World Electric Vehicle Journal

MDPI

Article

White Spots in Business and IT: An Explorative Study for E-Mobility Services

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Received: 17 May 2018; Accepted: 19 July 2018; Published: 23 July 2018

Abstract: E-mobility services are important enablers for the success of electric vehicles. In contrast to conventional mobility, where an ecosystem consisting of the vehicle and complementary services has been built up and has 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 in 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 explored opportunities for innovative e-mobility service business models through a systematic analysis. Furthermore, each e-mobility service depends on information technology (IT) support. Therefore, IT standardization is an important issue to consider in order 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 from Germany to help 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 into study results. In addition, gaps in the standardization of IT infrastructure that are important for the provision of existing e-mobility services are illustrated.

Keywords: e-mobility; innovation; service; business model; IT standardization

1. Motivation

Even though the German Government is striving to make Germany the international lead market for electric mobility (e-mobility) by 2020, the distribution of electric vehicles is still behind the government's expectations [1]. It seems that technically mature electric vehicles on their own are not enough to promote e-mobility to a broad audience [2]. Conventional mobility, based on the traditional combustion engine, can be seen as a complex ecosystem which contains a product that is linked to a multitude of services (gas stations, insurance companies, maintenance, etc.) [3]. This ecosystem has been built up and has improved over decades to the point that drivers do not have to worry about most aspects of their mobility (range, fuel availability, maintenance) 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 about a lower driving convenience. The most prevalent concerns, such as the insecurity about the actual driving range or the fear that using an electric vehicle is more expensive (total costs of ownership) and complex compared to using conventional vehicles, must be tackled to persuade potential consumers to buy or use an electric vehicle [4]. The consumer expectation of equal or even higher driving comfort with electric vehicles requires that e-mobility actors extend existing car-related services and provide innovative offerings. Setting up a new mobility system and developing such innovative services require the identification of 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., business models that have a high innovative potential to support the attractiveness of the e-mobility ecosystem. In addition, according to Busse et al. [5], the provision of an e-mobility service often requires a comprehensive IT architecture which transforms e-mobility services into IT-based services. IT systems and interfaces, therefore, play an important role in the mutual exchange and success of the business model and its underlying IT of the corresponding service. One requirement for the development and provision of IT-based services is founded upon standardized communication and platform formats that enable a consistent basis for service applications. Standardized IT communication formats allow for an easy and fast integration of new IT-based services in existing and fast-growing market structures as is the case with 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 into the market.

2. Business Model White Spots

First, potential white spots in a business context are analyzed. Then, in Section 2.1, the methodological approach of finding business model white spots in the field of e-mobility is described. Finally, in Section 2.2, a selection of the most promising ideas is presented. These are then evaluated according to their degree of innovation, depending on experts' opinions.

2.1. Methodology

A systematic analysis of existing business models [6] was conducted to identify white spots in the e-mobility services landscape. The analysis was based on the e-mobility service framework proposed in Stryja et al. [7]. The framework enables the holistic description of e-mobility business models taking into account the specific components and characteristics of e-mobility services, e.g., their value proposition or key resources.

The analysis systematically searched 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 on the three central components of the business model, i.e., value proposition [8], key resource [9] and key activity [10], as depicted in Figure 1. This focus is important to be able to handle the complexity of the analysis, which becomes extremely more complex with each component (O(n^2)).

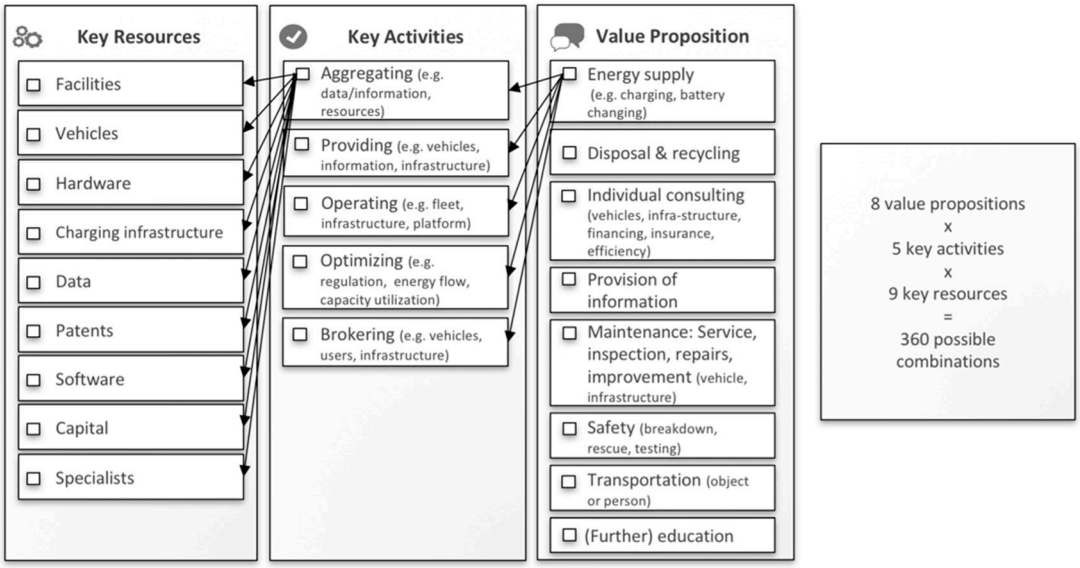

Figure 1. Methodology of business model white spot analysis, based on the e-mobility business model framework.

To find unexplored business models, all characteristics of all three components were first combined with each other in a matrix to produce a total of 360 combinations. In the next step, all combinations were checked against predefined questions concerning their meaningfulness and innovation potential which were asked during an expert workshop conducted with four researchers from the field of e-mobility. The participants then looked for existing businesses based on the combinations and excluded them from the selection. The remaining combinations were analyzed concerning their potential.

2.2. Selected Results

The results of the white spot analysis were several ideas concerning different topics of e-mobility, from which we selected 10 of the most interesting white spots. The top 10 are described in this section and ordered according to their value proposition. These results are depicted in Figure 2.

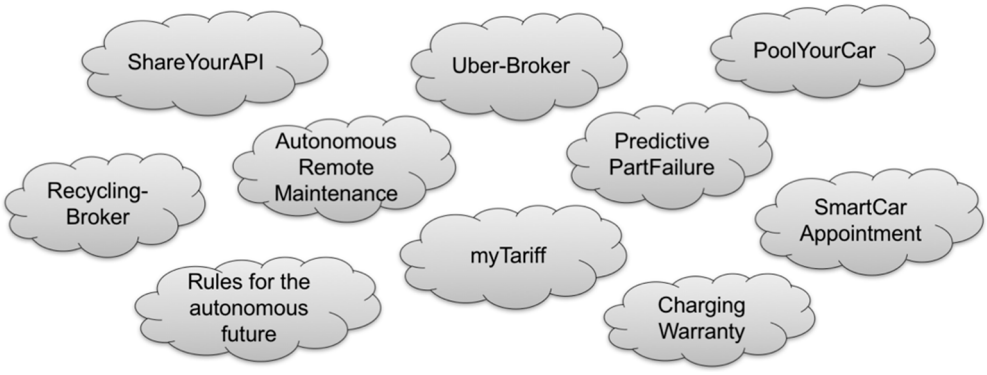

Figure 2. Top 10 identified white spots.

Several white spots can be found related to the value proposition of transportation. For example, as a service provider, it would be possible to act as an "Uber-Broker" and to therefore consolidate existing ride-sharing and taxi services digitally and 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 transportation is the "PoolYourCar" service, which allows individuals to provide their own car to a car pool—e.g., of the same manufacturer—which they can then lend to other individuals when they are not using it. This model allows for revenue generation 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, i.e., by visiting charging stations across all operators—independent of their charging contracts. Payment could be made by using standard payment methods—e.g., credit card or PayPal. Another interesting white spot, which we consider a research catalyst rather than a service, is the work of defining rules for the future of autonomous (electric) driving. What happens to bus, taxi and train drivers, if 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 were also discovered concerning the value proposition of 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; 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 auto shop in coordination with the owner's calendar, the result is an all-around solution that reduces the driver's cognitive effort and saves time. In the event of a breakdown, the vehicle could be supplied with the part and

repaired quickly by another autonomous vehicle having the necessary spare parts through the service "AutonomousRemoteMaintenance". This is made possible by the automatic exchange of measurements concerning the error.

With regard to the value proposition of individual consulting, a service could be conceived that 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".

A white spot in the area of disposal and recycling is the "Recycling-Broker" service, where the provider acts as a broker for companies with special know-how about battery recycling 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. In addition to these concrete instances of white spots, the analysis has also produced some abstract approaches for white spots with a high potential for innovation.

Numerous exciting project ideas can be identified, especially in the case of services with the value proposition of safety. The key activities of aggregating, providing and optimizing are helpful, for example, to intelligently and dynamically control traffic lights and to combine accident statistics and error logs in order to detect dangerous trends automatically. These are important foundations for promising new services, but additional efforts would be required to offer ready-made products. However, some projects (e.g., safetE-Car [11], TÜV Süd [12] or PTV Group [13]) are already showing first approaches.

Various potentials are also identified within the area of provision of information. One example would be the combination of different data sources such as Smart Home and vehicle data, to predict departure time and turn on the car's climate controls. To achieve even better prediction results, further data such as weather and traffic conditions could be included. First approaches pointing in this direction can be found at digitalSTROM [14] or BMW ConnectedDrive: Concierge Service [15].

There are numerous other ideas for new innovative services when considering autonomous driving. Examples are virtual fleets, where several vehicles can be aggregated spontaneously 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 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 of 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 age of the battery) to determine the most suitable reuse. A first approach can be found in the project EOL-IS [16].

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

Another promising idea is the combination of the value proposition of transportation with the key resource of charging infrastructure to offer a mobility warranty through 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 through a user-friendly and secure access system, e.g., mTAN (mobile TAN). 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 among all the operators, allowing the user to easily authenticate the information.

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 [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 methodology used, and Section 3.2 presents the most important insights concerning white spots for IT standardization in the context of e-mobility services.

3.1. Methodology

This analysis was carried out through an expert survey. Selected German IT decision-makers from different start-up and industry companies in the field of e-mobility services shared their insights in an online questionnaire. The participants were asked to evaluate the reality, the importance and any wishful thinking regarding the standardization of several IT aspects. The IT aspects were derived from subcommittees and working groups of the International Organization for Standardization (ISO) in the field of information technology [17]. At the time of the questionnaire design, 17 different working groups were active, which leads to the following aspects. Examples are shown in parentheses.

- Sensor technology (no ISO standards published yet)
- Big Data (no ISO standards published yet)
- Internet of Things (no ISO standards published yet)
- 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, driver's 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 had to answer the three closed questions concerning reality, importance and wishful thinking through a five-point Likert scale (1 "strongly disagree" to 5 "strongly agree"). In addition, the option "no opinion" was available. The participant could therefore specify whether an aspect should be standardized or, on the other hand, was standardized sufficiently and how important the existing or the future standardization was or would be. In addition, the interviewees were questioned about desirable standards that could have been used during the concept phase of their company projects as well as about their position within the company.

The survey took place in electronic form between September and November 2016. The participants were composed of three groups. In addition to researchers from the e-mobility field, stakeholders from projects registered in the e-mobility-atlas [18] and visitors to the e-mobility fair eMove360° 2016 participated in the online survey.

3.2. Selected Results

From the survey, 27 complete questionnaires were analyzed, and the results are described below.

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

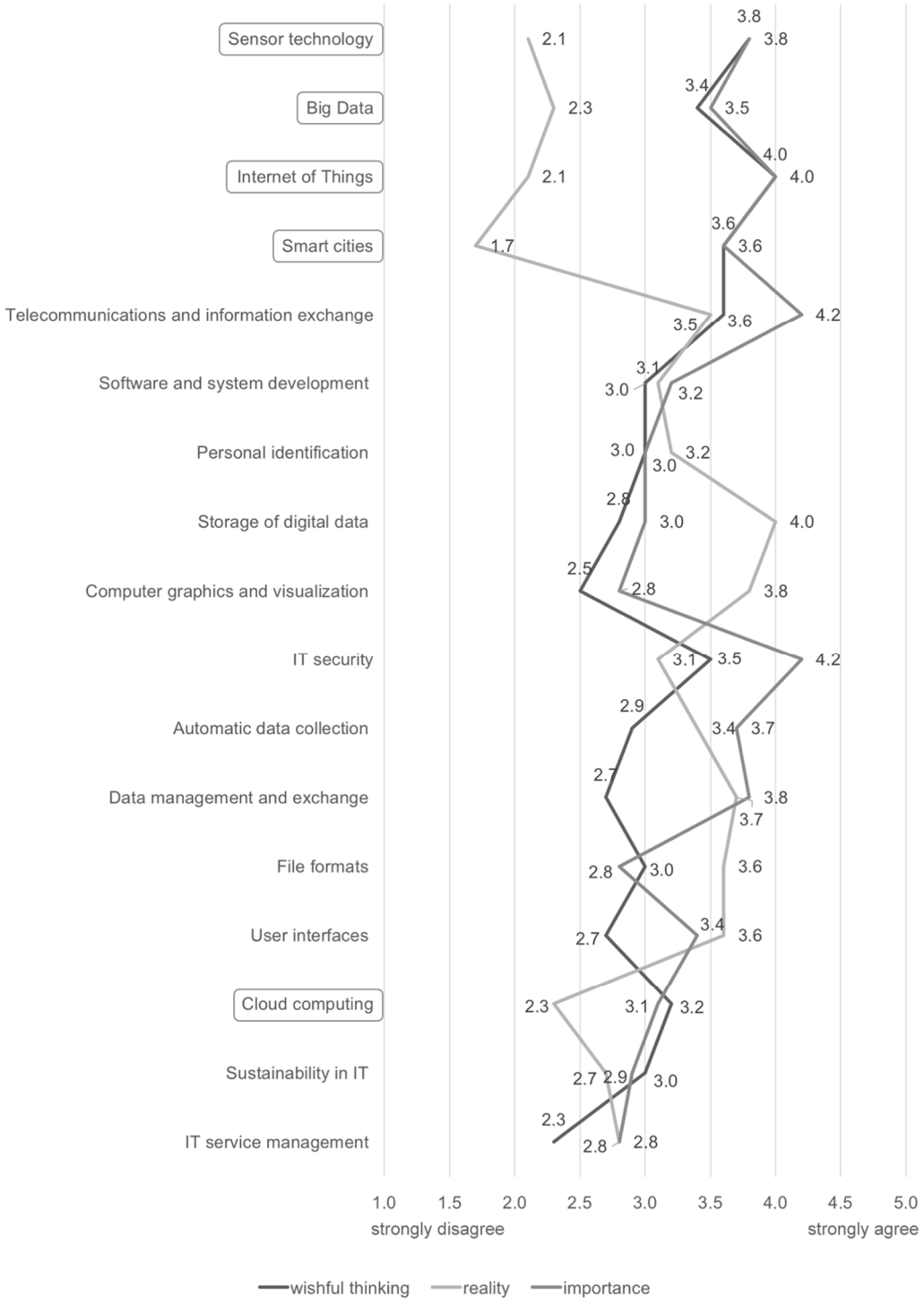

Figure 3. Aggregated aspects of the IT standards white spot analysis.

For the aspects of software and system development, personal identification and sustainability in IT, the values obtained concerning importance, reality and wishful thinking are very close to each other.

Thus, the participants seem to think that standardization exists to an acceptable degree. This results in promising starting positions for e-mobility services providers, since sufficient standards are already available for these aspects.

When considering the importance of IT standards, we see that the standards of Internet of Things, telecommunications and information exchange and IT security are of particular importance—all reaching values of 4 or higher. The greatest wishful thinking is related to the standards of the Internet of Things.

Furthermore, regarding the aspects of 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. More specifically, the emerging topics have important potential for IT standards.

It is mainly in these five areas that the data from this study clearly indicate where researchers and practitioners should focus on IT standardization in the future. They should do so in order to also promote service innovation in the area of e-mobility supported by IT and thus increase potential for success.

Another interesting observation is the recognizable discrepancy between a high importance and a lower wishful thinking in the area of data management and exchange. This can be explained by the fact that the participants regard IT standards in general as very important, but that the standards 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 rated higher than wishful thinking. It can therefore be said that, for both data management and exchange as well as IT security, the current state of standardization is even more advanced than the providers of e-mobility services currently expect.

Other important findings emerged from the open question to the participants concerning standards which would have been desirable during the concept phase of their respective service.

Due to the variety and heterogeneity of the answers, no clear pattern can be found, but individual feedback is described as follows. It gives an overview of the retrospective missing standards and shows possible white spots. According to three participants, there are missing standards in the field of smart home technologies. Standards are very important in this area 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 its own solutions; customers have to decide to obtain a purely proprietary solution, which binds them to a manufacturer. Another white spot originates from the field of charging infrastructure, where participants indicated 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 were very specific or criticized a lack of standardization in the field of e-mobility in general.

In summary, it can be said that certain IT aspects are highly standardized, even more than 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 IT standardization in the context of e-mobility.

4. Limitations

The methods applied for determining and analyzing white spots in the field of e-mobility in general and the related IT standardization are only one way of researching white spots. The main focus was an explorative view of white spots, without any claim of representativeness. Furthermore, the chosen formats of holding an expert workshop and using a survey can show subjectivity in the analysis of innovation potentials. Because the expert workshop focused 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. Conclusions and Outlook

The knowledge of white spots in general, and in the field of e-mobility specifically, offers enormous revenue-generating potential for providers of solutions and services. Not only start-ups, but also established companies can profit from 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 catalysts 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 framework combinations and, if necessary, uncover further potential for IT standardization.

The electrification of the powertrain results in a large number of innovation potentials, since the number of necessary parts in the car decreases. At the same time, more and more components are connected to control units and continuously record driving and utilization data with the help of sensors. Services that can predict an auto part's remaining life span and, using communication interfaces in the car, independently make an appointment in the auto shop, or—if in the case of an accident—can ensure mobility through autonomous remote maintenance, which could be offered as a worry-free package. Thus, IT standardization plays an extremely important role for such use cases, and is therefore essential to make electromobility more attractive.

Author Contributions: Conceptualization, D.M., N.K. and C.S.; Methodology, N.K. and C.S.; Validation, D.M., N.K., C.S. and J.H.; Formal Analysis, N.K. and C.S.; Investigation, D.M., N.K., C.S. and J.H.; Resources, D.M.; Data Curation, D.M., N.K., C.S. and J.H.; Writing-Original Draft Preparation, D.M. and N.K.; Writing-Review & Editing, D.M.; Visualization, D.M.; Supervision, N.K.; Project Administration, N.K.; Funding Acquisition, N.K. and C.S.

Funding: This research was funded by the German Federal Ministry of Education and Research (BMBF) under the promotion sign 02K12A001.

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.

Conflicts of Interest: The authors declare no conflict of interest.

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