LUND UNIVERSITY

Charging Information Services for BEVs – Two Competing and Complementary Business Models

Johansson, Magnus; Deniz, Sinan

2017

Charging Information Services for Market Introduction and Growth Stages of Battery Electric Vehicle Markets

Magnus Johansson[1a], Sinan Deniz[1]

[1]*Standardisation Research Centre, School of Economics and Management, Lund University, PO Box 7080, SE-220 07 Lund*

[a] *magnus.johansson@fek.lu.se*

Abstract

This paper examines information services in association with charging services, and in particular players that offer information services related to charging service offerings from many different operators. It identifies two main types of business models through studying and comparing 25 European charging information service providers. For one type of players the paper analyses the network character and how this is related to the business model. Future implications of European integration, standardization and entry on the two business models, operator information-consolidator and community-based business models, are also discussed. Keywords: EV, charging, market, information, services

1 Introduction

Research on market introduction of electric vehicles (EVs) and supporting infrastructures has focused on configurations within traditional boundaries of vehicles and infrastructures respectively, such as in Bohnsacka et al [1]. One stream of research that recognizes the interplay between infrastructure and EVs has focused on the potential business model benefits of utilizing EVs as energy storage units in relation to power grids. However EVs and charging infrastructure can also be seen as interdependent through indirect network effects [2], as the growth of one of them depends on the availability of the other, often described as a chicken and egg problem. Furthermore, business models based on various levels of control of each side of the network and facilitation of complementarity in different ways can provide different opportunities for market introduction and roll-out [3]. However such interdependence between markets also depends on information provision services that serve to facilitate the interplay between these markets. Of particular importance is how the connected car concept for EVs provides opportunities for optimization of the utilization of battery and drivetrain capacity and charging efficiency. For instance, route optimization services that integrate vehicle

characteristics with available charging network characteristics, real-time charging availability data, geographical data etc. can create value for drivers but also for charging service providers. This paper focuses on information services in association with charging services, and in particular on players offer information services related to charging service offerings of many different operators. In some instances this includes operators that have moved downstream and incorporate information from other operators in a more generic information service offering. Thus, this study has a different focus than those that deal with EV charging network operators (cf. Jerram and Gartner, [4])

The establishment of charging information services is still in its infancy and several different players in the converging EV industry strive to capture a share of the market. Furthermore, value creation and value capture models vary significantly between different players. This study provides an overview of typical business models currently present in the market and then tries to develop a set of scenarios for future development for charging information services. To study the presence of different business models on the European market, data on 23 charging information service providers was gathered, for instance with regard to their way of collecting data to create user

value and their way of generating revenue. The study also presents network structures of formal partnerships between charging information service providers and other players, for instance operators and OEMs. In total, 147 companies are included in the network visualization.

The article also discusses how existing business models relate to how consolidation might take place in Europe given the current geographical fragmentation. The US market is significantly more consolidated by comparison, both with regard to geography and number of players. Another important aspect is how future standardization, either through establishment of de facto standards, or through consensus-based processes can reshape the industry and contribute to the future structure of the industry.

2 Theory

Business models that utilize network effects often center on complementarities between markets and the creation of complementarities. Brandenburger and Nalebuff [3] propose three ways of securing complementarities: First, by forming a buying coalition for the customers. Second, by paying complementors to play. And finally three, by becoming your own complementor and by applying aggressive pricing. The final way of creating complementarities is especially relevant when two markets have to be developed at the same time and with interdependence. Further, they emphasize that complementary markets should not be viewed separately but profitability must consider the full picture, i.e. the markets as a whole.

Closely associated with the idea of complements is the concept of business ecosystems [5]. An ecosystem consists of the focal firm and firms that are critical to the focal firm's business, but normally fall outside of the traditional industry value chain definition. The ecosystem can also include competitors and customers when these influence the development of the firm's products and processes.

Stabell and Fjeldstad 6point to the particular business model where the firm acts as a "mediator" in the ecosystem. The focal firm links parties to each other and organize and facilitate exchange. Firm standards (but also industry standards) provide efficiency through enabling scale across the mediated parties. A typical category of mediators is companies that develop and nurture virtual communities where users can exchange information about companies and their products and services. According to Armstrong and Hagle [7] such communities have five particular characteristics: A distinctive focus, capacity to integrate communication and content, appreciation of user-created content, access to competing publishers and vendors, and a commercial orientation. For companies a key issue is the balance between utilizing the user-generated content and information and the respect towards the members of the community. Furthermore, the firm as an organizer of the community must make sure to nurture the community in order to maintain its members.

In some instances aspects of the virtual community are integrated with the business model of the firm and the value creation. Customers are thus co-producers [8] and help the firm to improve its offerings, its efficiency as well as acting as partial employees (cf. value constellation in Norman and Ramirez [9]). Not least is this relevant in relation to customization of services and products to customer needs.
Service dominant logic – customization
Standardization and platforms

2.1 Digitalization – ecosystem and business model implications

Digitalization is a sociotechnical process of leveraging digitizing techniques to broader social and institutional contexts that provide infrastructural base for digital innovation [10]. One of the challenges that increasing digitalization of innovation processes brings to the innovation management is how actors should organize for innovation [11]. As Benner and Tushman [12] noted the digital innovation may well be challenging the core assumptions of innovation management with introducing the notion of distributed innovation agency. In such context, innovation processes are driven by heterogeneous collection of entities with different motivations. Particularly, these entities are situated in a dynamic environment where a shift in one dimension can trigger a change on another dimension by introducing new goals, constraints, and opportunities, and by calling for new competencies for complementarity [13]. The importance of managing distributed innovation agency becomes apparent in the context of ecosystems [14]. An ecosystem is defined by the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize

[15]. In other words, the underlying unit of analysis of an ecosystem is value proposition and the main concern of the focal firm is to structure the participating distributed agency for an overall value creation effort. In realizing that goal, digital platforms and standards enable the collective action of these distributed agencies [10,16].

2.2 Industry standards, interfaces, modularity, development, innovation and decoupling (market structure)

Industry standards can facilitate market establishment and market growth. Gallagher [17] especially highlights the role of standards as enablers of network effects through providing compatibility. Thus, in this paper we are interested in ecosystems consisting of complementary markets, enabled by standards, resulting in cross-market network effects. However, standards are also interdependent with innovation, and standards can enable but also hinder innovation depending on the stage of development that a market is in [18]. Standards in themselves are not altogether static but can be subject to changes, depending on market and industry characteristics [19]. Therefore, during stages of product technology development, product standards have an opportunity to compete when significant lock-in has not happened yet. Such stages may also require changing a standard thereby contributing to evolution of industry technologies that ensures technological development while maintaining backwards compatibility and user retention [20].

2.3 Standards, core competence & make or buy?

Steinmueller [21] argues that standards play a key role in enabling a supplier industry as well as expanding the pool of potential purchasers by contributing to the pre- and co-requisites of the industry, thus providing a more complex picture of the make or buy problem. However, it also encompasses a trade-off between standardization being firm specific or industry wide, as well as retaining competitive advantage by focusing industry standardization on components or subsystems that are not the prime sources of competitive advantage.

Steinmueller sums up the role of standards and states that "technical compatibility standards have a role in mitigating the negotiation problems that arise when co-specialized assets are created in the division of labour between systems integrators and component and subsystem suppliers."[15] The nature of this role depends on first, the technological opportunities available and thus the pace of technological progress that may make the static arrangement of the standard abundant. Second, the role of the standard in relation to the source of competitive advantage of the firm, third, the size of the pool of purchasers, and fourth the possibility of implementing the standard in relation to the technology in question.

Thus, firm and industry standards can play a key role in forming the industry. This study focuses on players in an emerging ecosystem that try to take mediating positions and capitalize on the creation of network externalities in association with digitalization. The strategies and the business models employed vary in the way that they try to utilize standards and scale effects and through which business model components they try to gain competitive advantage. All of them rely on a specific type of information as part of their business model. However, the way that they generate value based on the information, and for whom, is different, albeit overlapping.

3 Charging information services - Background

The importance of the interrelationship between charging infrastructure and vehicle sales has been discussed for instance by the US Transportation Research Board [22]. The report points to the basic charging needs fulfilled by home charging but also the availability of charging infrastructure in the user's region, not least to ensure range confidence and ensure safety. The report also points to the role of infrastructure in increasing plug-in vehicle value and that further research is needed on infrastructure needs. These interrelate, resulting in cross-market network effects, in the same way as ICE vehicles and petrol stations [23]. The paper also recognizes that the emerging market has the character of a battle of ecosystems resulting from competing standards supported by different players in the industry.

However, alongside the network effects created by compatibility between chargers and EVs, information services are necessary to facilitate charging, optimize driving and ensure optimal utilization of the charging infrastructure. Thus,

information services enhance infrastructure-EV network effects, and thus market growth but they also make up a market of their own which has its own characteristics with its own creation of compatibility, economies of scale and network effects.

4 Data - European information service providers

The study reviews the European market for information services in relation to charging services. It considers major European players or international players with a substantial presence in Europe. In total 25 players are studied with regard to the extent of charging service information provided (such as geographical location, charging standard, service levels, route planner), interface types (webinterface, apps etc), commercial or not-for profit, revenue model, inclusion of roaming and payment systems, geographical coverage, ownership etc. In addition, the study includes seven in-depth interviews with representatives of operators, energy companies, charging information service providers, platform providers and industry alliances.

The study complements this data by insights into a consensus-based standardization organization in order to provide understanding of the potential of standards in creating new interfaces and thus increasing market efficiency. It also includes background insights into the development of the connected car concept and how this affects industry structures.

5 Empirical section

5.1 The role of standards in the EV charging ecosystem – implications for charging information services

The role of standards becomes apparent when relevant stakeholders and potential use cases regarding the vehicle charging have been identified [24]. Issues ranging from charging session authorization to billing, from grid management to charge point management, from roaming to smart charging, address the topic of interoperability among the relevant stakeholders as well as the standardization of various connectors and communication protocols [25]. It has been noted that throughout the history of electric vehicles –

one may argue that we are in the midst of the fifth or sixth wave of the electric's promise [26], the challenge of adequate charging and service facilities never completely was resolved, mainly because of the lack of standardization among relevant stakeholders and "must be concluded to have been one of the factors that caused the ultimate decline in the electric vehicle industry." [27].

Open standards that concern the charging information service providers could be OCHP (Open Clearing House Protocol), OCPI (Open Charge Point Interface Protocol), OICP (Open InterCharge Protocol), eMIP (eMobility Inter-Operation Protocol) [28]. These protocols constitute basis for various use cases for EV charging. From a theoretical point of view, open standards are an effective way to reduce transaction costs among distributed agents and the barriers to entry for entrepreneurial start-ups with resource constraints [29].

5.2 EV charging information service providers

In order to study EV charging information service providers data on such services and their associated organizations was gathered through web searches as well as based on information emerging in in-depth interviews. Also, by looking at adjacent players in the ecosystem further service providers emerged, i.e. a type of snowballing sample. Several of the players originate from dedicated charging map services and have subsequently complemented their offerings by adding apps that provide additional features for mobile usage. In some instances the original charging map service providers utilize the apps of partners. However, this study chooses to focus on the players that are associated with the players that are associated with the data handling and thus must either manage a database or at least some aspects of adding or removing data from the database rather than app designers. There are some exceptions as in some cases (for instance the Norwegian market) a national database is provide upon which services are based. 23 information service providers were identified (see table 1). They are either European players with a significant coverage of charging stations or international players with a rather strong European footprint. The study outlines the characteristics of these players through a number of categories. The "business model"-category primarily covers the way that the service provider gathers data and thus substantiates its services.

"Complementary services" describes if and how the service provider offers other types of services and the character of these. The "revenue model" category tries to identify sources of revenue streams in order to provide insights into how the player captures value from either its information services or its complementary services. Charging information service providers are more or less interrelated with the operators depending on their business model. It is worth noting that this can influence the character of the information services market. For instance, one of the interviewees of this study stated that they believe that charging services would be under strong price pressure in the future, partly due to transparency towards electricity markets in general. Depending on the business model of the information service provider, this may have a significant impact.

Among the information service providers approximately half include a community feature of its business model. In some cases it is limited to an interface where operators as well as users, or others, can submit information on new charging sites. The players that focus more in this type of data gathering method include for instance comments on availability, quality of service etc. In some instances such a setup is combined with the integration of information from partner operators, including data of a real-time character. However, it is apparent that some more strongly community based business models try not to forge formal partnerships, partly because they do not have to as they most often do not include payment clearing services .

An interesting exception from this distinction is the US-based information service provider Plugshare, which is part of the company Recargo which also includes Pluginsights, an infrastructure and EV user data and analysis provider. They provide EV payment clearing services towards operators. But, they do not charge for it and thus do not tap directly into the charging service revenue stream.

Name	BusModel	Complementary services	Revenue model	Ownership	Size(empl) - dedicated to charging information services	GeoCoverage	GeoMarket target (language)	Data exposure (Approx no charging spots, Europe)	App	Website	Origin	Route planner
Ccs-map.eu	Privately created umbrella data aggregator of CCS charging stations	No	Not for profit	Private	Private project	Major parts of Europe	English - limited language use	2500	No	ccs-map.eu	?	No
Chargemap.com	Community. Does not seem to for instance use Laddinfra data. Choice of brand name and registered domains on .com and main EURO top domains seems to attract individuals to add data.	Other services, such as news sites etc but under diffiferent brand names	Free for private users - sign in on certain markets (france) Some sites show up with Logo - probable revenue source A few partners and sponsors with links (i.e. a type of proprietary ads) - Companies, Regional public orgs etc	Saabre SRL	1-10	Focus on Europe Some sites in US Asia, Australia etc	France, UK, Germany, Spain, Netherlands, Portugal	30000	App users must register	chargemap.com	France	No. Not on site and not in app
Chargemaster/polar	Integrator of several operators into its own charging management system	Chargemaster supplies charging equipment and management systems	Probably through adjacent services/businesses	Private	?	UK only through "polar" network	UK focused	Total amount not available	No	polar-network.com/map	UK based	No
Dansk elbilalliance	Aggregator of data from industry organization members.	Generic information about charging and collaborators in chargemap project	Project within Dansk Elbilalliance, no explicit revenue stream from the service	Owned, developed and maintained by Dansk Elbilalliance - industry organization		? Denmark	Denmark	140	No	ladekort.dansk elbilalliance.dk/	Denmark	No
Electrolineras	No info	Information regarding EVs and infrastructure. Product sales/promotion.	Ad revenues	?		? Spain	Spain	377		electrolineras.es	Spain	No
Electromaps	Community + partners	Information services related to electric vehicles, overview of Evs, news etc	Aims to offer a billing system with roaming capability in the future			Major parts of Europe	Spain, Portugal	8000	Yes, Android	electromaps.com	Spain	Yes, in App
EnelDrive	Large operator, integrating other operators' data into its information service.	Mainly in relation to its own services as operator	Part of service as operator	Enel Group		? Italy	Italy	709		www.eneldrive.it/	Italy	No
E-stations	Community/open for charging station information submission. Not for profit. Specified to be independent of corporations or other financing.	Information on Evs, news, car sharing , charging, cost of ownership for EV owners etc, etc	Appears to be ads only currently	Private		3 Major parts of Europe	Germany	13000	Under development and testing	e-stations.de	Germany	Yes

Table 1: Overview of European Charging Information Service Providers

Name	BusModel	Complementary services	Revenue model	Ownership	Size(empl) - dedicated to charging information services	GeoCoverage	GeoMarket target (language)	Data exposure (Approx no charging spots, Europe)	App	Website	Origin	Route planner
E-tankstellen-finder	Submission of new sites open to users i.e. as a community but a substantial amount of corporate partners - i.e. a combination of top-down and bottom-up approaches.	Offers EV and emobility news through a search and filtering function from other sources. Otherwise limited complementary services if excluding KELAG offerings as generic services provider.	Most likely funded byu KELAG and partners - intention to promote e-mobility.	KELAG - energy company. Prject within KELAG business		Europe. focus on central europe, austria, germany, switzerland. Austria prime market.	Germany, UK, Italy, Slovenia, France, Netherlands, Spain, Croatia, Hungary	7500	Android and iPhone	e-tankstellen-finder.com/a t/de/info/mor e	Austria	Web yes,
EVWay	Operator and consolidator	Consulting for business, public organizations	Operator and consulting	?		? Southern/central Europé	Italy, UK, Germany	25000	Android and iPhone	evway.net/it/ mappa.html	Italy	No
Goelectricstations	Station activation and payment clearance Complementary service to charging systems. Community features - easy to add stations and information as user.	Charging management system provider, charging infrastructure. Information on EVs, charging systems etc.	Payment clearance claimed to be in Beta version.	Private		Europe , North America, SE Asia, additional spots globally	UK, Italy (app available in more languages)	Aggregated no of charging points not available	Yes, called "Next Charge"	goelectricsta tions.com	Italy	Yes
Goingelectric	Community	Chargemap only part of a site with news, forum etc on Evs - focus on german speaking markets	Onsite ads. Most likely google ads	Private?		? Europe but main focus Germany	Germany	17000	On Iphone/pad	goingelectric .de	Germany	Route planner webform at
Intercharge	Umbrella data and access providers - thus data and access through collaborations witb suppliers Only Charging spots compatible with intercharge and the Hubject platform (OICP)	IN-app-payment the prime service, via app or charging key	Revenue streams via payment service - payment faciliation via Hubject platform	Owned by HUBJECT who also offers its platform services to other players such as charge and drive. HUBJECT is in turn founded jointly by german OEMs		? Primarily northern Europe	Primarily northern Germany, UK, Spain, France	15000		intercharge.c om	Germany	
Ladestasjoner.no	Based on Norwegian national database (which is indirectly financed by the governemnt).	Services around charging station data to businesses, governmental and other public organizations etc.	Complementary services, ad revenue	Partly organized by Norwegian EV owners association		Nordic countries, especially Norway	Norwegian	2400	Android and iPhone	ladestasjoner .no	Norway	
Lemnet	Community accepting donations, i.e. a type of association whith membership system. Reporting of charging stations via email	Linked to standards development and development of technical solutions and functionality, OPI2020	Association/Donations/Me meberships	Geoservice of Park & Charge Association, including Association with OPI2020, organisation of European Electricity providers dediated tocharging technology and functionality including standards development.		Europe , origin ? central europe ; switzerland etc	Germany, UK, Czech republic, Denmark, Spain, Finland, France, Italy, Poland, Portugal, Sweden, Turkey	21000	Android and Iphone	http://www.l emnet.org/de ?	Czech/German	Yes

Table 1: Overview of European Charging Information Service Providers, continued

Table 1: Overview of European Charging Information Service Providers, continued

Name	BusModel	Complementary services	Revenue model	Ownership	Size(empl) - dedicated to charging information services	GeoCoverage	GeoMarket target (language)	Data exposure (Approx no charging spots, Europe)	App	Website	Origin	Route planner
Openchargemap.org	Community and peer review based - Not for profit, work done by volunteers. Top list of individual contributors.	No	Not for profit, accepts donations	Not for profit. Support from community and variety of businesses and other parties.	?	Worldwide	Multiple world wide	Worldwide: 43000	Android, Iphone, Windows Phone, Firefox OS	openchargemap.org	UK based	No
Oplaadpalen	Partnership model/community - open submission of new charging points	Data and analyses to public sector	Data provider to other players + complementary services	Econovment		Europe, main focus Netherlands	Dutch	30000 (thenewmotion), plugsurfing	Via partners (thenewmotion), plugsurfing	oplaadpalen.nl	Netherlands	Yes
Plugfinder	Community, also provdies data aggregation and maintenance services to operators, local location service providers	To other players such as operators and local information service providers. Through associated companies also charging equipment and consulting services related to e-mobility	Revenue through app sales. Most likely also through complementary services and businesses	TecGadgets	6	Major parts of Europe but majority central Europe	Germany	10000	Android and iPhone	plugfinder.de	Germany	No
Plugshare	Community - user driven data	Payment solution via app (but WO fee) for some networks. Via parent/corporation - Infrastructure analysis services, User/Driver data analysis - based on surveys to users etc.	Through adjacent/complementary services, see Pluginsights.com	Part of recargo. Umbrella org for plugshare and pluginsights. Provides data and analysis of charging infrastructure and EV users.	?	US player w presence in Europé	US/UK/(English)	European aggregate not publically available	Android and iPhone	plugshare.com	US	Yes, on website and in app
Plugsurfing	Umbrella data and access providers data and access through collaborations withb suppliers, Has more charge point data than those compatible with the payment solutions.	IN-app-payment the prime service, app/charging key	Payment service provider, share of payment revenues, charging management services	Private	1-10	Ccentral Europé, Germany, Benelux, Austria, Switzerland, etc	UK, Germany, Netherlands, France	Has more data than those compatible with the payment solutions.	Android and Iphone	plugsurfing.com	Germany	No
Strontankstellen	Information service provider	Information services related to Evs and energy solutions	Advertising	Private	5		Germany	Total amount not available		stromtankstellen.eu	Germany	No
The new motion	Consolidating data provider and access/payment network integrator, thus	Charging card access/payment service, charging equipment provider	Access service provider - fee per access/charging session	Private	?	Major parts of Europe	UK, Germany, Netherlands, France	27000	Android and Iphone	my.thenewmotion.eu	Netherlands	No
Upladdning.nu	Community	Limited	Onsite ads.	Private	2	Nordics, Sweden mainly	Nordic countries mainly	2400	Iph/Andr	uppladdning.nu	Sweden	

5.3 Partnerships – a network analysis

In order to provide further understanding how information service providers integrate data this article also provides an overview of formal partnerships of the focal players of this study. The website of each player in table X was checked for publication of partners and partnerships. Partner organizations where listed and then classified according to their business type. Formal industry classifications were deemed to general to capture details of this emerging industry and thus an assessment of each company had to be done by the authors. The companies were classified according to table Y.

Table 2: Classification of partnership companies (including color coding for network visualization).

Information service provider=Blue
Operator and/or Energy=Red
Roaming/clearance=Green
OEM=Grey
Other=Black
Charging Mgmt and/or equipment=Brown
Generic Maps & navigation=Indigo

In several instances the classification was difficult as several players stretch across different roles in the ecosystem. In order to produce a network visualization a choice had to made. Thus, it should be noted that some of these players can have other roles than the one chosen for the visualization. We then used network visualization for Power BI to produce a network image (see figure Z).

First, it is notable that the three players with the most partners (clearly specified on their websites; Intercharge, Plugsurfing and The new motion) are also ones that try to tap into the revenue stream from charging, i.e. by providing payment clearing services in association with their information services.

Second, the role of the information service providers as consolidators of operator data becomes visible in the network visualization. Although other types of players are interconnected with the information service providers it is clear that they act as hubs for many different operators. However, several operators are also connected to several information service providers. One of the reasons for this is the presence on several different national markets. It is also worth noting the direct partnerships between for instance Plugsurfing and Oplaadpalen. Plugsurfing is based in Germany and Oplaadpalen in the Netherlands.

In the four smaller networks the charging information service providers are primarily based on community business models, with the exception of Dansk Elbilalliance's map service which consolidates three of its operator member's charging station data.

6 Analysis and Conclusions

6.1 Two types of business models

6.1.1 Operator information-consolidation

The market for information services is in an early stage where market positions are far from being finalized. Players cover smaller or larger parts of the value creation and also overlap in many cases. Two generic kinds of business models can be identified. In some cases these are combined.

The first one is the operator consolidation-business model. This business model is based on consolidation of operator data, either through one operator's own platform and/or charging management system or through a dedicated consolidator who buys access to a platform or a charging management system. This type of business model has a number of opportunities and characteristics:

First, it has an opportunity to capture a portion of the revenue stream from payment from charging services. This can be done through the use of a platform for information sharing, roaming and payment and thus serve to handle the interaction between different operators. However, this is likely to require closer association with other players, and as we see in the network analysis, players that integrate payment clearance tend to have more formal partnerships.

Second, capitalizing on such opportunities requires developing or acquiring access to platforms and standardized interfaces for roaming and payment management. Are potential in integrating given to standards and interfaces enables such integration and reporting.

Third, some players combine the development of platforms with the offering of charging management systems to operators and in some instances hardware solutions related to its charging management system.

Fourth, capitalizing on closer data and information exchange setups with operators also requires contractual agreements and thus formal collaborations.

Fifth, Facilitating data and information exchange through standardized interfaces also opens up for closer, more efficient data and information exchange with operators. This provides a potential for integration of real-time data, adding additional value to end-users. However, this also depends on operators' willingness to provide such data.

6.1.2 Community-based

The second business model is the community-based business model. Players representing this model most often emphasize their independence and among them are several not-for-profit projects. Community based models mean that submission to databases are open to anyone and user-data (i.e. drivers/users of EVs) are seen as important sources of data. This does not mean that operators are not welcome to submit their data but users are also seen as highly important as sources of data and information. A few key characteristics can be identified:

First, the benefits of collecting user data related to the infrastructure is that it serves as a complement to operator data and can provide information on the experienced quality of the charging services. It can also serve as a complement to operator data in the sense that when reporting via operator systems fails, users can indicate availability, possibly erroneous equipment and details of how charging is working for a specific station or outlet.

Second, the fact that users themselves provide data can make it more attractive for other users since it provides an operator independent, and thus perhaps more reliable, source of information. Users can also provide additional information if the systems support this, for instance on services adjacent to charging services. As an example, users can recommend cafés, restaurants or other services that can be used during charging.

Third, this type of business model can also through its independence versus operators add data and information provision services to the industry and public organizations on top of its user-oriented services. Recargo is the clearest example where the position as information service provider to end-users has rendered it a position where it is also able to tap into user experiences of charging services. Together with data on the charging infrastructure it makes them an analysis firm based on data on infrastructure as well as user. Thus, having extensive infrastructure data in this case attracts users, which in turn provides an opportunity for gathering user experience data. Not just through existing systems, but also for instance through surveys.

The above two business model types rely on different data consolidation mechanisms. They also rely on different ways of creating value. Although both rely on scale when it comes to number of charging points, they utilize such scale differently. For the prior business model the primary scale of importance is the number of charging points associated with its roaming and payment clearing system. They may also benefit from user generated data for instance regarding usage etc. but the later business model more explicitly rely on this and may have a better position to utilize it due to a clearer independence towards operators.

Although the organizations that apply a community based business models do not include all features of a fully-fledged community model, they must take into consideration to show respect towards the community and thus exploiting both of the business model types outlined in this paper is a balancing act. Therefore, integrating payment services and thus forging closer relationships with operators may be problematic vis-à-vis users that provide information and thus contribute to value creation. An interesting example of a solution to this problem is the US player Plugshare who does provide payment clearance but without a fee. By doing so they limit the risks inherent due to their position as community facilitators and user data gatherers. Thus, they provide payment clearance services for free in order to generate revenue from data provision and analysis, including a wide infrastructure data coverage and user experience data coverage. An interesting effect of this is of course that they might undermine the market for payment clearance for information service providers.

6.2   Future scenarios

What are then the effects of European integration on the presence and position of the above two business model types? Operator-consolidation players have a larger share of established formal partnership that enables the exchange of data sets, which in turn allows for coverage over large geographical areas. The reason for the formal partnerships may be that these players to the larger part are trying to get part of the payment stream coming from the exploitation of charge services. That means not only providing information but also trying to deal with roaming and payment. In turn, community based business models could are likely to have to cover larger areas than single

nation states in order to fully exploit the role of independent information providers to the industry. As the charging infrastructure industry, and operators consolidate and search for scale effects, alongside with increased involvement from the automotive industry, pan-national services are likely to be expected.

What is the role of standardization? An effective and broader standardization of interfaces that also solves roaming and payment processing could potentially blur the boundaries between the two business models as the first is largely based on the utilization of what currently are either commercial platforms or proprietary backward integration towards suppliers of information. That is, if one or a few platforms will have a major impact either as de facto standards or industry standards through consensus processes, it would be easier for all providers of services to integrate operator data. This would reshape the market especially for operator consolidators and lead to easier entry, price competition, perhaps more consolidation across geographical areas, as well as search for other means of differentiation. The way the standards would evolve in the charging information market would impact the business models of the current and future players on three dimensions. First, although European integration is the ideal scenario the local factors such as driving distance, types of the charging network, charging time, and impact to the power network can all have different implications on the development of standards, therefore on the business models of the charging information companies. Second, if the push towards open standards becomes prevalent, we can expect a rise of new entrepreneurial opportunities in the charging information services and therefore the rise of vertically specialized companies [29]. This would in return influence the design of the charging information market with several competing business models. Third, to continue with the open standards, we might expect to see disintegration of traditionally integrated companies, such as utilities, with regards to the increasing digitalization of charging information process.

The interrelation with charging services also poses some very particular threats to the charging information services industry. Some of the interviewed players in this study, particularly those with a clear connection to or with its origins in the energy industry, pointed out that the margins for charging services are likely to eventually become

limited, partly because of market transparency on electricity prices. If the market for charging would get a commodity-character it would also affect those players who rely mainly on the consolidation of operator information as these try to tap into the revenue stream directly related to charging fees.

Another apparent risk for the current players in the market is the entrance of players that provide more general information services. For instance, what will be the future role of Waze, and what role will Here play when fully integrated into for instance the next generation VW EVs?

Acknowledgments

References

[1] Bohnsacka,R ; Pinkseb, J; Kolka, A. 2014. Business models for sustainable technologies: Exploring business model evolution in the case of electric vehicles. Research Policy 43: 284– 300.

[2] Li, Shanjun; Tong, Lang; Xing, Jianwei; Zhou, Yiyi. 2016. The market for electric vehicles: indirect network effects and policy design. Journal of the Association of Environmental and Resource Economists, forthcoming.

[3] Johansson, M 2015. Market Introduction Strategies from the perspective of EV Unit and Charging Network Complementarities - A Study of the Swedish Market. EEVC, Brussels.

[4] Jerram, L; Gartner, J. 2016. Navigant Research Leaderboard Report: EV Charging Network Companies. 2016. Navigant Consulting Inc.

[5] Iansit, M & Levien, R. 2004. Strategy as ecology. Harvard Business Review, 82(3), 68–78.

[6] Stabell, C. B., & Fjeldstad, Ø. D. 1998. Configuring value for competitive advantage: on chains, shops, and networks. Strategic management journal, 413-437.

[7] Armstrong, A & Hagel, J (1997) "Net Gain: Expanding Markets Through Virtual Communities".

[8] Agrawala, AK & Rahmanb, Z. 2015. Roles and Resource Contributions of Customers in Value Co-creation. International Strategic Management Review. 3: 144–160

[9] Normann, R & Ramirez, R. 1993. From value chain to value constellation: Designing interactive strategy. Harvard Business Review, 71 (4): 65–77.

[10] Tilson, D.; Lyytinen, K.; & Sorensen, C., 2010. Research Commentary---Digital Infrastructures: The Missing IS Research Agenda. Information Systems Research, 21(4), pp. 748-759.

[11] Nambisan, S.; Lyytinen, K.; Majchrzak, A.; & Song, M., 2017. Digital Innovation Management: Reinventing Innovation Management Research in a Digital World. MIS Quarterly, 41(1), pp. 223-238.

[12] Benner, M.; & Tushman, M., 2015. Reflections on the 2013 Decade Award—"Exploitation, Exploration, and Process Management: The Productivity Dilemma Revisited" Ten Years Later. Academy of Management Review, 40(4), pp. 497-514.

[13] Lusch, R.; & Nambisan, S., 2015. Service Innovation: A Service-Dominant Logic Perspective. MIS Quarterly, 39(1), pp. 155-176.

[14] Moore, J., 1996. The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems. Harper Collins.

[15] Moore, J., 1996. The Death of Competition: Leadership and Strategy in the Age of Business Ecosystems. Harper Collins.

[16] McIntyre, D.P.; Srinivasan, A., 2017. Networks, Platforms, and Strategy: Emerging Views and Next Steps. Strategic Management Journal, 38(1), pp. 141-160.

[17] Gallagher, S, 2007. The Complementray Role of Dominant Designs and Industry Standards. *IEEE Transactions.* 54(2), pp. 371-379.

[18] R. H. Allen; D. Sriram, 2000. The Role of Standards in Innovation. Technological Forecasting and Social Change 64: 171–181.

[19] T.M. Egyedi,; K. Blind, 2008. General introduction, in Egyedi, T and Blind, K (Eds.) The dynamics of standards. Edward Elgar, Cheltenham UK.

[20] C. Shapiro, H.R. Varian, 1999. The art of standards wars. California management review 41 (2), 8-32.

[21] Steinmueller, W. E. 2003. The role of technical standards in coordinating the division of labour in complex system industries. In The business of system integration. Eds Prencipe, A; Davies, A; Hobday, M. Oxford University Press, New York.

[22] Overcoming Barriers to Deployment of Plug-in Electric Vehicles. Committee on Overcoming Barriers to Electric-Vehicle Deployment; Board on Energy and Environmental Systems; Division on Engineering and Physical Sciences; Transportation Research Board; National Research Council. 204 sidor. 2015.

[23] Eisenmann, T., Parker, G., & Van Alstyne, M. W. 2006. Strategies for two-sided markets. Harvard business review, 84(10), 92.

[24] Brown, S.; Pyke, D.; & Steenhof, P., 2010. Electric Vehicles: The role and importance of standards in an emerging market. Energy Policy, 38, pp. 3797-3806.

[25] Chan, C.C.; Jian, L.; & Tu, D., 2014. Smart Charging of electric vehicles – integration of energy and information. IET Electrical Systems in Transportation. 4(4), pp. 89-96.

[26] Mom. G., 2014. The future of the electric automobile. Society of Automotive Historians Journal. Issue 268, pp. 4-5.

[27] Ebert, R.R., 2017. The Historic Electric Vehicle Industry: The case of Baker and Rauch & Lang. Automotive History Review. Issue 57, pp. 20.

[28] EV Related Protocol Study, Original Study Report, Version 1.1, ELaadNL, 2016.

[29] Funk, J.F.; Luo, J., 2015. Open standards, vertical disintegration and entrepreneurial opportunities: How vertically-specialized firms entered the U.S. semiconductor industry

Authors

Magnus Johansson is a postdoc at the Standardization Research Centre, Lund Institute of Economic Research, Lund University. His research is focused on business model and value creation and capture strategies in association with standards, innovation and network effects.

Sinan Deniz received this MSc in Information Systems from the School of Economics and Management at Lund University, 2013. He is a Ph.D. candidate at the Standardization Research Centre (SRC), Lund Institute of Economic Research. His research interest is focused on platform-oriented businesses in association with standards, interfaces, and architectures.