Social Media Monitoring as a Tool for the Development of Disruptive Innovations

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ABSTRACT

Understanding how electric vehicles (EVs) are driven in the real world has massively advanced with the implementation of the MINI E and BMW ActiveE field trials. The results of these studies served as a key learning project for the development of the BMW i3, the first purpose-designed EV produced by the BMW Group. Especially in the early phases of the fields trial in 2009, the design of user research and analysis methods posed a challenge as it was unclear how users would react to an EV. As with all disruptive innovations, the collection of immediate and unbiased feedback as well as long-term feedback was required to separate first-contact phenomena from permanent effects. Our research partners from academia therefore established a research schedule with repeated face-to-face interviews and diaries. In order to make sure that the questions asked also sufficiently reflect the customers' everyday life with the EV, social media monitoring was established as a means to participate in usual driving and charging experiences and to support the development of the methods tool set. This approach proved to be very fruitful as early tendencies in customer satisfaction and dissatisfaction were identified and later on systematically reviewed with quantitative methods. Several examples of relevant findings in the MINI E field trial are presented and social media monitoring is discussed as a tool for customer feedback in the development chain. Presented as a case study for the development of electric vehicles, the data basis for this discussion are 2242 Facebook and relevant blog comments of US MINI E users between April 2009 and October 2011.

Keywords: Electric Vehicle, Electromobility, MINI E, Field Study, Social Media

EARLY STEPS IN SERIES-PRODUCED ELECTRIC VEHICLES

With the introduction of several new electric vehicles (EVs) in the last years, the different underlying approaches in development become apparent. Most vehicles are based on existing product solutions by building conversion EVs. The obvious advantage is that well-established production processes can be applied to a large extent, adapting only for EV-specific components. Correspondingly, it allows for rather quick development progress. Purpose-designed EVs however, which are planned and developed for driving electric since product ideation, offer several advantages. Not only in terms of vehicle architecture with a secure and advantageous arrangement of the battery in order to give the vehicle a low center of gravity and optimum weight distribution, but also in terms of innovative use of materials, lightweight design and driving agility. Purpose design also enables to target two especially important aspects in the context of electromobility: a holistic approach on sustainability along the entire value added chain and tailoring the vehicle and associated services to fit the customers' needs.

Electromobility can truly be seen as a disruptive innovation. Not only the driving task in itself changes with a completely silent engine, limited range and a different acceleration behavior of the vehicle. The driving environment also changes, with the need for charging stations and online information about charging locations. Designing for purpose in combination with user-centered design poses a particular challenge in that environment: Obviously, several years ago there was no broad prior customer experience any manufacturer could built on to develop electric vehicles. In order to explore new solutions for sustainable individual mobility, a BMW Group think tank was established in 2007 called *project i*. Thinking outside of the box, *project i* analyzed future developments and driving factors for mobility. It was borne out of the necessity to provide answers for changes in mobility needs associated with new opportunities like electromobility, which led to newly developed offers such as 'DriveNow' car sharing. One of the earliest steps of *project i* was the implementation of EV field trials in cooperation with academic, public and private partners providing a huge number of pilot customers for a substantial period of time with vehicles running purely on electric power. Starting in 2009, more than 600 MINI E – a conversion of the familiar MINI hatch specifically developed for field trials – were on the road in the USA, Europe and Asia to gather important feedback on customer experience and customer requirements. In 2011, a fleet of more than 1000 BMW ActiveE – which is based on a 1 Series Coupé and like the MINI E a conversion vehicle for pioneer customers – was launched in several countries for research on EV-related technology, charging solutions, service and sales processes. The BMW ActiveE can also be regarded as the first iteration loop on the way to the BMW i3. The BMW i3 is the BMW Group's first series-produced all-electric car. It is purpose-designed based on customer feedback of both field trials and more than 34 million test kilometers of experience achieved during these studies.

These MINI E and BMW ActiveE projects are unparalleled worldwide in their scope. A conventional market research approach would not have been possible in the early phases of EV development. Hardly any customers with EV experience were available, target customer groups unknown, the interdependencies between charging infrastructure needs and using an EV on an everyday basis were largely unclear and end-customer EV driving patterns have not even been touched by in-depth analysis on a valid large-scale basis. Therefore, the goal of the field trials was to gain knowledge on this new terrain in the context of disruptive innovations by widening the research focus with a large partnering network. Experts from universities and research institutions took care of the scientific monitoring of the field trial. Cooperation partners from infrastructure and energy provided the necessary means for regular charging, at home and in public. A close cooperation with governmental institutions involving all project partners helped to inform decision makers and relevant stakeholders. Several overview articles provide further details on the field trials (Vilimek & Keinath, 2014; Ramsbrock, Vilimek & Weber, 2013; Vilimek, Keinath & Schwalm, 2012).

To depict the role of social media monitoring during the field trials and the corresponding influence on the development of the BMW i3, the focus will reside on the MINI E field trials, especially on the early phases. The field trials started in 2009 in Germany, Berlin and in the United States, west and east coast. Customers applied online for participation in the field trial. They needed to fulfill certain selection criteria such as being willing to use the EV on regular basis and agree to pay a monthly leasing fee. Based on the application data, a sociodemographic and psychographic profile of potential customers seriously interested in becoming EV users was assembled. Customers selected from that pool, remarkably more than 15.000 applicants at the end of the international MINI E field trials, were chosen to represent that early adopter profile. The Berlin study can be seen as the methodological blueprint of the field trials in general. While all academic partners contributed their specific research background to the projects and in doing so made each single study partly unique, the methods tool set developed in cooperation between the Institute of Cognitive and Engineering Psychology at Chemnitz University of Technology and the Concept Quality and Usability department at BMW Group installed a common ground between all field trials. Bringing in their strong expertise in experimental designs, human-machine interaction and user research for in-vehicle systems, scientists from Chemnitz University of Technology proposed a very systematic research plan with repeated user interviews before, during and at the end of a usage period as well as additional instruments like charging and travel diaries. Whereas the basic set of questionnaire items remained constant over time, an initial review of blogs, social media posts and comments and newsgroup discussions conducted by the BMW Group's Concept Quality and Usability department shortly after the start of the field trial showed that many new topics arised directly from customer perspective that deserved deeper and systematic analysis. Weekly summaries on discussion topics were set up to provide input for research planning on a regular basis. This unfiltered feedback proved to be a very early and quick indicator on which characteristics of electric driving appeal to the customers and what they think must be improved in the future.

The largest customer group in the same country with 246 private customers and about 200 fleet vehicles resided in the United States. These customers were also most active in the web. Social media monitoring therefore concentrated on this part of the field trial. Scientific research activities in the US MINI E field trial were led by the Institute of Transportation Studies at the University of California at Davis. Their research with a strong qualitative component influenced by prior work of Axsen and Kurani (2012) on the effect of drivers' social networks in shaping their understanding of plug-in hybrids was ideal to interpret many discussions among the customers during the phase of getting to know their new vehicle.

SOCIAL MEDIA EV CASE STUDY

Methods

While interviews, diaries or focus groups conducted during the MINI E field trial are classic active data collection methods, social media monitoring falls within the range of passive data collection (Sampson, 1996). Using direct unfiltered qualitative data from social media, newsgroups or online communities is an appealing idea since the early days of customer exchange via the web, it was critically reviewed and refined (cf. for instance Kozinets, 1999, 2002; Finch, 1999; Edwards, Housley, Williams, Sloan & Williams, 2013). Reading social media discussions can be a very helpful way to listen directly to the voice of the customers. But certain precautions must be taken to ensure valid use of this piece of information (Sampson, 1996; Klein & Spiegel, 2013). As the MINI E discussion groups were not restricted to MINI E users only, non-EV drivers could have been active contributors. Among the MINI E drivers, only a subset was part of the online community. Therefore, self-selection and a nonresponse bias must be kept in mind as confounding factors. The opinion of those active members of the community may not be misjudged as synonymous with the view of the target customer group. Finally, product-related discussions might not represent a balanced view of the customers' perception as they are often prompted to seek help when something does not work, while praises for positive product characteristics may only enter public debate in the case of unique outstanding features. Finding out about those extremely appealing features has of course a high value, but features that are simply regarded as well designed and appreciated in normal everyday use may go unnoticed – leaving a biased overall picture. Taking this into account, we used feedback from online communities and blogs besides methods development for two purposes.

1. Innovation. The aim was to get an impression about which ideas the customers exchange. When it comes to actively shaping features or functions during early phases of product development, even single opinions, impulse ideas or innovative wishes of customers can be very helpful from a practitioner's point of view (Füller, Bartl, Ernst & Mühlbacher, 2006). Although it is possible to involve online communities in terms of co-creation in innovation processes (cf. also Füller et al., 2006), we opted for a completely passive role to maintain neutrality. This was especially important for the to-be-performed interviews during the field trials.

2. Product optimization. Any discussion led with emphasis in public debates yields a very good indication that the respective topic seems to bother at least some customers. We concentrated on a small number of sources with high likelihood of being lead by real MINI E drivers. Several relevant topics discussed were translated into our systematic research instruments used for as many MINI E users as possible in order to get a representative vote from that early adopter sample. By doing so, we made sure that the voice of the customer expressed online is validated and finds its way into systematic scientific items in the questionnaires.

Starting with an open query via search engines and on Facebook it became clear that most MINI E drivers were active in an Facebook group called "MINI E". The group was established by a private MINI E driver. Soon after its establishment the group had a high number of members, staying at about 500 members during most of the time. This open group, i.e. requiring no further authentication to contribute than a Facebook login, was the most active community. Some MINI E drivers started blogs and a small number of other groups. All MINI E related sources were screened during the core field trial time between April 2009 and October 2011. In total, 2242 posts in 222 discussion threads were analyzed. Unlike in most social media analyses all data was processed manually. This approach was required because of the exploratory nature of the task without any prior experience or relevant categories for clustering and analysis. Furthermore, as Bartl and Ivanovic (2010) argue, language processing software is currently not capable to isolate all relevant statements or recognize, for instance, ironic comments. Finally, the risk of overlooking a salient single comment is extremely high in automatic analysis.

Results

All posts were read in detail and categorized manually. Twelve different categories emerged and were dichotomized according to the emotional valence of the post into "likes" and "dislikes" (see Figure 1). As discussed above, it would make absolutely no sense to treat the absolute number of positive or negative posts as results in itself. A helpful approach starts with asking about the reason for a high number of posts and a qualitative analysis to the core of the discussion. Analyzed with the additional background of further analysis of MINI E US customer feedback (cf. Turrentine, Garas, Lentz & Woodjack, 2011) and MINI E worldwide results (cf. Vilimek, Keinath & Schwalm, 2013) several quite interesting highlights can be found in the likes/dislikes data. In the following, a small subset of these results is summarized to depict the role of social media monitoring.

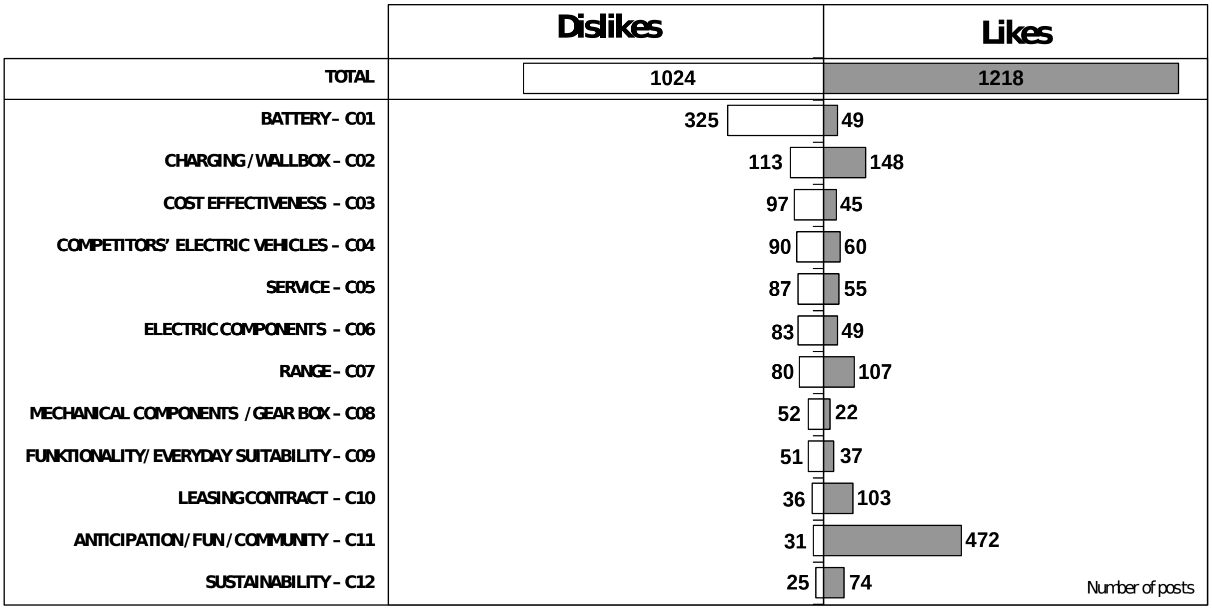

Figure 1. Categorization and number of analyzed posts.

The overall largest category is "C11: Anticipation, Fun, Community". Even before the actual handover, later MINI E drivers already formed a strong online community. Discussions mainly focused on expected vehicle features, assumed everyday suitability and service or infrastructure issues. After the handover customers shared experiences about how much fun it is to drive an electric vehicle with the sporty characteristics of a MINI E (150 kW engine, 220 Nm instant torque). The important role of an electric vehicle which is not only usable in everyday life but in fact fun to drive was later on confirmed in the UC Davis study (Turrentine et al., 2011). Also part of the fun and community aspects of electric driving were the self-organized driver meetings. Customers organized themselves not only online, but met on a regular basis bringing their EVs with them. It is obvious that a commercially available EV may not have the same potential to give the owner the feeling of being pioneers. However, it was significant to understand that community building is very important to EV customers. On the one hand, it reinforces the feeling of being part of an early adopter group, on the other hand there is the simple useful advantage of being able to share relevant information with other users that is not yet publicly available. For instance, when having difficulties to get high occupancy vehicle lane access stickers for EVs, MINI E drivers shared their experiences and suggestions on how to proceed.

Problems with the high-voltage system of the MINI E, "C01: Battery", includes the largest number of negative comments. The main complaint of the customers was that the function of the MINI E was massively compromised especially during very cold weather. In some cases, it took much longer than normal to charge the vehicle or was even not possible to charge if the battery was too cold. Cold temperatures also negatively affected the range while driving, partially because of a suboptimal working temperature for the battery, and partially because of the higher energy consumption of the heating system. The reason for this drawback can be found in the thermal management of the MINI E which relied on air cooling only. The air-cooled batteries performed somewhat better during very hot temperatures, but customers also complained about situations in which the regenerative braking was temporarily not available. Regenerative braking as implemented in the MINI E uses the electric motor as a generator when the foot is lifted off the accelerator pedal while driving, thereby feeding back deceleration energy into the battery. During very hot outside temperatures, it was possible that regenerative braking was temporarily deactivated by the vehicles' thermal management system in order to protect the battery from damage by charging an overheated battery. Some online customer feedback was very straightforward in terms of technical aspects: "*Note to BMW for the EV Citycar* *project - please water-cool the batteries! It's not so much the lost range, but the unpredictability…*” Turrentine et al. (2011) analyzed that about one third of the MINI E drivers experienced difficulties due to hot or cold outside temperatures. The integration of liquid cooling/heating systems was technically not feasible at the time of the MINI E development. Prompted even more by customer experience reported in the field trials, a liquid thermal management system was introduced already in the BMW ActiveE in 2011, significantly reducing the reported problems and ensuring vehicle functionality even under extreme environmental conditions.

Category “C02: Charging / Wallbox” holds various interesting findings with a high number of positive but also negative comments. Particularly at the beginning of the field trial, technical difficulties complicated the installation of wallboxes at the customers’ homes. Although difficulties like this are not unusual at the beginning of field trials and negative comments did not come as a surprise, the adverse situation provided valuable insights about customer expectations and potential for improvement. Most negative comments concerned the waiting time for the installation, uncertainty about installation costs or uncertainty about installation success as expressed in this statement: “*I just had my wall unit inspected and it failed. The inspector, really nice guy and very informative, told me he has failed three others and still has a few more to inspect (and fail)*”. Without a wallbox, customers charged their vehicle on a standard wall socket with mach longer charging durations. From a customer’s perspective these installation drawbacks were severe obstacles in intended EV use and they expected better service and assistance. For them, vehicle and wallbox are *one product* used in combination. From a car manufacturer’s perspective, this situation very much reflects the magnitude of the shift from traditional sales processes with conventional cars. It means that it will not suffice to provide customers with a premium vehicle but that additional services beyond the car itself must be offered. Traditional structures in the automotive industry are not prepared for this. The BMW Group decided very early to close that gap as a part of the 360° ELECTRIC portfolio by offering wallbox solutions, installation checks and installation services and even green energy solutions, using information on future scenarios and customer requests from the field trials. Positive comments in category C02 were very beneficial to understand the meaning of home charging for EV customers. As could be expected and also reflected in later quantitative methods, the installation of a wallbox with shorter charging times greatly eased the charging process. One customer summarized it like this: “*I'm charged up - what normally takes 13 hours just took under 2 hours and I was at 98% from 62% in just over an hour. People - I've been with this 110 since June - I feel like I just exited the steam age.*” Much more as a surprise came the fact how much EV customers valued the independence from driving to the fuel station for gas. Opinions like this could be read frequently: “*I stop by my former gas station and wash my windows occasionally (but that’s just because I like to rub it in) don't miss buying gas and would prefer to never do it again!*” Charging the EV can not only be performed at home but also in public. Public charging opportunities, however, were very limited during the MINI E field trials in the United States. Showing a strong sense of community and pioneer spirit, the MINI E drivers organized themselves: “[A MINI E driver] *has setup a pretty cool web site for people to sign up to be on a charger sharing list. This could be a very handy list for MINI E users if anyone is ever running low on battery a good distance from home. Or a good resource if you wanted to go on a longer trip.*”

As a final case study example the discussions about the already mentioned regenerative braking depict very well the advantages of social media monitoring in field trials. Regenerative braking allows an EV to use energy otherwise lost during deceleration and increases driving efficiency and range available. It also enables the customer to drive the electric vehicle very differently compared to a combustion engine vehicle: Regenerative braking slows the MINI E down up to -2.3 m/s, which, after a short while of practice, even allows to stop the car at a red traffic light without using the friction brake. The question was, however, and asked with emphasis from a development point of view in the light of introducing a substantial change in vehicle driving dynamics: Will customers accept the feature, as it helps to save energy? Even if so, how do they rate the resulting driving experience? Social media monitoring helped again to get unfiltered and very early customer opinions, especially as we did not want to ask explicitly for the customers’ opinions in the very first approach to avoid any response biases. Shortly after the first contact with the new vehicle many customers commented online that although regenerative braking feels quite unusual it is very well accepted: “*I'm just back from test driving the MINI E!* […] *It will take a few drives to get use to the auto regenerative brakes. When your foot comes off the gas pedal the regenerative brakes kick on. It's a little jarring at first but once you learn to slowly take your foot off the gas you almost never need to actually use the brake pedal.*”; “*After only one day and 50 miles, I am pleasantly surprised at how much fun it is to drive* [… I] *rarely have to use the brakes thanks to the aggressive regeneration.*”; “*Most people have the same reaction. At first they are a bit put off by the strong regen* [=regenerative braking], *but after a short while driving it, they love it.*” Customer interviews conducted by our research partners after at least three months of EV usage reveal an even stronger appreciation with growing driving experience. Following the interview plan, a random subset of customers was asked if they liked regenerative braking and the associated single-pedal driving. Feedback was overwhelmingly positive with agreement rates of 88% in China (n=49) to 92% in Japan (n=26) up to even 100% in the UK (n=33), Germany (n=25) and the US (n=72). Between 74%-95% of customers over all countries involved stated that it has become a highly self-motivating almost game-like situation to stop the vehicle at the desired position with regenerative braking only. Given this rare unambiguity in customer feedback, regenerative braking and single-pedal driving were recognized as a positive EV-specific factor that was defined as a requirement for all following pure battery electric vehicles including the BMW i3. However, derived from the reactions on social media and validated with later customer interviews, it was also important to see the customers' surprise in first contact that necessitates adequate information about this newly developed feature.

SOCIAL MEDIA MONITORING AS AN EARLY FIELD STUDY TOOL

Social media monitoring proved to be very helpful to guide the development of qualitative and quantitative research instruments for later phases of the field trials. Using this feedback in early phases of a long-term study corresponds also to the highest activity rates of web users. It may not come as a surprise that almost half of the total number of comments was posted during the first half year of the trial (see Figure 2).

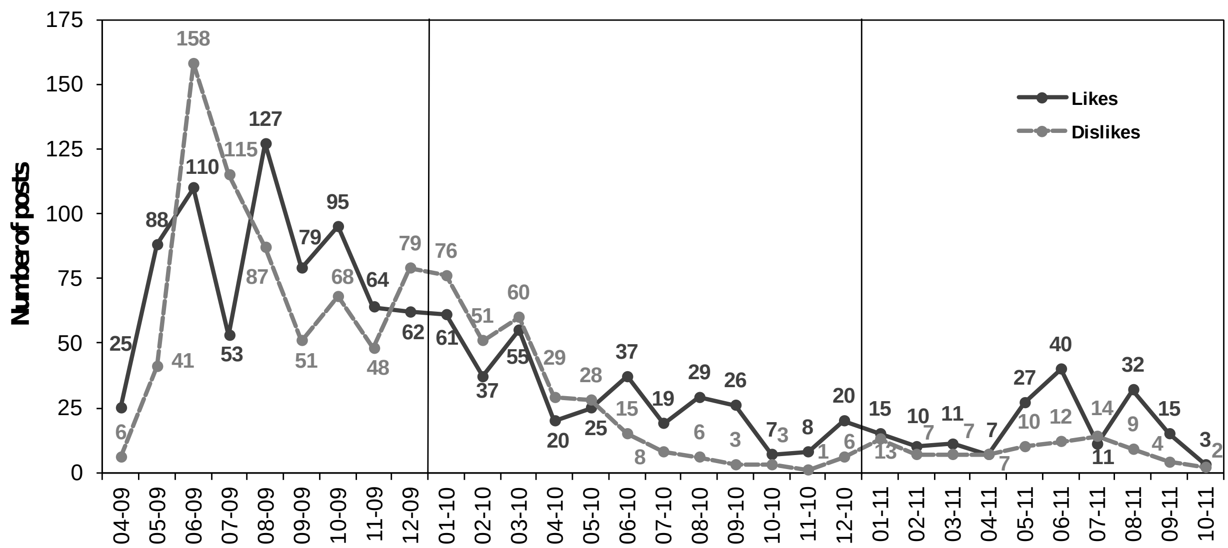

Figure 2. Number of posts during the analysis period 2009-2011.

Prior publications on that subject as listed in the first section of this document already pointed out the risks associated with confusing using social media comments with representative customer feedback or misunderstanding total numbers of likes and dislikes as a representative pattern of opinions. These precautions were also essential when looking at the overall MINI E social media feedback. At the same time it is obvious that a lot can be learned even from single comments. For instance, the report of several MINI E users experiencing difficulties in the installation process is a direct hint that actions need to be undertaken as this problem may occur to any customer. However, as this example also shows, adequate and cost-effective solutions always depend on deeper analysis: Are really all customers affected by a certain (no matter how obvious) problem or does it apply only to sub-groups? Which underlying causes led to the problem (missing service infrastructure, missing technological solutions, regulations restricting solution options, etc.) and are the explanations valid for all (sub-)groups? Can the same range of services be offered to all customers in all countries in order to solve the problem?

These questions point out that findings in social media can only be the first step in an wider chain of analysis methods. Used as a shaping tool for following systematic quantitative or qualitative research with controlled samples, social media monitoring in the context of disruptive innovation processes proved to be extraordinarily beneficial delivering the earliest possible indicators for further research in the field trials reported here.

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