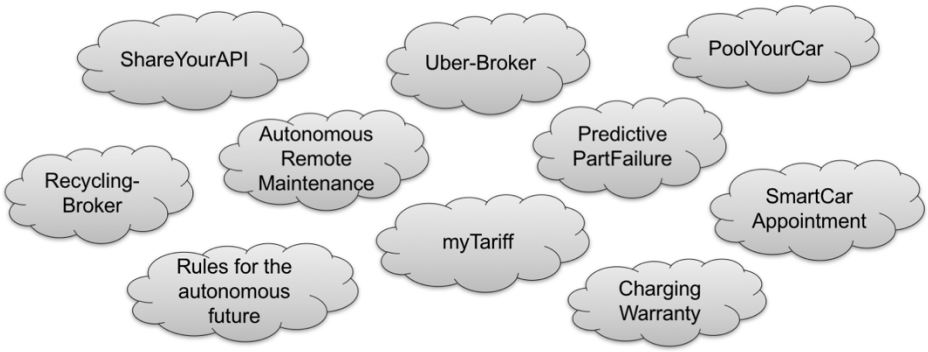

Figure 2: Top 10 identified white spots

A white spot in the area of *disposal and recycling* is the service of a "*Recycling-Broker"*, where the provider acts as a broker for companies with special know-how in recycling batteries or charging stations.

As a central white spot in the field of *energy supply*, the "*ShareYourAPI"* is a service worth mentioning. This service combines the proprietary solutions of different actors (e.g., solar panels, energy networks or the tesla system) to help energy suppliers to balance their network utilization. Apart from these concrete instances of white spots, the analysis has also produced some abstract approaches for white spots with a high potential for innovation.

Especially in the case of services with the value proposition *safety*, numerous exciting project ideas can be identified. The key activities of *aggregating*, *providing* and *optimizing* are helpful, for example, to intelligently and dynamically control traffic lights, to combine accident statistics and error logs in order to detect dangerous trends automatically. These are important foundations for promising new services but it requires additional effort to offer ready-made products. However, some projects (e.g., safetE-Car [6], TÜV Süd [7] or PTV Group [8]) already show first approaches.

Various potentials are also identified within the area of *provision of information*. One example could be the combination of different data sources such as Smart Home and vehicle data, to predict the departure time and to pre-climate the car. To even achieve better prediction results further data such as e.g. weather and traffic conditions could be included. First approaches pointing in this direction can be found at digitalSTROM [9] or BMW ConnectedDrive: Concierge Service [10].

There are numerous other ideas for new innovative services when considering autonomous driving. Examples are virtual fleets, where spontaneously several vehicles can be aggregated to meet the requirements—e.g., the use of several self-driving cars instead of a bus. Another service could be the testing on standardized test tracks of autonomous travel—with the aim of improving the quality.

There are also a few combinations that have emerged from the analysis, which have already been implemented in a similar form and, therefore, have only a medium to low potential for innovation. However, there are also some ideas in this field that are worthy to be included in this paper.

One example is the combination of the value proposition *disposal and recycling* with the key resource *data*, which makes it possible to collect historical data from a battery (e.g., temperature and pressure curves, charge cycles or the age of the battery) to determine the most suitable reuse. A first approach can be found in the project EOL-IS [11].

Another new service in the field of *maintenance* could be a mobile workshop, whereby not only an emergency supply is undertaken, but a complete repair is carried out location-independent. It is, therefore, possible that a customer does not have to drive to a workshop, which is a gain in comfort and convenience.

Another promising idea is the combination of the value proposition *transport* with the key resource *charging infrastructure* to offer a mobility warranty through the intermediation of charging stations. This allows users to charge their car conveniently at charging stations to which they have no access. The user is given a charging warranty by means of a comfortable and secure access system, e.g. mTAN. Thus, a user can check whether all the charging stations, which are visible on a map, can be used conveniently. A prerequisite for this is collaboration of all the operators in that allows the user to easily authenticate.

3 White spots in IT standardization

Information technology is a very important enabler of e-mobility services and standardization is necessary to develop basic services on top of which more complex and sophisticated services can be built on [4, 12]. The second part of the paper is focused on identifying white spots for IT standardization in the context of e-mobility services. Section 3.1 elaborates on the used methodology and section 3.2 presents the most important insights on white spots for IT standardization in the context of e-mobility services.

3.1 Methodology

This analysis is carried out through a study. In an online questionnaire, selected IT decision makers from different start-up and industry companies in the field of e-mobility services share their insights. The participants are asked to state their evaluation of the reality, importance and wishful thinking regarding the

standardization of several IT aspects. The IT aspects are derived from the sub committees and working groups of the International Organization for Standardization (ISO) in field of information technology [13]. At the time of questionnaire design, 17 different working groups were active, which leads to the following aspects. Examples are shown in brackets.

- Sensor technology (no ISO standards published yet)
- Big Data (no ISO standards published yet)
- Internet of Things (no ISO standards yet published)
- Smart cities (no ISO standards published yet)
- Telecommunications and information exchange (e.g., OSI, WSDL)
- Software and system development (e.g., CORBA, UML, SQuaRE)
- Personal identification (e.g., machine readable passports, driving licenses)
- Storage of digital data (e.g., CD-ROM, DVDRAM, BluRay Disk Recordable Erasable)
- Computer graphics and visualization (e.g., PNG, VRML)
- IT security (e.g., Message Authentication Codes, Ciphers)
- Automatic data collection (e.g., OCR, RFID)
- Data management and exchange (e.g., SQL)
- File formats (e.g., OpenDocument formats, OpenOffice Formats, EPUB)
- User interfaces (e.g., keyboard layouts, accessibility)
- Cloud computing (e.g., SOA, DAPS)
- Sustainability in IT (e.g., efficient data centers)
- IT service management (e.g., ITIL, ITES-BPO)

For each of these features, the participant has to answer the three closed questions concerning the reality, importance and wishful thinking through a five-point Likert scale (1 “strongly disagree” to 5 “strongly agree”). In addition, the option "no opinion" is available. Thereby, it could be specified whether an aspect should be standardized or, opposingly, is standardized sufficiently and how important the existing and/or the future standardization is. In addition, desirable standards during the concept phase of the interviewee’s company and his/her position within the company were requested.

The survey takes place in electronic form between September and November 2016. The participants are composed of three groups. In addition to researchers from the e-mobility field, stakeholders from projects registered in the e-mobility-atlas [14] and visitors to the e-mobility fair eMove360° 2016 are participating in the survey.

3.2 Selected results

27 complete questionnaires are analyzed, of which the results are being described below.

Figure 3 shows the results of the data generated by the empirical study. Particularly well-developed are the aspects *storage of digital data* and *computer graphics and visualization* with values above “3.8”. An interesting finding is that in these areas, the coverage in reality is significantly greater than the wishful thinking.

For the aspects *software and system development*, *personal identification* and *sustainability in IT*, the obtained values concerning importance, reality and wishful thinking are very close to each other. This results in promising starting positions for e-mobility services providers, since already sufficient standards are available.

Considering the importance of IT standards, it is seen that the standards of *Internet of Things*, *telecommunication and information exchange* and *IT security* are of particular importance—all reaching values above “4”. The greatest wishful thinking is related to the standards of the *Internet of Things*.

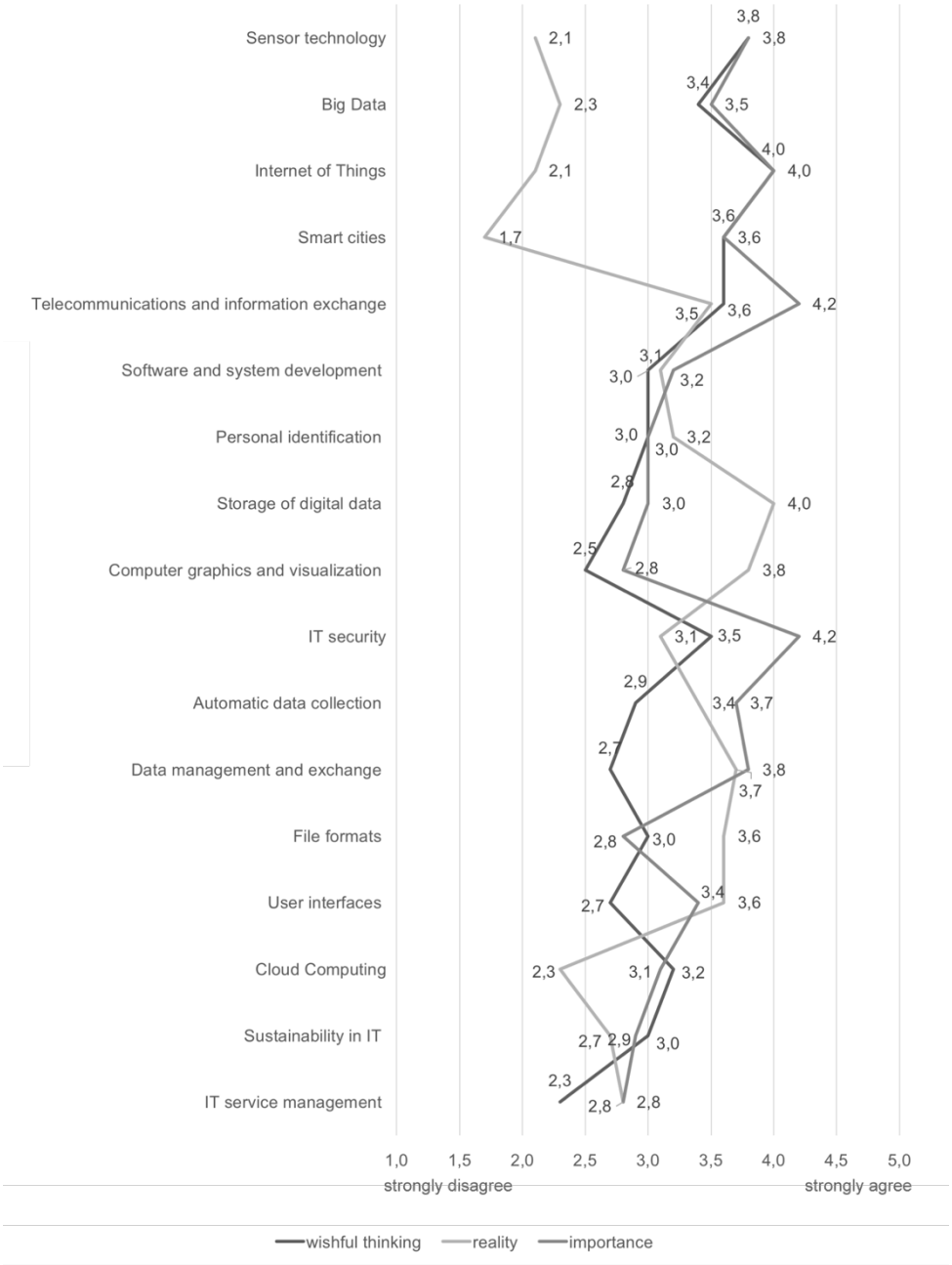

Figure 3: Aggregated Aspects of the IT standards white spot analysis

Furthermore, regarding the aspects *Internet of Things*, *Sensor technology*, *Big Data*, *Smart Cities* and *Cloud computing*, a high deviation between reality and wishful thinking can be observed. These largely negative deviations are an indicator for the most important white spots with regard to IT standards. Particularly the emerging topics have important potential for IT standards.

Mainly in these five areas, the data from this study clearly indicates where researchers and practitioners should focus on IT standardization in the future, in order to also promote service innovation in the area of e-mobility by the IT and thus to increase potential for success.

Another interesting observation is the recognizable discrepancy between a high importance and lower wishful thinking in the area of data management and exchange. This can be explained by the fact that the participants generally regard the IT standards as very important in this area, but they play a rather subordinate role in

their specific case. A similar effect can also be observed with the aspect of *IT security*, whereby even the reality of IT standards is more pronounced than the wishful thinking. It can, therefore, be said in both *data management* and *exchange* as well as in the area of *IT security* that the current state of standardization is even more advanced than the providers of e-mobility services currently expect.

Further important findings come from the open question to the participants, which standards would have been desirable in the concept phase of their respective service.

Due to the variety and heterogeneity of the answers, no clear pattern can be found, but the individual feedback is described. This gives an overview of the retrospective missing standards and shows possible white spots. According to three participants, missing standards come from the field of smart home technologies. In this area, standards are very important to enable different devices and services to communicate with each other. For this reason, it is very important to provide interface standards in the Internet of Things—also for private households in the Home Area Network (HAN). At the moment, this is not the case, since every manufacturer offers his own solutions, so a customer has to decide for a purely proprietary and thus binds himself to a manufacturer. Another white spot originates from the field of charging infrastructure, where participants indicate that the development of a uniform charging infrastructure is not possible due to the low acceptance of the Open Charge Point Protocol (OCPP). Many vendors use proprietary standards or provide incomplete OCPP implementations.

All other answers are very specific or criticize a lack of standardization in the field of e-mobility in general.

Summarizing, it can be said that certain IT aspects are highly standardized, even more than it would be required in the context of e-mobility. On the other hand, there are also areas like the Internet of Things and Smart Cities that have great potential and can be seen as white spots in the IT standardization in the context of e-mobility.

4 Limitations

The applied methods for the determination and analysis of white spots in the field of e-mobility in general and the related IT standardization are only one way of researching white spots. Its main focus is an explorative view of white spots, without the claim of representativeness. Furthermore, the chosen forms of an expert workshop and a survey can show subjectivity in the analysis of innovation potentials. Due to the focus of the expert workshop on a subset of the business model components, no absolute completeness is to be expected. Similarly, the sample size of the survey with regard to expectations and desires in IT standardization is obviously not large enough to be representative and only allows preliminary insights.

5 Conclusion and Outlook

The knowledge of white spots in general, and in the field of e-mobility in specific, offers enormous potential for generating revenue for providers of solutions and services. Not only start-ups, but also established companies can profit with the knowledge of innovative new business areas with high potential. Particularly in relation to the very new field of e-mobility, some new business ideas can be implemented.

Although the results are certainly not complete, they offer a good starting point and promising impulses for the further analysis of innovation potentials in the e-mobility environment. Future research approaches could discover additional white spots through a deeper analysis of the combinations of the framework and, if necessary, uncover further potential for IT standardization.

Acknowledgments

This paper has been written in the context of the research project DELFIN. The DELFIN project is funded by the German Federal Ministry of Education and Research (BMBF) under the promotion sign 02K12A001. The authors also thank the Project Management Agency Karlsruhe (PTKA) for the project support.

References

[1] K. Dudenhöffer, "Why electric vehicles failed," *J. Manag. Control*, vol. 24, no. 2, pp. 95–124, 2013.

[2] C. Stryja, H. Fromm, S. Ried, P. Jochem, and W. Fichtner, "On the Necessity and Nature of E-Mobility Services – Towards a Service Description Framework," *Proc. Int. Conf. Explor. Serv. Sci. 1.5.*, vol. 201, no. Lecture Notes in Business Information Processing, pp. 109–122, 2015.

[3] T. Franke, I. Neumann, F. Bühler, P. Cocron, and J. F. Krems, "Experiencing Range in an Electric Vehicle: Understanding Psychological Barriers," *Appl. Psychol.*, vol. 61, no. 3, pp. 368–391, 2012.

[4] S. Busse, S. Runge, U. Jagstaidt, and L. M. Kolbe, "An Ecosystem Overview and Taxonomy of Electric Vehicle Specific Services," *MKWI Tagungsband*, 2014.

[5] C. Stryja, R. Schüritz, N. Kühl, P. Hottum, and G. Satzger, "Entwicklung eines Frameworks zur Beschreibung von Geschäftsmodellen für Elektromobilitätsdienstleistungen," *9. Int. Energiewirtschaftstagung an der TU Wie*, pp. 1–17, 2015.

[6] D. Beverungen, C. Fabry, W. Ganz, M. Matzner, and G. Satzger, *Dienstleistungsinnovationen für Elektromobilität. Märkte, Geschäftsmodelle, Kooperationen*. Stuttgart: Fraunhofer Verlag, 2015.

[7] TÜV Süd, "Aktive Sicherheit: Fahrerassistenzsysteme." [Online]. Available: http://www.tuev-sued.de/automotive/. [Accessed: 29-Jun-2017].

[8] PTV Group, "Transportplanung, Verkehrsplanung und Verkehrssimulation." [Online]. Available: http://vision-traffic.ptvgroup.com/de/produkte/. [Accessed: 29-Jun-2017].

[9] D. Boennighausen, "Smart Home: Tesla und digitalSTROM vernetzen das Elektroauto," 2015. [Online]. Available: https://www.saving-volt.de/2015/12/smart-home-tesla-und-digitalstrom-vernetzen-das-elektroauto/. [Accessed: 29-Jun-2017].

[10] BMW, "Concierge Service," 2017. [Online]. Available: http://www.bmw.de/de/topics/faszination-bmw/connecteddrive/digital-services/concierge-service.html. [Accessed: 29-Jun-2017].

[11] EOL-IS, "End-Of-Life Solutions für eCar-Batterien – Entwicklung hybrider Leistungsbündel und Informationssysteme zur Entscheidungsunterstützung," 2017. [Online]. Available: http://www.eol-is.de. [Accessed: 29-Jun-2017].

[12] A. Pfeiffer, "E-Mobility 1.0 --- Informationstechnologie für nachhaltige Mobilitätskonzepte," *Wirtschaftsinformatik und Manag.*, vol. 2, no. 2, pp. 18–22, 2010.

[13] International Organization for Standardization and ISO, "ISO/IEC JTC 1 Information technology committies," 2017. [Online]. Available: http://www.iso.org/iso/iso_technical_committee?commid=45020. [Accessed: 16-Feb-2017].

[14] C. Stryja, N. Kühl, and G. Satzger, *Mit Informationstechnologien zu innovativen Dienstleistungen und Geschäftsmodellen in der Elektromobilität: Empirische Studien zu Geschäftsmodellen und IT für Elektromobilitätsdienstleistungen*. Stuttgart: Fraunhofer Verlag, 2017.

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