User involvement in disruptive innovation – A study on users of a light electric vehicle sharing system

Liridona Sopjani, Jenny Janhager Stier, Sofia Ritzén
Department of Machine Design, Royal Institute of Technology KTH, Stockholm, Sweden
liridona@kth.se

***

ABSTRACT
This paper investigates the extent to which user involvement in disruptive innovation influences the users in terms of their experiences when exposed to such innovation for a period of time. The study is conducted in an on-going research project undertaken in collaboration with academia and private stakeholders, which is developing and implementing a product-service system for light electric vehicles. This solution is environmentally driven and new in two ways: it integrates a different type of vehicle and introduces a new service concept i.e. the caretaker concept. The users are studied while they interact with the innovation in their own environments, where emphasis has been placed on the experiences of these users when disruptive innovations as such are introduced into their everyday life. Data from the first seven users (caretakers) were collected through a survey and semi-structured interviews over two periods of time, from which early user characteristics are presented and user experiences when deploying disruptive innovations, as well as enablers and barriers for integrating these into daily life. As disruptive innovations tend to redefine or restructure market trajectories to some extent, understanding these user segments and their experienced enablers and barriers may facilitate the creation of better strategies on how to make these innovations more desirable for society at large. Findings suggest that user involvement positively influences users experiences toward adapting to new ideas with regards to mobility.

INTRODUCTION

With the urgency of environmental issues such as CO_2 emissions, there is a growing need to move the innovation trajectory toward sustainability (Hekkert el al., 2007). This trajectory points to not only new technologies but also systems of products and services where more disruptive innovations are to be required, as seen e.g. in transport industries (Pinkse, Bohnsack, & Kolk, 2014). Electric, hybrid, and fuel-cell vehicles are emerging in the market and expected to be mainstream technologies in the near future, however, with a low market share currently. In parallel, service solutions that integrate these vehicles, known as car sharing, become even more interesting from a sustainability perspective (Luè et al., 2012; Shaheen and Cohen, 2007), further increasing the level of disruptiveness of offers to the market with new user behavior requirements. Light electric vehicles (LEVs) and particularly small battery electric vehicles are seen as disruptive innovations in the transportation technology (Lorentz et al., 2015; Hardman, Steinberger-Wilckens & van der Horst, 2013; Rezvani et al., 2015). They are considered as disruptive both in terms of technology and the market. They are technologically different from incumbents (internal combustion engine-ICEs) and require different infrastructure, whereas from a market point of view they pose different behavioral demands on consumers i.e. charging the battery, planning of trips ahead due to limited range, limited size, and other product attributes. In general, electric vehicles currently do not satisfy the requirements of performance on the mainstream gasoline and diesel market, therefore cannot compete in such market (Lorentz et al., 2015). Scholars assert that it is yet unclear as to what market EVs will

be precisely positioned but it is rather certain that the EV market cannot be found in an established automobile market segment (Lorentz et al., 2015). On the other hand, the concept of car sharing may relate to disruption as well from the user point of view in the sense that it proposes a change of a long-lived social norm – car ownership (Sopjani, 2015). Katzev (2003, p. 68) suggests that "car sharing divorces the notion of automobile use from ownership by providing individuals with convenient access to a shared fleet of vehicles, rather than a single privately owned one." Moving society from ownership, to use or access based consumption is attractive for sustainability, for instance curbing traffic congestion, pollution, and long term economic costs for individuals among others (Firnkorn and Müller, 2011; Huwer, 2004), though, achieving this is rather challenging in the current mindset and consumption practices of society at large. New behaviors and lifestyles are arguably necessary for such ideas to be embodied in society.

Positioning this within the theoretical framework of disruptive innovation (Christensen and Bower, 1996) requires extended understanding of other dimensions beyond developing the technology, oriented toward the demand side. An increased focus on users regarding new systems of products and services may bring us forward into understanding how disruptive innovations that benefit society and environment in terms of products and services can become commercially attractive to large segments of customers at an accelerated pace. While innovation literature has suggested that involving users at different stages of innovation development brings positive outcomes i.e. higher acceptance, improved solutions, and reduced uncertainty (Bano and Zowghi, 2014) for new solutions, it remains less known as to how this involvement may affect users themselves. Therefore, the purpose of this paper is to investigate the extent to which user involvement in innovation affects users and how insights on users' experiences can contribute to our understanding of making disruptive innovations more desirable for society at large. The study is conducted in an on-going research project undertaken in collaboration with academia and private stakeholders, which is developing and implementing a product-service system for LEVs.

The paper contributes by extending further the knowledge in disruptive innovation beyond the firm dimension while looking into customers and learning about their experiences when exposed to disruptive innovation. Second, it builds further knowledge on the insights that firms need to acquire about users when developing and commercializing disruptive innovations, and how these insights can add valuable input in bringing those technologies closer to the mainstream markets at an accelerated rate. Finally, it provides practical insights into the current debate about collaborative projects with users as key stakeholders through experimenting in real life environments as an approach to both knowledge acquisition for the firms in one side, and user behavior change on the other. Initially, we briefly introduce the context of the research and empirical study, where we describe the research project setup and the disruptive innovation focus in terms of the industry and the type of product and service being investigated. The second section dives into the theoretical construct of disruptive innovation, where we narrow onto the demand and market side of disruptive innovation and relate this theory to the user involvement framework. The third part presents the method used in the study following the results, where we present findings from the research project. Finally, we discuss the main findings and

the implications these findings may entail. In the end, the paper draws conclusions from which further research in the topic may be put forward.

LEV-pool PROJECT

LEV-pool project is a collaborative project between Integrated Transport Research Lab (ITRL), a research center at the Royal Institute of Technology (KTH), and several large and small size firms in a joint effort to design, implement, and test an innovative approach to mobility. The collaborative project is conducting experiments in real-world user contexts, where a product-service system (PSS) is introduced in two large workplaces, as a new mobility alternative for the employees, particularly for short trips in-between offices and commutes to and from work. The project integrates a LEV, a new two passenger battery electric vehicles (Twizy) –developed by carmaker Renault and released first in 2012 in France, and offers these vehicles as a mobility service in the form of carpool. In these experiments, users are studied in their environments such as at workplace and home while being involved in the development of the solution. The research experiments are set out in two different geographical contexts and settings. One of the experiment sites is in a small city in Sweden, where a large workplace is situated with approximately 6000 employees, which basically constitute a large majority of inhabitants in that area. The second site is a suburban region of Stockholm, where the experiment is being conducted in the municipality as the workplace with similar number of employees as the first site.

The LEV-pool system is a car sharing service (Shaheen et al. 2004), but is new in the sense that it integrates a much different type of vehicle (in terms of design, performance, and functionality) with a different service concept i.e. the caretaker concept, which is the focus of this paper. A fleet of seven vehicles is running throughout six departments in one of the workplaces, and a fleet of three vehicles will be running in the second site among three departments. From a user perspective, this is a completely new proposition to how they move because the fleet of vehicles is partly co-owned with the caretakers –users who take care of charging and maintenance based on rental agreements. Here, we can relate the PSS more in terms of its use and business model, where reaching maximum efficiency and effectiveness have been thought as primary objectives with regards to value addition both for the business and the environment as well. This has been done by designing a use model that ensures high occupancy rate of vehicles throughout the whole day while catering to various users and their needs simultaneously as opposed to leaving private cars standing idle throughout the day.

In each of the sites, the experiment has been set out as an alternative solution for the mobility needs of the employees, whereby through registration in the project, employees can become users. Here the project has categorized the system in two sets of users: daytime users and morning/evening weekend users, i.e. the caretakers. The daytime users can be any of the employees from the departments contracted by the project, who can book the service on a short notice or planned travel in advance. Whereas the caretakers have gone through an application process and selected based on certain criteria. This is the set of users where the project has made deliberate ‘intervention’, whereby users have agreed to co-own the vehicles to use privately for their needs after work and during weekends. In return, they are assigned to bring the vehicle to work every morning and take it back after work, charge and maintain cleanliness of the vehicle. In this way, this group of users is pushed to commute to

work with a different means other than the private fossil fuel car that they own. Throughout the study, in one hand, referring to the user involvement methodologies, the users are seen as active co-creators (Svensson, Eriksson, & Ståhlbröst, 2009) being involved in the process contributing with their feedback and input, and on the other hand, they are passive (in Almirall, Lee & Wareham, 2012) because we are studying how this involvement affects their experiences when they are exposed to disruptive changes in their everyday life context. In this paper, we focus our analysis in the testing period at one site and on one of the sets of users, as mentioned before, the caretakers.

The project is taking a user-centered approach (Daae and Boks, 2014) in developing the mobility alternative following an iterative cycle in designing and improving the PSS similar to the newly observed open innovation approaches such as living labs (Almirall, Lee & Wareham, 2012; Bergvall-Kåreborn et al. 2009; European Commission, 2009; Svensson et al., 2009). It is based on three-phases methodology, which began with a pre-study of the context and users' travel behavior and needs to support idea generation, then followed a development phase where the service and the product were emerged into a product-service system design in which each stakeholder from the project brought different expertise and competences. The third phase is following a testing period through which users are exposed to the idea for a longer period, allowing them to interact and get accustomed with the PSS, while being encouraged to reflect throughout the whole study. This third phase can be interpreted as form of a deliberate 'intervention' because a certain groups of individuals are provided with a different means to commute to and from work. Users' feedback from such intervention is then taken into the iterative cycles of PSS development as input for improvement of the offering in a similar study setup conducted by Hesselgren, Hasselqvist, and Eriksson (2015). The experiments are conducted throughout a period of one year in both sites with different set of users in every six months so that a deeper understanding of diverse users is captured.

THEORETICAL EXPOSITION

Our study can be related to disruptive innovation theory and user involvement, which have had a significant influence on research in the fields of user-producer relationships as critical to the success of innovations, and particularly innovations that are disruptive both from a technological standpoint but also from a social point of view.

Disruptive Innovation –The user of disruptive innovations

To maintain competitiveness firms cannot afford only incremental innovation, rather, they need to generate new markets through more disruptive innovations simultaneously (Paap and Katz, 2004). Such innovations shift market structures and require user learning as they often induce significant behavior changes on users too (Urban et al., 1996). However, disruptive innovations are not always the firms' least concern because developing these innovations is a huge challenge. Over time, the basis of competitive advantage changes and considering that technical and market information are both imperative in the innovation process Paap and Katz (2004) mention two implications. They assert that either pioneering companies fail to detect changes in the technologies or the leaders of these firms fail to detect changes in consumer needs and/or market conditions. Technologies, and later referred to innovations, 'which disrupt an established trajectory of performance improvement, or

redefine what performance means, are referred to as disruptive technologies' (Christensen, 1997, 2006; Christensen and Bower 1996; Christensen and Raynor 2003). In line with Abernathy and Clark (1985), Adner (2002), Christensen (1997), Christensen and Bower (1996), Charitou and Markides (2003), Christensen and Raynor (2003), Gilbert (2003), and Govindarajan and Kopalle (2006), these innovations introduce a different set of features and performance attributes relative to the existing products, which are not so attractive to mainstream customers in the beginning. They "initially provide different values from mainstream technologies and are initially inferior to mainstream technologies along the dimension of performance that are most important to mainstream customers" (Adner 2002, p. 668). Here disruption not necessarily refers to the technology per se; rather it describes the effect of these technologies on markets that are based on technology innovation (Paap and Katz, 2004). This market disruption occurs when the new product has displaced the mainstream product in the mainstream market despite its inferior performance on focal attributes, which are valued by the existing customers (Yu and Hang, 2010). Nevertheless, literature notes two preconditions for such market to occur: "overshoot on the focal mainstream attributes of the existing product, and the asymmetric incentives between existing healthy business and potential disruptive business" (Yu and Hang, 2010). The theory further distinguishes between low-end and new-market disruptive innovations (Christensen and Raynor, 2003). While the low-end disruptions are considered those that target the least-profitable and most over-served customers at the end of the original value network, new-market disruptions create a new value network, where it is the non-consumption, not the incumbent, which must be overcome (Christensen and Raynor, 2003). As such, 'addressing these technologies requires changes in strategy in order to attack a very different market' (Christensen and Bower, 1996). Based on the assumptions that such innovations attract fairly different customer segments at the time of their introduction, Govindarajan and Kopalle (2006) saw as relevant to distinguish this different (or niche) segment from the framework of 'early adopter segment' for instance as observed in the diffusion of innovation research. They argue that those finding a disruptive innovation attractive are distinct from the early adopters because among others, they are typically more price sensitive than the rest of the market and are not seen as those that can influence the rest of the mainstream market. Only a number of forward-looking customers will be attracted to them in the entry phase (Christensen and Bower, 1996). Subsequently, implications arise in terms of the dilemmas that disruptive innovations create, of which two are critical. One is the disruptive innovation being ignored due to their lower margin offering and the continuation of incumbents to serve larger and more attractive segments. The other is the difficulty of these innovations to reach mainstream markets because of the different value offered than the mainstream products or services (Govindarajan and Kopalle, 2006). These implications therefore may impede or inhibit firms to pursue such innovations because firms will perceive it too difficult to succeed even when innovations are technologically straightforward (Christensen and Bower, 1997). With regards to sustainability, where more fundamental changes are required both in terms of technology innovation and customer behavior, this can have serious implications. In the case of electric vehicles, for instance, the slow movement into mainstream markets may indicate that carbon emissions reduction may take much longer than aimed. In addition, the smaller the user segment, the lower are the expectations that these technologies may be further improved to penetrate mainstream markets, therefore enhancing the possibility to create a vicious rather than a virtuous cycle of change.

In such considerations, the market side or demand side for disruptive innovation is therefore a crucial factor in the development and acceleration of these types of innovations. Paap and Katz (2004) among others have proposed that firms shall not ignore the customers, both current and potential, even though this perspective was at first neglected in the theoretical assumptions of disruptive innovation. Yu and Hang (2010) in their review of disruptive innovation theory research noted that among the enablers of successful implementation of disruptive innovation, the external perspective i.e. the context and environment and the customer orientation under disruptive change are relevant. Paap and Katz (2004) and Daneels (2004) proposed that focusing on what is happening with the customer and operational needs is key to avoiding negative effects of disruptive technologies. Literature from different research domains has emphasized the role of the demand side in bringing valuable knowledge into innovation. Though, there has been little explicit identification of R&D strategies to the creation of these type of innovations, remaining thus a less explored research arena. Focusing on the market related aspects, a key competence is involving the 'right' users at the 'right' time in the 'right form' where firms shall be able to identify which users may contribute throughout the different phases of the innovation process and how to interact with them (Lettl, 2007). The high market uncertainty of disruptive innovations arguably requires firms to involve users as a crucial source of market related knowledge (Lettl, 2007). And, because disruptive innovations theoretically attract only a margin of customers that are totally different from mainstream markets (Christensen and Brown, 1996; Daneels, 2004, Markides, 2006), it is important to understand the characteristics of these users and their differences from mainstream customers. To make these innovations reach mainstream markets at an accelerated pace, understanding these can be fruitful in terms of making these innovations appealing to a larger user segment and facilitate the adoption process. How users are affected when they are exposed to disruptive ideas that fundamentally require or enact changes in their everyday life is crucial for firms that want to engage in such innovation. User knowledge can be a huge source for both development and diffusion of innovations (Daneels, 2002; Ives and Olson, 1984; Rose, 2001). Users are often attributed a cardinal role in new product and service development and success, and researchers acknowledge the need for new ways of integrating this aspect into the innovation (in Traitler et al., 2011). Driven by the assumption that knowledge about users is beneficial to firm innovation capabilities (Daneels, 2002), there is much research devoted to identifying user needs rather than identifying other underlying dimensions that may serve impetus for disruptive and radical innovation for instance such as how user involvement in the innovation process affects users, subsequently their willingness to adopt or adapt to disruptive ideas.

User Involvement in Innovation

A user "is someone who would be actually using the system and her/his work and environment in some way would be effected by the system" (Bano and Zowghi, 2014, p. 149). In this paper we adopt this conceptual definition of users. 'Involvement' has been inconsistently used in literature and stands in between 'participation' and 'engagement' but which are quite dependent on the techniques and methods used in the process (Bano and Zowghi, 2014). One of the more clear distinctions between user involvement and user participation has been provided by Barki and Hartwick (1989, p.53) defining it as ''a subjective psychological state reflecting the importance

and personal relevance of a system to the user'' whereas user participation as ''a set of behaviors or activities performed by users in the system development process''. 'Engagement' on the other hand has been used synonymously with the above two. In this paper, we are oriented toward the involvement perspective as the interest is to see how an innovation is brought into the users everyday life and how the users embody it in their everyday situations.

The theoretical construct for user involvement has far been based on the assumptions that success of systems is highly dependent on users being involved in the design and throughout implementation in the innovation process (Alam, 2002; Gales and Mansour-Cole, 1995; Kujala, 2003). However, the primary focus of users being involved from an innovation perspective has been to identify sources of innovation where users have been placed a cardinal role as von Hippel's seminal work has shown (1976, 1977a, 1997b, 1988). The discussions have often concluded purely economic incentives to be large motives for engaging users in the innovation process, although, such interactions have been useful and beneficial in other aspects as well (Gales & Mansour-Cole, 1995, 1995). Involving users in the innovation process may reduce uncertainty by allowing a more accurate picture of user requirements (Ives and Olson, 1984) and result in more successful implementation (ibid.). User involvement benefits firms in a way that reduces marketing and R&D, accelerates diffusion by providing an initial user and aids implementation of new technologies (cf. Gales and Mansour-Cole, 1995). Scholars note that inability to consider users' constraints and requirements in innovation can negatively affect commercialization later (in Gales and Mansour-Cole, 1995). Lettl (2007) found that close interaction of firms with specific users has positive influence in their radical innovation work. On the other hand, scholars have also argued that in the context of development processes, user input may be not as necessary because of the users' limited ability to bring insights into the process (in Alam, 2002). This can be due to the characteristics of radical or disruptive innovation for instance, which face firms with severe challenges when involving users in the process (Lettl, 2007). Evaluating concepts and prototypes of radical or disruptive innovations when no reference exists can be a difficult task for users; therefore, their input may be limited (ibid.).

There is an overarching consensus in research that in depth understanding of user needs and requirements is crucial to maintain competitiveness through new products and services (Alam, 2002; Bano and Zowghi, 2014; in Magnusson, Matthing, & Kristensson, 2003). Nevertheless, in much of literature, user involvement has mainly been focused into the outcomes that it brings centered on the system performance when users interact with it (Bano and Zowghi, 2014). Namely two classes of outcome variables have been the focus: system quality and system acceptance (Blake and Olson, 1984; Baroudi, Olson, & Blake, 1986), which are operationalized in terms of usage, user attitudes, and user information satisfaction (Baroudi, Olson, & Blake, 1986). Within these classes of outcomes, however, two variables may act as Blake and Olson (1984) put 'intervening mechanisms': cognitive factors and motivational factors, which could bring fruitful information beyond user input toward improving the system. The cognitive factors include improved understanding of the system, improved assessment of system needs, and improved valuation of system features whereas motivational factors include increasing user perceived ownership of the system, decreasing resistance to change, and increasing commitment to the new system (Blake and Olson, 2984, p. 590). Although these studies have emphasized the

benefit of involving users in the process for the sake of implementing successful innovations, these important underlying cognitive and motivational characteristics of individuals affected by the changes have been neglected (ibid.). There are few studies however, that have addressed changes in user behavior or attitudes (see Alter 1978; Edstrom 1977; Franz, 1979; Ives and Olson, 1980; Marsh 1979). These studies have focused primarily on outcome variables such as user information satisfaction, which has been relatively a measure of both system quality and system acceptance (Gales and Mansour-Cole, 1995; Ives and Olson, 1984). A logical conclusion can be made that the focus has been predominantly toward how much users' involvement can bring to the innovation process, but not vice versa.

Research on how user involvement affects users is stretched among different streams of research and there is not much explicit focus in this dimension of user involvement. Among the few articles, one that has addressed this is Rohracher (2003) who studied how a specific category of end users is involved in shaping environmental technologies, how these end users develop practices of using and valuing these technologies and how this socio-technical embedding feeds back into the design of these products. He concluded that the way users appropriate technologies and integrate them into daily practice while making sense of them plays a crucial role in the early phase of diffusion when technologies are still characterized by a degree of malleability. Urban et al. (1996, p.443) postulate "individuals who are active in the system development process are quite likely to develop beliefs that the system is both important and personally relevant, and the feeling that the system is good".

RESEARCH QUESTIONS

As such, user involvement may expand beyond user input as a valuable external source solely into the innovation process (Chesbrough, 2006; von Hippel, 2005) in terms of reducing uncertainty about the technology being developed. Rather, our understanding can be extended toward how involvement can facilitate transition of user practices by learning about these users more in depth. User involvement from the perspective of users and how they are affected by the new technology in their daily life environments may be relevant for the R&D and market related capabilities of firms (Daneels, 2002; Lettl, 2007; Urban et al. 1996). Particularly for some products and services that revolutionize product categories or define new categories, this knowledge is paramount since they shift market structures, represent new technologies, require consumer learning, and induce behavior changes (Urban et al. 1996). As disruptive innovations tend to redefine or restructure market trajectories to some extent, understanding these user segments and their experienced enablers and barriers that may facilitate or inhibit adoption from mainstream users is critical. Why these innovations are appealing to non-mainstream customers in the beginning and how this trajectory changes over time brings into surface the need for looking at the different user segments more in-depth, their characteristics, and lifestyles. Therefore, the following research questions have emerged:

What are the characteristics of the users when deploying a sustainability driven disruptive innovation?

What are the experiences of users when deploying a disruptive innovation?

Which enablers and barriers can be derived from users' experiences?

METHOD

In this paper we investigate how user involvement in innovation projects is affecting users when they are introduced to a disruptive innovation. To answer the research questions, data from the first period of testing the new PSS in the LEV-pool project has been gathered using a mixed-method approach (Creswell, 2003), this in order to gain sufficient user insights both from qualitative and quantitative data. The main focus is on qualitative research methods as the study intends to obtain deeper understanding of experiences in users' everyday life as they interact with the PSS for a period of time, which is complemented by the quantitative data obtained on a daily basis from logbooks inserted in all vehicles, and with surveys regarding background data and knowledge, attitudes and interest in matters of concern to the PSS. For the test phase in the project, users have been recruited to become the so-called "caretakers". These users had to meet certain criteria mainly relating to the practical matters such as being able to charge the vehicle at home, maintain it, and bring it to work and take it back, as well as be able to pay a small monthly fee for co-owning it. The study intentionally did not bring out more criteria in terms of the user characteristics since it was imperative to see which users find the solution appealing first. The first seven users who applied were also selected to become caretakers for the seven respective vehicles. Upon selection, the research team had an introductory meeting describing the whole project to these seven users and signed contracts with them to participate in the project. Then, prior to start, a survey was given for completion to each user (n=7). The survey was designed to understand patterns of early users of the system and identify the characteristics of these users. The data was compiled and based on the recurring characteristics found in each user, through which a model of early user profile is generated. This technique is generally adopted in user-centered design studies, where in-depth user profiles are generated from gathering of user insights (Parker and Heapy, 2006; Stickdorn and Schneider, 2010; Teixeira et al., 2013). The semi-structured interviews were conducted in two time periods before the start of the testing (7 interviews) and after one month of testing (7 interviews). The first round of interviews was focused on understanding motivations and expectations about the solution prior to use and the expected challenges and benefits from the system. The second interview was more focused on tangible and intangible factors related to the solution after users were exposed to the PSS for a period of time. The interest was to see both how the solution has worked in practice and how it has affected the users after switching to a different mobility alternative. All of these data were then compiled, coded, and categorized as themes emerged from the data sets (Silverman, 2011). Since the study is not strictly looking at one dimension of user involvement, emerging themes are relevant and may support understanding of previously unexplored variables (Silverman, 2011). From the survey, four categories were used for preliminary data collection, which gave an overview of the early user characteristics. Sequentially, the variables investigated in each category lead to the structuring of the following interview questions allowing for a more in-depth exploration. However, the interviews were semi-structured in order to capture the users' views and thoughts, whereby the data sets revealed new themes and patterns. The intended categories together with the emerging themes helped in constructing the data analysis as suggested by Silverman (2011).

RESULTS

Survey and interviews have been used in a mixed method approach as described above and in the following, results from the different data sources will be presented separately. The survey data will illustrate the users involved and interview analysis will contribute with the users experiences of the PSS in focus.

LEV-pool early user profile

The results from the survey reveal the profile of the 'caretaker' users. Results have been divided into four main categories: demographics, mobility, environmental considerations, and knowledge/attitudes/interest. It is clear that the caretaker users are similar in their profile, see Table 1 where data are reported as is or for some of the factors to a certain extent interpreted.

Table 1: LEV-pool early user characteristics (Survey data)

Demographics	
Gender	3 women, 4 men
Age	1 29-30, 4 30-39, 1 40-49, 1 60-69
Income	2 20-30 000, 2 30-40 000, 2 40-50 000, 1 >50 000 SEK
Family structure	4 in partnership and children at home, 2 in partnership, 1 single
Education level	3 Gymnasium, 3 Graduate, 1 not specified
Mobility	
Car ownership	All own car
Preferred travel mode	5 mixed car or bike as primary choice, 2 primary bike
Frequency of car usage	Various degrees of car usage "from sometime to every time in need of mobility"
Car positive factors	Availability, comfort (2), distance (2), weather, needs, fast (2), easy, shopping,
Car negative factors	Pollution (6), costs (6)
Usage of company car/bike	Rare use of company car or bike, or no use
Mobility needs at work	1 many times a week, 2 sometimes, 4 rarely
Environmental considerations	
Environmental conscious decisions	never, sometimes, regularly (2), often (2)
Environmental investments	energy efficient light bulbs (3), windows (1), insulation (1)
Examples of environmental choices	local products, organic food, waste sorting, led bulbs
Use of eco-products/attitude to more eco-products	7 yes/ 7 positive
Knowledge/awareness/interest	
concerning EV	1 knows a lot , 6 familiar/ knows only little
concerning car pools/sharing	5 unfamiliar with carpools/sharing, 2 used before

concerning cars	Varies from like due to function to highly interested
concerning technology	strong interest (7)

With regards to the environment category presented in Table 1 above, since the PSS in focus is oriented toward environmental benefits in comparison to a private car, it was paramount to investigate users' view in this dimension where more open-ended questions were used in the survey. All the users reflected as environmentally conscious individuals with strong interest in eco-products and investments related to greener products and services. Regarding what kind of decisions, investments, and products or services related to environment the users currently take the results range from a very high commitment toward more sustainable lifestyle to those with lower commitment. Two of the users showed that they do not make environmentally conscious decisions nor have they made any environmentally conscious investments, but they all consume some eco-products and express a desire to use more. These users, although they own a fossil fuel based vehicle, they use it rarely when their mobility needs cannot be met by bike. The users relate their environmental decisions and investments mainly with household consumption such as energy saving solutions at home, new windows and better insulation, sorting waste, water saving taps, and organic food and larger investments are clearly rare or lacking. For factors relating to knowledge, awareness and interest the users seem to have different information about EVs, ranging from those who know a lot about EVs and those who know little about them. On the other hand, a surprising factor due to the project that they are actually involved in, is users' information about car sharing and carpooling service, where they claim to only have heard about it but that they know very little about what it is and how it works. Similar to the knowledge on EVs the interest in cars varies among the users from being highly interested to being interested in cars only due to the function they can provide. In addition, the users seem to be characterized by a high interest on adopting new technologies in their life, which was more detailed described in the survey by stating how they are usually the first in their network to adopt new innovations.

Usage of the PSS

The first interviews were made before the users started the trial period. Some of these users had tried the vehicle once during a test session. The interviews provided insight in the users' motivations to join the research project, the expected challenges and benefits, as well as their expectations in terms of switching behavior from private car use to a shared use system with a totally different vehicle.

Key motivators for joining

Switching to a more environmentally alternatives for their mobility was one of the key motivator for joining the project in parallel with their interest in testing an electric vehicle and this new concept of mobility. The users believe that environmental actions, such as reducing emissions, are urgent and matter for them as well as reducing our dependence on fossil fuel. In addition, an observed pattern is an urge to show others that there are alternatives to 'normal' car life. Above the environmental concerns, one user shows a desired change related to the convenience of having an extra vehicle in the household that does not have same cost as the private car and also being environmentally friendly. For two of the users, there is a genuine interest in cars and motor vehicles, which is their major motivation to join.

Expectations before testing

All the seven users claimed to be curious to try the new vehicle and see how it works in different situations and related the experience as fun, exciting, and interesting. The users showed interest in learning and getting acquainted with the new technology and see if they would possibly buy it in the future. They perceive that there is a lack of knowledge about such new technologies, therefore trying it out for a while may help them to learn and see how it fits into their daily activities as well as spread this knowledge across their colleagues and friends. What was also observed among these users was their positive expectation that the solution should work both for them and their colleagues at work. As one user stated "it should feel like a natural choice for mobility". Concerning challenges that users foresaw before testing, mainly all of them (6) related these to the practicality of the system and how it would work both with regards to the new vehicle and the booking system. Major factors foreseen as challenging were the range of the vehicle i.e. the number of trips and distance possible without charging, the need to recharge the vehicle throughout the day, and the effects of weather on the vehicle. Concerning benefits, users reported four major benefits that they expected from the new solution. The first is the environmental impact of the vehicle, which they think is a positive benefit for moving around on with small vehicle. The second is the convenience of the vehicle, which they relate to as quick and easy to move around with because of its size. In addition, some of the users (3) see it as a good complement to their first private car or bike, which they think will add value to their household. A third benefit that was highlighted was that the vehicle should be fun to drive. The interviewees expected a feeling of acceleration due to the closeness to ground, and that it should be quiet, "like sailing" as one interviewee put it. Finally, the fourth benefit that users reported was their perception that by having access and moving around with such vehicle, they will be able to show others that this is a practical and useful solution at work and perhaps convince them to try it out. As one of the users put it "…make people see that sustainable solutions are not just science fiction and that they are actually here now".

Expected changes in everyday life

All the seven users claimed that they expect some changes in their everyday life when applying the new mobility system. The major change that they foresee is their daily commute to work, back and forth, which is obvious because the project requires them to bring the vehicle to work and take it back every day. On the other hand, they also related this change with the replacement of their private car to do their daily activities, such as training, sports, shopping and other short trip errands. For one user, the solution is seen as a simplification of their life particularly when two family members share only one vehicle. For some (4), the solution will make their daily errands much more comfortable because of the size of the vehicle making it easy to move around and park. Nevertheless, all users share two major concerns such as the longer distance trips and large shopping to be an issue for using the Twizy since the range is limited as well as the size not fitting more than two persons or bulky stuff. Five of them also relate this change to their strong desire to replace their fossil fuel car as much as possible with energy efficient and greener vehicles, without having to compromise their daily activities. A user states "…I am already on the hunt for an electric vehicle, Twizy will probably not be my next vehicle, but this is a foretaste of a full electric vehicle." They all were optimistic in replacing the majority of their trips with Twizy, and expressed a strong willingness to do so in all activities that Twizy could support. For some of the users (3), the newness of the vehicle and being fully electric is

perceived as very exciting for the fact that they can still enjoy driving a 'fun and interesting' vehicle without compromising the environment.

Actual change after one month into intervention
The seven users have adapted their practices of how to get to (and from) work and are now using the Twizys for these journeys. Five of them have replaced car usage and two of them have replaced bike use as mean of transport for work. They are satisfied with the solution and feel the new Twizy practice is easy and simple for them. They do not experience that any big sacrifices have been done. They have not adapted so many other practices in their everyday lives since they have used the Twizy to a limited extent for private errands i.e. going shopping, going to the gym or football, and driving kids to school or their other personal activities but experience a good flexibility during weekends and state that they have with this PSS an ability to do things easy and quick. When going shopping with the Twizy, one user points out a problem of not being able to leave things in the vehicle and another user experience a tension in not being able to bring both his children at the same time.

Experiences after one month of use
Users expressed that it has been a good experience so far. They still think that it is fun to drive the Twizy and they still got attention from people in the surrounding, when they drive around in the neighborhood. Some minor technical issues were faced by each of them in the beginning but overall, they think it is going well and they feel satisfied. The vehicle restrict one user to certain roads where speed limit is lower and suits this vehicle better and another user use his conventional vehicle for the same reason. Apparently, the size restricts them, however, this is also positive when parking and driving. The users have overcome some technical issues themselves and then if it did not work, they turned to service support. In summary, the users experienced the following practical issues with the vehicles:

- limited size (sometimes there is a need for fitting more people and things),
- handbrake (other users pulling too much),
- condensation inside,
- cleanliness (from streets),
- steering wheel (too hard),
- comfort (for longer trips),
- fit (tall persons),
- inability to lock vehicle;

and with the service:

- requirements to bring the vehicle to/from work sometimes feels controlling and restricting,
- difficulties in booking in the beginning (how, receiving too many sms-s, which car it was whose, cancel booking/change booking instantly through the phone),
- card reader (not recognizing the card),
- when finishing early at work, or travelling away for a couple of days, users felt limited and a bit constrained by the system.

Fit to daily activities

The users think that they make some compromises depending on what activity they are doing. For example, due to the size of the vehicle and that it is not lockable, they decide on small or large shopping, when going shopping. Doing things around with more than one children or the whole family is another issue for the three users who have two small children. Despite this, the users point out that they mainly choose the Twizy for daily errands; if it does not require more passengers or transport of bulky luggage. Still, they recognize that they are using Twizy slightly more than their car and that sometimes they substitute their bikes with Twizy. The vehicle for them is a good addition/supplement to their life and its perceived newness makes them want to try it more in different situations.

DISCUSSION

The results presented reveal new information about the characteristics of early users of this particular disruptive innovation: the LEV with a service function of carpooling. They also illustrate how the deployment of a disruptive innovation is experienced which is in particular interesting in order to understand how such innovations can be deployed at a faster pace. Analyzing the illustration that the results are providing can contribute with identifying barriers and enablers for disruptive innovations and this particular set up can be evaluated in terms of its contribution to deploying disruptive innovations.

Early users characteristics

The findings from this study reveal some of the characteristics of the 'niche' market segment, which scholars of this research domain have identified theoretically (Adner, 2002; Govindarajan and Kopalle, 2006). Although the demographic data points toward the direction of Rogers (1995) model of early adopter, other relevant factors shown in these findings describe a rather different user profile which not necessarily correlates with identified attributes of the model. However, neither does this user profile fit into the disruptive innovation's forward looking customers, although the studied users were the first ones to be most attracted by the offering. If we look into product attributes as a comparative point for each user segment (mainstream and niche), the users of LEV-pool are somewhat in between the two segments. They are all highly interested in new technologies but at the same time are as price sensitive as the rest of the market, which is the case for the disruptive innovation forward looking customers. In addition, if theoretically such innovation performs poorly on the attributes mainstream customers value (Govindarajan and Kopalle, 2006), the results may then indicate that the LEV-pool early user is coming from the mainstream market, since the studied users do not yet value other attributes of the PSS different from their private car for instance. The findings somewhat suggest a combination of these two models, in which the early user is seen as one that is highly interested in new technologies but is also reluctant to see value in the disruptive innovation different from the mainstream customer. In addition, the LEV-pool user despite being highly interested in new technologies has limited awareness and knowledge about the new technology for instance. In this construct, Rogers (1995) model does not fit to this early user profile because often the early adopters are well informed about the new technology prior to decision making to adopt the new technology. Although all the users are environmentally concerned and motivated to make more sustainable choices in their everyday life, when it comes to mobility, they still relate the product with its performance as a mobility tool and not with its environmental impact although it is a highly appreciated attribute. A study by Lane and Potter (2007)

implied that environmental impact of EVs is among the least attributes for some consumers. This may raise an important implication for the innovating firms, which have specifically integrated the environmental aspects into their market strategies for gaining new customers. Nevertheless, in our analysis of users, we must be clear that LEV-pool is offered in a specific project that is run in a specific context and where the employer of the users as well as the other partners in the project are playing important roles for easing the deployment of the PSS.

Deployment of a disruptive innovation – user experiences

In this initial phase of testing we can observe that the 'disruptiveness' of the system seems to be changing as users move from having expectations about the innovation, knowing about it, testing it on a daily basis, and rethinking their expectations based on the experiences of the trial. The findings show some extent of 'adaptability' where the solution is slowly being integrated as part of the users' everyday life despite the occurring challenges that these users experienced throughout the first month of testing. At first, the studied users perceived the product-service system as something new and different, which made them curious to try and test. They were all environmentally motivated to apply for becoming a user, though, the rather 'different-looking' vehicle and the 'shared-use' idea were of much higher value to make them try the solution as seen in their expectations about the solution. Here we can observe what Vandecasteele and Geeuens (2010) name as instrumental, hedonic, and symbolic motives of the early consumers of EVs for instance. These motives relate to the consumer focus on the functionality of the vehicle (instrumental); the significance of anticipated emotions i.e. pleasure of driving experience (hedonic); and, the importance of symbolic attributes of a vehicle for the consumers (symbolic) (in Rezvani et al. 2015). The early users of LEV-pool seem to be strongly oriented toward the three motives: environmental impact of the solution, convenience of the vehicle to move around, good complementary to their first car, and fun to drive. The affective or hedonic attributes have been highlighted by other studies on EVs as well, such as the pleasure and joy are seen as important factors in influencing EV purchase intentions for instance (Schuitema et al, 2013). In this particular study, the timing when these motives were more expressive is rather interesting since we can observe the hedonic and symbolic motives to be more prevalent before the users began trying the solution. Whereas the instrumental motives were more shown as the users began using the solution on a daily basis, which we discuss further below.

After starting trial period, users became more interested in the practicality of the solution in their daily life and related their experiences in terms of the vehicle's performance and the 'caretaker' concept in meeting their needs and supporting their daily activities. Much of their experience is related to cases when the vehicle worked well when doing an activity and when it did not fit, although the perceived newness of the vehicle and users' environmental motivation prevailed in their choice of mobility i.e. small electric vehicle over their private car. Based on the results, these users are making attempts to prioritize the solution over their private car, however, this decision depends on their personal activities that these users perform on a daily basis. Shuitema et al. (2013) have shown a similar observation where they indicate that the perceptions of instrumental attributes influence the perceptions of symbolic and hedonic attributes. In such regard, despite the users being enthusiastic about the innovation, as they try it, the product functionality or performance may become more relevant than the first. An implication of this may be that user involvement may

actually allow a higher degree of affecting the perceptions about the innovation since the users have not yet adopted the innovation but are rather trying it. Consumers' attitudes towards EVs' technical features and perceptions of utility of EVs are a group of factors that has been shown to both drive the rate of intention and/or adoption (Rezvani et al., 2015). Among the technical attributes, the limited range of battery electric vehicles for example is a well-known adoption barrier (Skippon and Garwood, 2011). Skippon and Garwood (2011) studied 56 UK households, which were given the opportunity to try such vehicles for a week and their findings suggest that the limited range for instance was more of a created perception than the users actually experienced. This is argued to be more of a perceived barrier than an actual one (Rezvani et al., 2015). Range limitation and charging behavior however, can be considered as the adaptation demand or the needed change in behavior relative to conventional ICE cars, argue Rezvani et al. (2015). These posed requirements on consumers make them more resistant to accept battery electric vehicles (Caperello and Kurani, 2011; Lane and Potter, 2007).

From our results, it can be noted that the users had these perceptions before the testing period as major concerns; however, the users are slowly overcoming these challenges as they get acquainted with the vehicle, where they already show positive experiences in terms of use of the vehicle. The users have become accustomed to the 'limitations' of the vehicle and do not feel they are experiencing big compromises due to the product performance. They experience barriers on a daily basis, but also try to overcome them by slowly adapting their practices within the 'limitations' of the vehicle i.e. doing smaller shopping or taking kids with them in turns. Users do relate this with the limited flexibility offered to them, but they also acknowledge the other benefits that the solution has offered them i.e. quick and easy daily errands.
This may indicate that exposing users to the solution for a longer period of time, may actually allow enough time for these users to adapt and pass the needed time for new behaviors to take place. Franke et al. (2011) point at interventions such as interface design and driver training could potentially overcome the psychological barriers in adapting to limited range and other perceived or experienced barriers for instance. Jensen et al. (2013) showed that hands-on experience with battery electric vehicles affected positively consumer's preferences and attitudes. Rezvani et al. (2015) suggest that the provision of opportunities for trial and hands-on experiences with EVs may affect consumers' adaptation. In this experiment overall it seems like the caretaker users are reporting positive experiences and are gradually getting into using the PSS in way that suits them. The PSS is reaching a level of actual deployment and is not only perceived as a trial period since the users will be using the solution for a period of six months. The users show a high interest to contribute to this change by attempting to adapt to the new solution to the extent it does not compromise their activities. This particular set up of user involvement may potentially be a way for disruptive innovations to reach the more suitable markets and perhaps even penetrate mainstream markets quickly, however, further user analysis in the remaining part of the experimenting period is needed to make any inference.

Enablers and barriers

A deeper analysis of enablers and barriers when experiencing disruptive innovation may bring to surface further understanding of when user involvement becomes an effective mechanism to deploy environmentally driven disruptive innovations. From these results, we identify a few of these. The users expected that the solution would

bring some changes to their everyday life in terms of their mobility. They felt committed to replace their private car with the new solution and were positive to adopt the new behavior. For them the solution was easy and simple, therefore, seen as practical and beneficial. By being introduced with the idea, although requiring them to change the way they traveled to and from work, users had still the freedom to 'drive' and do so without compromising the environment. Being both technologically and environmentally interested, the solution despite new was not seen as so disruptive from the users' point of view. However, after one month of trying it out, the innovations' performance in terms of the product and the service affected the users in the sense that they were not able to perform some of their activities using the solution. In terms of the product, some of the limitations posed affected their switching behavior back to their private car i.e. limited size of the vehicle when shopping, doing sports, or carrying other passengers. In terms of the service, they began to feel a bit restricted and controlled i.e. the requirement of bringing the vehicle to and from work everyday at an agreed time. This may indicate that the perceived 'newness' or 'difference' of disruptive innovations as such is more important when these innovations are introduced into consumers' life, but that their performance attributes become more relevant as the users try them, subsequently their 'disruptiveness' scale from a market perspective starts to increase. From users experiences, we summarize these enablers and barriers as follows:

Experienced enablers

- incentives for use may attract users
- information and awareness on the innovation
- perceived newness and difference of the product
- environmental attributes combined with economic incentives

Experienced barriers

- the practicality of the solution for the user
- users' particular lifestyles and daily activities in relation to the PSS
- the general construct of everyday life not supporting disruptive innovations as such, thus, requiring behavior changes not only on one aspect i.e. shopping malls stimulating larger shopping
- the fit of the solution to certain user segment only

CONCLUSION

Analysis reveals that users are to some extent typical early adopters and in some aspects typical mainstream users. A cautious conclusion is that the project has attracted not typical disruptive innovations users, which is interesting when targeting the users of these innovations. Users are affected by their own usage and continuously accept the disruptive innovation in the form of 'adaptation' to some extent. In relation to before being introduced and after experiencing the PSS for a period of time, we can observe that users are gradually integrating the new solution into their everyday life despite some challenges that arose on a daily basis, which in some cases are also overcome by the benefits experienced from the solution. In such regard, a conclusion can be made that user involvement does positively affect the users' in the sense that these users are able to see that with time, the perceived functional barriers on light (battery) electric vehicles may be overcome and that they can slowly begin to adapt to the new idea of how they commute to and from work, as well as in performing their

private daily activities. The involvement of these users in the research project facilitates their experiences and motivations for change, however, we believe that this is partly due to the environmental concern driving both the project and the users as well. We also believe that such experimental setup may ease the deployment of disruptive innovations of this kind into larger segments of users, which may begin with a smaller group of users in a certain context and gradually expand. Nevertheless, it is important to acknowledge the fact that these users are aware such innovation is under development, which may also imply their willingness to collaborate and feel that such solution may work for them in the long run.

Finally we can conclude that such approach may be important for the battery electric vehicle and car sharing development process in order to understand to what kind of markets disruptive innovations would most likely serve and be adopted at higher pace. Such knowledge may serve critical input for the automotive firms in changing their strategy toward the 'right' user segments when it comes to environmentally driven disruptive innovations. However, further understanding into the non-user segments may be the next step for researchers and practitioners involved in this matter.

REFERENCES

Adner, R., (2002) 'When are technologies disruptive? A demand-based view of the emergence of competition', *Strategic Management Journal,* 23(8): 667–688

Abernathy, W. J., Clark K. B., (1985) 'Mapping the winds of creative destruction', *Research Policy,* 14: 3–22.

Alam, I., (2002) 'An Exploratory Investigation of User Involvement in New Service Development', *Journal of the Academy of Marketing Science*, 30(3), pp.250–261.

Almirall, E., Lee, M. & Wareham, J. (2012) 'Mapping living labs in the landscape of innovation methodologies',*Technology Innovation Management Review*, September, pp.12–18.

Alter, S., (1978) 'Development Patterns for Decision Support Systems', *MIS Quart.,* 2,3

Bano, M. & Zowghi, D., (2014) 'A systematic review on the relationship between user involvement and system success', *Information and Software Technology*, 58, pp.148–169. Available at: http://dx.doi.org/10.1016/j.infsof.2014.06.011

Barki, H., Hartwick, J. (1989) 'Rethinking the concept of user involvement', *MIS Quart, pp.* 53–63.

Baroudi, J., Olson, M. & Ives, B., (1986) 'An empirical study of the impact of user involvement on system usage and information satisfaction', *Communications of the ACM*, 29(3), pp.232–238. Available at:http://dx.doi.org/10.1145/5666.5669.

Bergvall-Kåreborn, B. & Eriksson, C.I., (2009) 'A milieu for innovation - defining living labs', *2nd ISPIM Innovation {...}*, September 2015.

Berghman, L. et al., (2013) 'Deliberate Learning Mechanisms for Stimulating Strategic Innovation Capacity', *Long Range Planning*, 46(1-2), pp.39–71. Available at: http://linkinghub.elsevier.com/retrieve/pii/S002463011200074X.

Caperello, N.D., Kurani, K.S., (2011) 'Households' stories of their encounters with a plug-in hybrid electric vehicle', *Environmental Behavior* 1–16. http://dx.doi.org/ 10.1177/0013916511402057

Charitou, C. D., Markides, C. C., (2003) 'Responses to disruptive strategic innovation'. Sloan Management Review 44(2): 55–63.

Chesbrough, H. (2006) ‘Open Innovation: A New Paradigm for Understanding Industrial Innovation’, In Open Innovation: Researching a New Paradigm, eds. H. Chesbrough, W. Vanhaverbeke and J. West. Oxford: Oxford University Press, pp. 1-12.

Christensen, C.M. (2006) ‘The ongoing process of building a theory of disruption’, *Journal of Product Innovation Management*, 23, pp. 39–55.

Christensen, C. M. (1997) 'The Innovator’s Dilemma', *Harvard Business School Press: Boston*, MA.

Christensen, C.M., Bower, J. L., (1996) 'Customer power, strategic investment, and the failure of leading firms', *Strategic Management Journal* 17(3): 197–218.

Christensen C. M., Raynor, M. E., (2003) 'Innovator’s Solution', *Harvard Business School Press,* Boston, MA.

Creswell, J.W., (2003) Chapter One, ‘A Framework for Design’, *Research design Qualitative quantitative and mixed methods approaches*, pp.3–26.

Daae, J. & Boks, C., (2014) ‘A classification of user research methods for design for sustainable behaviour’, *Journal of Cleaner Production*, 106, pp.680–689. Available at: http://www.sciencedirect.com/science/article/pii/S0959652614004120.

Danneels, E., (2004) ‘Disruptive technology reconsidered: a critique and research agenda’, *Journal of Product Innovation Management,* 21(4), pp. 246–258.

Danneels, E., (2002) ‘The dynamics of product innovation and firm competences’, *Strategic Management Journal*, 23(12), pp.1095–1121. Available at: http://doi.wiley.com/10.1002/smj.275.

European Commission, (2012) ‘Transport. Clean Transport’. Retrieved March 2016 from: http://ec.europa.eu/transport/themes/urban/vehicles/road/ electric_en.htm.

Edstrom, A., (1977) ‘User Influence and the Success of MIS Projects’, *Human Relations*, 30, pp. 589-606.

Franke, T., Neumann, I., Bühler, F., Cocron, P., Krems, J.F., (2011) ‘Experiencing range in an electric vehicle: understanding psychological barriers’ *Appl. Psychol.* http://dx.doi.org/10.1111/j.1464-0597.2011.00474.x. Frijda,

Franz, C. R., (1979). Contingency Factors Affecting the User Involvement Role in the Design of Successful Information Systems. Ph.D. dissertation, University of Nebrasaka.

Firnkorn, J. & Müller, M., (2011) ‘What will be the environmental effects of new free- floating car-sharing systems? The case of car2go in Ulm’, *Ecological Economics*, 70(8), pp.1519–1528. Available at: http://dx.doi.org/10.1016/j.ecolecon.2011.03.014.

Gales, L., Mansour-Cole, D., (1995) ‘User involvement in innovation projects: Toward an information processing model’, *Journal of Engineering and Technology Management*, 12(1-2), pp.77–109.

Gilbert, C., (2003) ‘The disruption opportunity’ *Sloan Management Review,* 44(4): 27–32.

Govindarajan, V., Kopalle, P.K., (2006) ‘Disruptiveness of innovations: measurement and an assessment of reliability and validity’, Strategic Management Journal, 27 (2): 189-199.

Jensen, A.F., Cherchi, E., Mabit, S.L., (2013) ‘On the stability of preferences and attitudes before and after experiencing an electric vehicle’ *Transp. Res. D Transp.* Environ, 25, pp. 24–32. http://dx.doi.org/10.1016/j.trd.2013.07.006.

Ives, N., Olson, M. H., (1980) ‘Measuring User Involvement in Information Systems Development’, *Proceedings of International Conference on Information Systems,*

Philadelphia, pp. 130-143
Ives, B., Olson, M. H., (1984) 'User Involvement and MIS Success: A Review of Research', *Management Science* 30(5): 586-603. http://dx.doi.org/10.1287/mnsc.30.5.586
Hardman, S., Steinberger-Wilckens, R. & Van Der Horst, D., (2013) 'Disruptive innovations: The case for hydrogen fuel cells and battery electric vehicles', *International Journal of Hydrogen Energy*, 38(35), pp.15438–15451. Available at: http://dx.doi.org/10.1016/j.ijhydene.2013.09.088.
Hekkert, M.P., Suurs R.A.A., Negro, S.O., Kuhlmann, S., Smits, R.E.H.M., (2007) 'Functions of innovation systems: A new approach for analysing technological change', *Technological Forecasting and Social Change*, 74(4), pp.413–432. Available at: http://linkinghub.elsevier.com/retrieve/pii/S0040162506000564.
Hesselgren, M., Hasselqvist, H. & Eriksson, E. (2015) 'A Car-free Year: Providing vehicles for change', In: Design Ecologies: Challenging anthropocentrism in the design of sustainable futures. Paper presented at Nordes 2015, Konstfack – University College of Arts, Crafts and Design. Stockholm, Sweden Sunday 7 – Wednesday 10 June 2015. Nordes.
Huwer, U., (2004) 'Public transport and car-sharing - benefits and effects of combined services', *Transport Policy*, 11(1), pp.77–87. Available at: http://dx.doi.org/10.1016/j.tranpol.2003.08.002.
Kujala, S. (2003) 'User involvement: A review of the benefits and challenges' *Behaviour & Information Technology*, 22:1, 1-16, DOI: 10.1080/01449290301782. Available at http://dx.doi.org/10.1080/01449290301782
Lane, B., Potter, S., (2007) 'The adoption of cleaner vehicles in the UK: exploring the consumer attitude–action gap', *Journal of Cleaner Production,* 15 (11–12), pp. 1085–1092. http://dx.doi.org/10.1016/j.jclepro.2006.05.026.
Lettl, C., (2007) 'User involvement competence for radical innovation', *Journal of Engineering and Technology Management - JET-M*, 24(1-2), pp.53–75.
Lorentz, V.R.H., Wenger, M. M., John, R. and März,M. (2015) 'Electrification of the Powertrain in Automotive Applications: "Technology Push" or "Market Pull"?' In Springer International Publishing, pp. 169–178.
Luè, A. ,Colorni, A., Nocerino, R., Paruscio, V., (2012) 'Green Move: An Innovative Electric Vehicle-Sharing System' *Procedia - Social and Behavioral Sciences,* 48, pp. 2978–2987.
Katzev, R., (2003) 'Car Sharing: A New Approach to Urban Transportation Problems', *Analyses of Social Issues and Public Policy*, 3(1), pp.65–86.
Markides, C., (2006) 'Disruptive innovation: In need of better theory' *Journal of Product Innovation Management*, 23(1), pp.19–25.
Magnusson, P.R., Matthing, J. & Kristensson, P., 2003. Managing User Involvement in Service Innovation: Experiments with Innovating End Users. *Journal of Service Research*, 6(2), pp.111–124.
Marsh, A. M., (1979) 'A User's Behavior Toward His MIS', *MIS Quart*, 3, 39-52
Paap, J. & Katz, R., (2004) 'Anticipating Disruptive Innovation', *Research Technology Management*, pp.13–22.
Parker, S. & Heapy, J. (2006). The Journey to the Interface: How Public Service Design Can Connect Users to Reform. *Demos*, pp. 1-62.
Pinkse, J., Bohnsack, R. & Kolk, A., (2014) 'The Role of Public and Private Protection in Disruptive Innovation: The Automotive Industry and the Emergence of Low-Emission Vehicles', *Journal of Product Innovation*

Management, 31(1), pp.43–60. Available at: http://doi.wiley.com/10.1111/jpim.12079.
Rezvani, Z., Jansson, J. & Bodin, J. (2015) 'Advances in consumer electric vehicle adoption research: A review and research agenda', *Transportation Research Part D: Transport and Environment*, 34, pp.122–136.
Rogers, E.M., 1995. *Diffusion of innovations*, Available at: http://hollis.harvard.edu/?itemid=|library/m/aleph|006256656.
Rohracher, H., (2003) 'The Role of Users in the Social Shaping of Environmental Technologies', *Innovation: The European Journal of Social Science Research*, 16, pp.177–192.
Rose, D. A., (2001) 'Reconceptualizing the user(s) of—and in—technological innovation: the case of vaccines in the United States', in Coombs, R. et al. (eds), Technology and the Market. Demand, Users and Innovation, Cheltenham and Northampton, Edward Elgar, pp. 68–88.
Schuitema, G., Anable, J., Skippon, S., Kinnear, N., (2013) 'The role of instrumental, hedonic and symbolic attributes in the intention to adopt electric vehicles', *Transp. Res. A Policy Pract,* 48, pp. 39-49. http://dx.doi.org/10.1016/j.tra.2012.10.004.
Shaheen, S. & Cohen, A., (2007) 'Growth in Worldwide Carsharing: An International Comparison' *Transportation Research Record*, 1992, pp.81–89.
Shaheen, S., Wipyewski, K., Rodier, C., Novick, L. (2004) 'Carlink II: a commuter carsharing pilot program final report', *Transportation*, August, pp.1–186. Available at: http://escholarship.org/uc/item/63z755sc.pdf.
Silverman, D. (2011) *Interpreting Qualitative Data.* SAGE Publications Ltd
Skippon, S., Garwood, M. (2011) 'Responses to battery electric vehicles: UK consumer attitudes and attributions of symbolic meaning following direct experience to reduce psychological distance', *Transp. Res. D Transp. Environ,* 16 (7), pp. 525–531. http://dx.doi.org/10.1016/j.trd.2011.05.005.
Stickdorn, M. and Schneider, J. (2010). *This is Service Design Thinking*. BIS Publishers. ISBN 9063692560.
Sopjani, L., (2015) 'Mapping users' needs and service requirements for electric car sharing service design', Master thesis in Sustainable Development at Uppsala University, 63 pp, 30
Svensson, C. I., Eriksson A., Ståhlbröst, J. (2009) 'A Milieu for Innovation – Defining Living Labs', *2nd ISPIM Innovation Symposium*.
Traitler, H., Watzke, H.J. & Saguy, I.S., (2011) 'Reinventing R&D in an Open Innovation Ecosystem', *Journal of Food Science*, 76(2), pp.R62–R68. Available at: http://doi.wiley.com/10.1111/j.1750-3841.2010.01998.x.
Teixeira, J., Patricio, L., Nunes, N., Nóbrega, L., Fisk, R., Constantine, L. (2013). Customer experience modeling: from customer experience to service design.
Vandecasteele, B., Geuens, M. (2010) 'Motivated consumer innovativeness: concept, measurement, and validation' *International Journal of Research and Marketing*, 27, pp. 308–318.
von Hippel, E. (2005) '*Democratizing Innovation'*, Cambridge MA: MIT Press
von Hippel, E., (1976) 'The dominant role of users in the scientific instrument innovation process', *Research Policy*, 5: 240-266.
von Hippel, E., (1977a) 'Successful and failing internal corporate ventures: An empirical analysis', *Industrial Marketing Management,* 6: 163-174.

von Hippel, E., (1977b) ‘The dominant role of the user in semiconductor and electronic equipment subassembly process innovation’ *1EEE Transactions on Engineering Management*, EM-24 (2) 60-71.
von Hippel, E., (1988) *The Sources of Innovation*. Oxford University Press, New York.
Urban, G.L., Weinberg, B.D., Hauser, J.R., (1996) ‘Premarket forecasting of really new products’, *Journal of Marketing* 60 (1), pp. 47–60.
Yu, D. & Hang, C.C. (2010) 'A Reflective Review of Disruptive Innovation Theory' *International Journal of Management Reviews*, 12(4), pp. 435–452.