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2010

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Journal:	*18th European Conference on Information Systems*
Manuscript ID:	ECIS2010-0061.R1
Submission Type:	Research Paper
Keyword:	Open innovation, Human-computer interaction, Innovation, Mobile commerce

TOWARDS A DESIGN THEORY OF USABILITY AND GENERATIVITY

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Abstract

Generativity is introduced and argued as essential as well as interdependent with usability in technology design. Where usability is well rooted in the design discourse, generativity, or how easy independent innovators can leverage on technology as a platform to develop new services and applications, has had little attention. We enquire into how the elements of usability and generativity are interrelated, how they contradict and how they can be combined. The mobile phone in general, as well as the Mobile Internet and iPhone in particular is used to illustrate our argument. We discuss different configurations of mobile phones, such as open, flexible and generative devices actively inviting and supporting free innovation and sophisticatedly designed appliances offering high quality services and superior usability. As an outcome of our discussion, we describe four different design approaches and ways to combine generativity and usability, and the properties of each of them.

Keywords: Usability, generativity, mobile phones, Mobile Internet, iPhone, Android

1 INTRODUCTION

The iPhone represents a new chapter in the development of the mobile phone. It has indeed become a design icon, and people have been queuing up like never before just to buy a mobile phone. A key factor behind Apple's success is the way the iPhone offers improved *usability* in combination with offering a *generative* platform for independent innovators. Where usability refers to how easy people can employ mobile phones for their purposes, generativity refers to how easy innovators independent of mobile phone vendors and network operators can leverage on the mobile phone as a platform to develop new services and applications. In this paper we argue the importance of and discuss these two essential elements in the development of the mobile phone. Our aim is to show the crucial importance of the elements of generativity and usability in current information systems design, and enquire into how the elements of usability and generativity are interrelated, how they contradict and the ways in which they fruitfully can be combined. With the emergence of Web 2.0 and user driven innovation, we argue the importance of taking both usability and generativity concerns into account and striking the right balance. We use the mobile phone in general, as well as the Mobile Internet and iPhone in particular to illustrate our argument.

We take as our starting point two different and disjunctive discussions. One is related to the complexity of technology and ease of use, the other to the properties of technological platforms and how they influence innovation. One has its basis in the design discourse, the other emerging from the field of cyber law. By bringing these independent discussions together, we initiate a discussion about what the nature of the future mobile phone will be like. Will it be open, flexible and generative devices actively inviting and supporting free innovation? Or, will mobile phones be sophisticatedly designed appliances offering high quality services and superior usability? Or, do mobile phones need to be both to achieve success in the future? Another way of entering this debate is to focus on the different and possibly conflicting needs of users and innovators. Usually, technology is developed to be used, but not tampered with by its users. They are developed with usability in mind. Like a car, an iPod or a TV set. This is what we can term appliances. Other technologies, which we can term infrastructure technologies, are also made for users as innovators. This is the kind of technologies we focus on in this paper. An example here is the Internet, being open for new applications, for tampering, experimentation and innovation by its users. Our main question then becomes how to serve the needs of users and innovators at the same time. How to combine ease of use, and ease of innovation?

The mobile phone has changed dramatically since its introduction in the early 1980s. During the last decades, it has become smaller while being equipped with improved memory, processing power and input and output capacities. From simply being a device for transmitting and receiving the sound of two people conversing, mobile phones are now in addition high definition cameras, web browsers, email clients, high speed data modems, etc. Network operators and phone manufacturers previously controlled the mobile phones as appliances. They are today offering (even if to a varying degree) open interfaces for independent innovators to play with and extend. There are several factors that motivate this change away from strict vertical integration. On the one hand, Apple as an entrant in the Telecom industry is challenging the incumbent actors. As a response to such new actors, network operators and phone manufacturers are trying to mimic their approach. On the other hand, network operators appreciate a long tail of services, but do not have the resources to develop them internally. As a result, mobile phones will necessarily have to offer some kind of space for external entrepreneurs to innovate.

In many ways, the mobile phone is becoming similar to the PC with related generativity opportunities and challenges. For innovators, this is the opening up of new arenas for innovation. At the same time, the usage of mobile phones for new purposes and applications has not quite lived up to expectations in particular in Europe and the US (2005). While this indeed should be an appealing field for entrepreneurial activities, the pace of innovation is disappointing. There are many candidates for explaining these shortcomings, such as the shaky usability of handsets, numerous chicken and egg challenges (users, services, networks etc.), dubious network capacity, an opaque cost picture as well as

the relative high quality and accessibility of PCs in Western markets (Nielsen and Herstad 2004). Interestingly, all of these challenges seem to prevail over time, and there has been a dearth of suggestions on how to meet them. At the same time, we are currently witnessing a case where innovation seemingly has better conditions for development: Apple's iPhone. An important factor making the relationship between the usability and the generativity argument relevant is the move the mobile phone is making away from being simply an appliance to more of an open platform for innovation. While the mobile phone is becoming more open for innovation, the properties of the mobile phone, such as its limited size, will continue to generate usability challenges. In this situation, we necessarily come to a dilemma where we need offer openness for innovation, as well as serving the more immediate needs for usability. We will use the case of the iPhone to discuss the particular role and the challenging tradeoff between usability and generativity.

This paper is primarily conceptual but also uses the mobile Internet to illustrate the arguments. Methodologically, we draw on a literature review that primarily focuses on the generativity discussions made by cyber law scholars and the usability argument made by Donald Norman. Further, we are following the recent developments of the mobile Internet on the industry side and have studied the development of the mobile Internet in Norway since early 2000 with a focus on service platforms and their influence on innovation (see e.g. Nielsen 2006). The rest of this paper is structured as follows. First, we introduce the usability and the generativity arguments. Second, we briefly describe the recent developments of the mobile phone by particularly referring to the case of the iPhone. Third, we analyze the mobile phone in general with the perspective of usability and innovation and discuss their interrelation, before we end by describing four approaches and models of balancing between usability and generativity. Finally, we draw some implications for the further development of the mobile phone.

2 THE USABILITY ARGUMENT

Put simply, usability is the sum of properties of a technology that denotes how easy it is for humans to use it. It relates to how the user experience using the technology concerning for example efficiency, how easy it is to learn and how satisfying it is. This characteristic has been extensively addressed in the field of Human-Computer Interaction (HCI) with a focus on the quality of the users' interaction with a particular design. More particular, Nielsen (1993) has developed a widely used definition of usability as being related of the following components: Learnability, efficiency of use, memorability, few and non-catastrophic errors and subjective satisfaction. Recent IS research has also stressed that elements of usability also resides on the communication and the business process level (Cronholm etc. 2009). The HCI field has further had a strong focus on the development of methods to measure usability such as Usability Engineering and User-Centered Design (Livari 2008) and a range of heuristics has been developed (e.g. Shneiderman's Eight Golden Rules).

One of the key proponents behind the usability perspective is Don Norman. In his 1998 book *The Invisible Computer* (Norman 1998), Norman argues that the PC has become too complex. As natural development, Norman predicts (or at least hopes) that the PC in the future will change into appliances to solve this challenge. According to Norman, the PC does not serve the needs of its users. Rather, it appears as an annoying tool crafted by engineers without the proper understanding of usability needs. Where it should be working unobtrusively in the background, supporting the tasks we aim to achieve, it is all too visible and all too demanding. Norman sees this as a result of the PC being engineered as feature driven technology. It is the new features that count; it is the features that sell. The ones who are ignored are the users because their functional and usability needs are not served.

All technologies have a *life cycle*, maturing over time. From being complex, over time they will change to offering convenience, ease of use, and pleasure. When new technologies are introduced in a market, so called *early adopters* can accept their weakness and inconvenience (where the majority of users cannot). Enthusiasts focusing on new features and functionality accept early but shaky products. Over time, technology needs to mature to reach the majority of the users. It must change from

complex and multipurpose devices and into appliances. If not, other more convenient technologies will oust them. Through experimentation and competition over time, technology can develop into simple and more appropriate tools for the everyday lives of everyone. According to Norman, this is the *common trajectory* of maturing technology, from feature driven techno-centrism to user-centric appliances. This is a move from the high-tech world to the very different consumer world.

Early adopters can deal with the costs of technology misfit. For them, it does not matter if new technology is cumbersome to use as long as the benefits using it are big enough. Usability is not a primary concern for these technology-driven users. While early adopters may suffer any costs, the majority of users want reliability and simplicity. The solution to this challenge is the introduction of more dedicated technologies that is suited for the tasks at hand – what Norman terms *appliances*. A typical example of an appliance is a car. It is a technology enabled by information technology, but does not require its user to be a computer scientist. Rather, while the driver can focus on driving, the complexity of the technology is submerged and hidden behind easy to learn interfaces. Norman also uses examples such as cassette tape recorders and CD players to describe readily accepted and easy to use technologies. They are task specific and hold the power of modern technology while hiding away their complexity. The PC has yet to become an appliance. It is rather a compromise, sacrificing ease of use for the goal of having one device for everything. This general purpose nature of the PC is not a virtue for Norman, but a source of complexity. From a usability perspective, the PC ought to become an appliance.

In Norman's own words, the argument that fewer features make technology more usable is likely to be considered as blasphemous among technologists. As a quite strong criticism of the technology enthusiasm of the 1990s, Norman's argument has not received too much attention lately. At the same time, his rather traditional usability perspective has been extended by notions such as user experience in the HCI community (see for example Law et. al 2008). Today, more than a decade after the book was published, Norman's dream about appliances has also not (yet) been fulfilled. On the contrary, we may argue that the PC is becoming even more complex as new operating systems are introduced and software becomes open sourced allowing anyone to influence and shape its further developments.

3 THE GENERATIVITY ARGUMENT

More recently, a group of so-called cyber law scholars have argued that the grid of PCs and the Internet now is at the risk of becoming appliances. They foresee the fulfillment of Norman's dream, but for them this is not a sweet one. It is rather portrayed as a nightmare from an innovator's point of view. The foundation of this innovation argument lies in how the PCs and the network that connects them (the Internet) compose a 'commons' for innovation.

The success of the Internet in terms of the breadth of usage and number of users has triggered many discussions about lessons to be learned on how to design technology that promotes innovation. In the later years, this 'essence' of the Internet has been much in focus among cyber law scholars discussing the regulation of cyberspace. A core issue in their discourse has been the way in which the Internet can be designed so that unwanted use (for instance distribution of child pornography and music, film and software piracy) is constrained at the same time as the qualities of the Internet that has made it so successful is maintained. The central quality of the Internet that these scholars focus on is the speed and scope of innovations that the Internet allows for, enables and triggers.

As a core argument in this discourse, Lessig (2001) points to the importance of the location of functions close to the application that uses the function in communication networks. This principle was originally proposed by Saltzer et al. (1984) and is also a way of providing flexibility by systems design. According to Saltzer, functionality in communication networks can only be appropriately implemented if based on knowledge about its usage. This knowledge only exists close to the applications located at its end-points. Thus, the network should not control how it grows, the applications should. Both Lessig (2001) and David (2005) exemplify this argument by illustrating the

Internet as a network where intelligence is in the fringes. Since the network is not optimized for any application, but rather open for and inviting the unexpected and surprising, innovations by independent actors can flourish without changes in the underlying infrastructure. The Internet is based on the Internet Protocol (IP) that simply moves datagrams and a more advanced Transfer Control Protocol (TCP) assuring reliable arrival of the datagrams (error detection, retransmission etc). The network only needs to implement IP, while the endpoints can run TCP on top of it. This is the so-called end-to-end principle and architecture. The important role of the end-to-end architecture in the success of the Internet is also underscored by historian Janet Abbate (1999) in her analysis of the history of the Internet. In particular, she demonstrates the substantial difference this end-to-end architecture represented as opposed to traditional telecommunication (where all functionality is in the network and not at the ends (i.e. the telephones)) and argues convincingly that this was a key element when the Internet won the 'war' against the ISO/OSI standards.

Benkler (2006) develops the end-to-end argument one step further by underscoring the mutual dependence of the end-to-end architecture of networks with (easily) programmable terminals. In the case of the Internet, such terminals are general purpose PCs. Benkler contrasts programmable computers and appliances. Appliances have computers inside, but their software is not to be modified by others than their manufacturers. Benkler as well as David (2005) caution us that several proposals for increasing security and preventing harmful use of the Internet, i.e. cyberspace regulation, will possibly result in constraints on the Internet users' (as innovators) ability to program their computers, and thus turn them into appliances (or at least something closer to appliances). An example of this is the proposed 'trusted computing' technologies.

Zittrain (2006) takes this argument yet another step by means of the concept of *generative technology*. This concept particularly addresses the properties of technology which influence innovation. He argues that the success of the Internet is closely linked to its generative nature, and that regulation of cyberspace must carefully avoid doing harm to this. Generativity is "the essential quality animating the trajectory of information technology innovation [… It] denotes a technology's overall capacity to produce unprompted change driven by large, varied, and uncoordinated audiences" (ibid., p. 1980). Zittrain argues that the grid of PCs connected by the Internet has developed in such a way that it is consummately generative. He defines generativity more detailed as a function of a technology's capacity for leverage across a range of tasks, adaptability to a range of different tasks, ease of mastery, and accessibility. *Leverage* refers to the extent to which a technology enables valuable accomplishments that otherwise would be either impossible or not worth the effort to achieve. *Adaptability* describes the breadth of a technology's use without change and the readiness with which it might be modified to broaden its range of uses. A technology's *ease of mastery* reflects how easy it is for broad audiences to adopt and adapt it: how much skill is necessary to make use of its leverage for tasks they care bout, regardless of whether the technology was designed with those tasks in mind. And finally, *accessibility* refers to how readily people can come to use and control a technology, along with what information might be required to master it, the more accessible the technology is.

Generativity is primarily about how innovation is influenced by the technological infrastructure it is growing out from, and not about innovation as an independent activity. It is about how certain technological arrangements and their properties invite for new usages and applications by independent innovators, where others do not. But as an innovation argument, the concept of generativity does not consider such issues as usability. Its consideration of ease of mastery is limited to the experiences of innovators understanding and applying technology. It concerns how the infrastructure generates innovation, but not the effects of openness on the users. It is an argument that does not focus on the upside of appliances, but considers appliances as a dead end.

4 USABILITY AND GENERATIVITY COMPARED

How can it be that Norman's sweat dream is Zittrain's nightmare, and vice versa? Perhaps we are trying to pull together two debates that are too distant? We argue that both usability and generativity

are important elements to understand the further evolution of the mobile phone and critical for their design. Despite their differences, both the usability and the generativity arguments are about the properties of technology and how technology relates to their users. Where the usability argument is founded on end-user needs, generativity considers the end-users only indirectly by seeing innovation as creating value for the users.

The usability and the generativity arguments can be compared and discussed along several axes. By analyzing the discourse of Zittrain and Norman, we recognize that on a general level both arguments are triggered by technological advancements at the time they were made and a critical perspective on the implications of these. Further, they are both strong proponents of a particular user group (Norman on end-users, Zittrain on innovators). More particular, these issues can be discussed along five axes as follows. *First*, the arguments are made by researchers at different points in time and from the different fields of HCI and regulation. The usability argument, with its origin in the PC era, focuses on the relationship between technology and people based on a mix of cognitive psychology, social sciences and engineering. Growing out of the Internet era, the generativity argument comes from cyber law, governance and regulation, with a focus on censorship, content control and computer security. *Second*, their arguments in favor of and against appliances are triggered by and are responses to different events. Norman's argument is a result of his consideration of the PC being too complex and intrusive for its users. As it diffuses into the market, it is time for it to mature and take the nature of an appliance. It should follow the conventional path of technologies, from complex feature-driven ones, and into invisible tools. Zittrain and colleagues enter the appliance debate from a very different angle by focusing on the grid of PCs and the Internet as being used in unwanted ways, triggering an increasing focus on stricter regulation. A common solution argued to fix this 'challenge' is to implement mechanisms in the technology that reduces these unwanted usages, but according to Zittrain inevitably also running the risk of changing PCs and the Internet to an infrastructure that cannot be tinkered with. And thus, innovation will suffer. *Third*, the very nature of and features of appliances is understood differently. From a usability perspective, appliances are easy to use, hiding away the complexity for the user, appearing as mature technology. From a generativity perspective, appliances are also easy to use, but at the same time obstruct tinkering and innovation. It is easy to use for the end-users, but cannot (or only to a very limited degree) be used by innovators. Appliances are the direct opposite of generativity. *Fourth*, the usability argument focuses on the role of technology as serving user needs, while generativity focuses on technology as infrastructure for innovation. *Fifth* and finally, where the usability argument advocates the individual user and their needs in the short term, the generativity argument represents innovators in a collective sense and the need for creating 'commons' where innovation collectively can flourish and develop over time. These axes of difference are summarized in table 1.

	Usability	Generativity
Origin	Design discussion in the PC era	Cyber law and regulation discussion in the Internet era
Response to	The increasing complexity of the PC	The increasing focus on regulation of the Internet
Features of appliances	Easy to use, hiding away complexity, mature technologies	Obstruct tinkering and innovation
User focus	End-users as individual, short term	Innovators collective, long term
Role of Technology	Serving user needs	Infrastructure for innovation

Table 1. The Usability and the Generativity arguments summarized

5 BALANCING INNOVATION AND USABILITY: THE CASE OF THE MOBILE PHONE AND INTERNET

Both the usability and the generativity arguments have been developed debating the PC. The mobile phone is a related but also a different technology. However, the differences between mobile phones and PCs are fading. The mobile phones are increasingly being equipped with PC like operating systems and significant storage, processing as well as communication capacities. Further, the mobile phone is becoming and important Internet access technology and increasingly being used for office as well as consumer applications previously only accessible from PCs. At the same time the mobile phone is, and will necessarily continue to be small in size. Size puts particular limits on the user interface in terms of output (screen size) and input capacities (keyboard/touch screen), making usability a key issue. The wide diffusion of the mobile phone in the western world (close to saturation) in combination with increasing mobile Internet usage is making usability and generativity considerations pressing in this area.

The majority of mobile phones offered today are feature driven. They evolve by offering new features (such as mp3 players and high definition digital cameras) and improved specifications. We may thus argue that the main trajectory of the mobile phone is not going in the direction of Norman's model of technology development. It is becoming a less rather than more mature technology. At the same time, the pool of mobile phones in use today is fragmented. For example, the large installed base of Nokia 1000 series phones (in particular widely used in the developing world) is composed of rather simple handsets. This is however not commonly seen as an advantage, but rather an unequal distribution of the newest technologies where the unfortunate are still using 'outdated' mobile phones.

Closer to our discussion are the recent handset innovations where the development is taking a different path than the feature driven, such as Vodafone Simply and the iPhone. While Vodafone Simply is based on a back to basics approach serving the needs of those who only need to make phone calls and send text messages, iPhone focuses on delivering standardized and easy to understand and access services based on decentralized and independent innovation. Apple's iPhone has received much attention after its introduction in June 2007. The iPhone has a few important properties that at least partly explain this. It offers a relatively large touch screen with easy to access icons that provide services ready at hand. Equally important, buying an iPhone is also buying into a value network where new services can easily be bought and installed from an application store (App Store). This two-sided market enables entrepreneurs as application providers to offer iPhone users new applications and get paid for them. Even if the application store has been criticized for challenging some of the core values of the Internet since all applications have to be signed by Apple, this has really made a difference for the users, and other mobile phone manufacturers are following (like Nokia's Ovi). In many ways, the iPhone has become a love and hate object. But looking beyond its hype, beauty and problems (battery capacity, inferior antenna technology etc.), it does plot a new direction that mobile devices are likely to head in: a new range of devices that explicitly focus on improving usability and offering an easy to access marketplace for new applications.

While we can question the iPhone approach from a free and open innovation perspective, it has at the same time shown as a fairly successful model in serving users and innovators. In many ways, Apple has found an adequate balance between generativity and usability. Apple takes interest in the quality of the services and controls their introduction to assure that the service offering is of the highest usability standards. Innovation is facilitated as a decentralized activity by entrepreneurs, software developers and content providers. While the infrastructure is stable and fixed, it is continuously extended at its fringes, enabling new usages. Apple also offers the marketplace required for innovators to get engaged in innovation as well as content production and provisioning, and have proved simple in the sense that it enables a broad audience of innovators to participate. More particularly, Apple

offers the iPhone DevCenter[1] with a software development kit, getting started documents and videos, sample code, reference library etc.

As a quite similar case, the major Japanese carrier DoCoMo provides a range of I-mode services of which the most popular are traveling information, SMS equivalent e-mail services, weather and news, music, games and entertainment [4,5]. NTT offers independent content providers a business model where they can sell their services. I-mode is based on a proprietary web access protocol, websites programmed in compact HTML (C-HTML) as well as I-mode end-user terminals. I-mode is based on NTT exploiting content services for strategic purposes and for differentiation to attract and retain customers. Because of its strategic importance, NTT has been willing to allocate significant resources for its development and assuring high-quality services. And as a result, I-mode as a brand stands for high quality services in Japan. The users' acceptance of NTT DoCoMo's I-mode has been found remarkably high, and I-mode has been identified as a unique success case incomparable to other approaches to Mobile Internet (presented by e.g. McDonald (2003)).

In many ways, iPhone appears as generative. In particular, it appears easy to master and accessible. Its adaptability and the way in which it acts as a lever are at the same time uncertain. On the one hand, innovations must go through a process where they are certified by Apple. On the other, Apple is not controlling only the innovation processes, but also the handsets. Apple has managed to design an infrastructure that reduces the potential confusion and fragmentation when involving independent innovators. A key element in this is a well founded, uniform and thus easy to use user interface. Only offering one handset (by contrast, handset producers such as Samsung introduces up to 50 different handsets a year) strengthens the usability further and makes it easy to offer superior usability. While this controlled approach to innovation may improve the usability and the quality of the service offerings, it will necessarily increase time to market and there is a risk of rejecting potentially successful services. While iPhone can make great play with usability, they also perform a certain sense of innovation suppression. The approach of using an application store (iTunes) as a key component has proved favorable for generating innovation and bringing simple services to a large market. Even if this approach has resulted in a wide service offering, the services are within a quite narrow scope of entertainment and messaging. Innovators are not allowed to develop and offer their own APIs, and there is little if any room for more radical innovations.

6 FOUR MODELS OF BALANCING BETWEEN USABILITY AND GENERATIVITY

Through our discussion of the mobile phone we have illustrated that usability and generativity are elements of technology that do not usually go hand in hand. Rather, they appear at least to a certain extent to be mutually exclusive. Open commons for innovation are not likely to result in a high degree of usability, and a high degree of usability requires limitations and standardization, centralized control and closure. Returning to Zittrain's definition of generativity, easy to master and easy to access technologies are likely to attract and inspire a range of independent innovators. But offering a broad audience the abilities to adapt, use and control technology will most likely result in a messy and fragmented offering.

According to Norman, maturing technologies need to go through a process of becoming more usable and less feature-driven to reach beyond the early adopters. The current development and the trajectory of the mobile phone currently show a much more complex picture. The mobile phone is developing from rather standardized and simple appliances, to a range of different, fragmented, to a varying degree programmable, and complex, multipurpose terminals. Even if the iPhone has shown success, there are new platforms just around the corner with different operating systems, different approaches

[1] http://developer.apple.com/iphone/

to openness as well as other application stores. Looking at the totality of handsets and their development, the mobile phone is not at a stage of maturity, but highly feature driven. In this 'chaos' it becomes more fruitful to look at the mobile phone not as *one* technology with *one* trajectory, but rather several technologies with parallel trajectories. By doing so, we are better prepared to study and improve our understanding of how different 'configurations' (including handsets, app stores etc.) influence innovation and usability. Based on the discussion in this paper we can identify four such trajectories or models of balancing between generativity and usability; the *feature driven model,* the *open innovation model*, the *usability by simplicity model* and the *standardized innovation* model. Each of these models has strengths and weaknesses. Some of them are deliberately based on a pragmatic balance between usability and generativity. Others seem to have a configuration without a deliberate and clear focus on these matters.

The *feature driven* model is today represented by the vast majority of existing and recently introduced mobile phones. The development and 'progress' of the mobile phone is in general driven by including extra features and improving performance. The development of the handsets is controlled by the phone manufacturers based on technical innovations and customer demands. In this category, there seems to be no strong and specific strategy related to combining usability and innovation. Even if the phone manufacturers are focused on interface design, the end result is not simplicity but more and more features and functionality. And even if manufacturers are opening up for independent innovators and developers, there are strict restrictions on what parts of the phone they can tamper with and limited support for taking new services and applications to the market.

The iPhone (and also I-mode) is an example of a *standardized innovation* model, allowing independent entrepreneurs to contribute with innovations while at the same time centrally filtering and standardizing innovation in a way that secures usability. There is a particular focus on offering superior usability while also supporting innovators. Apple focuses on sheltering the end-users from not usable, as well as not suitable innovations according to predefined criterions. For independent innovators, conformity is awarded and a prerequisite for access to the marketplace. It is up to the infrastructure owner to define the space for innovation, and by doing so assuring quality and usability for their customers. While the users are likely to be pleased in the short term, more radical and unexpected innovation and usages are most likely to be filtered out or perhaps just happen elsewhere.

The Vodafone Simply range of handsets represents the *usability by simplicity model* (there are also other, similar initiatives like Doro HandleEasy, Kyocera Simple Mobile Phone, DoCoMo's Raku Raku phones etc.). These mobile phones are only focused on offering usability as ease of use. This can be seen as an explicit reaction to the common *feature driven* approach, resulting in handsets 'messed up' with a range of nice to have, but irrelevant functions. Usability is achieved by developing extremely simple and basic phones with very few and easily accessible features. There are no cameras, web browsers, MP3 players etc., only what is necessary to make phone calls and send SMS. With a strategy of offering handsets as pure appliances, there is no need to facilitate innovation. On the contrary, the innovativeness of these phones is exactly that there is no innovation at all. Offering 'highly' usable appliances serves the needs at least for the late adopters and those not (yet) dependent on more advanced services. At the same time, they do not play any role at all in driving innovation on the mobile phone arena.

Rather than only focusing on usability, the *open innovation model* goes in quite the opposite direction, by offering phones that are generative and widely open for innovation without any centralized constraints and filtering. In 2007, Google backed by the Open Handset Alliance launched the Android platform as an attempt in this direction (see e.g. Grøtnes 2009). The Open Handset Alliance is composed of technology manufacturers as well as mobile operators and application providers. Thus, the Android platform does not origin from and is not locked up with a specific handset vendor or any other actor. The alliance' aim with Android is to provide an open and free mobile platform to accelerate innovation and at the same time offer a richer and less expensive mobile experience. Android is open on multiple levels as innovation is distributed related to hardware, operating system as well as applications. With its Linux and thus open source based operating system, developers can

access core device functionality and the libraries used in the core components. The modularity of the platform further allows developers to change and extend many of the core components. At the same time, Android is not about gate keeping and central selection of applications as in the case of the iPhone. There is no registration or certification requirements for developers and applications can be launched freely and without particular permissions from Google or any other member of the alliance. In sum, Android appears as more open for new and unexpected usages, and applications can be launched at any time without filtering since hardware, software and applications are less coupled. The strength of the Android platform and the phones based on it thus lies in the way it generates new and surprising applications. For those who are keen on exploring the newest in technology and applications (the early adopters), this should indeed show as an attractive offering.

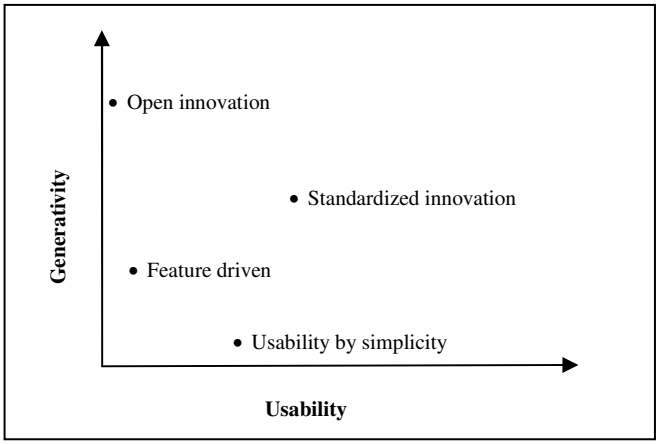

Figure 1. Four models of balancing generativity and usability

Figure 1 illustrates the tradeoff between usability and generativity and the relative position of each of the four models described above. This taxonomy is not meant to be exhaustive when it comes to describing the wide variety of trajectories the mobile phones are developing in, but illustrates the bigger, more general trends (for example, in the developing world we see a different model of flexibility when it comes to recycled phones. Local repair guys are taking a closed system, cracking it open and reconstructing phones with new software and new physical parts). Another way of illustrating the position of each of the models could be to describe each of them related to Norman's concept of mature technologies. From this perspective, the feature driven as well as the open innovation model account for immature technologies, while the usability by simplicity model would illustrate the typical mature technology. The standardized innovation model would be something in between. With a generativity perspective, the open innovation model facilitates innovation, while the usability by simplicity model renders innovation impossible. The feature driven and the standardized innovation models are to varying degrees allowing for and supporting innovation.

Each of the models has their strengths and weaknesses. Where the open innovation model facilitates innovation, it cannot guarantee and is not likely to generate usability in a coherent fashion. And where the usability by simplicity can guarantee usability, there is no room for innovation. Both these approaches may deliver mobile phones that are adequate for certain user populations, respectively early adopters and laggards or people such as elders with special needs. However, if we are to find ways in which to combine generativity and usability fruitfully, we must look to other models. The feature driven model is basically neither offering usability nor generativity. We may observe that some of the handsets that belong to this category offer improved possibilities for innovation, and some that focus particularly on usability, but they do not make a real difference for users or innovators.

It is really only in the standardized innovation model that we see the outcome of a fruitful balance between usability and generativity. For example, where Apple filters new applications for the purpose of assuring usability and as a consequence limits innovation, Apple also offers a highly attractive marketplace acting as a key motivator for innovation. What Apple has managed to do is to focus on both the users and the innovators. This is clearly reflected in the way in which they have managed to create a two-sided market with their application store. Rather than offering their own applications only, they offer a platform open for users and innovators to interact. Filtering applications for the sake of usability will increase the time to market, but at the same time the market is available and well working. Also, the iPhone is indeed feature driven and Apple has delegated the responsibility of innovation to external and independent innovators. While running the risk of jeopardizing the quality and the integrity of their brand, Apple has introduced certain filtering mechanisms to assure adherence to their quality standards. Thus, even if being open for innovation, certain mechanisms have been introduced to assure a certain level of usability. Finally, the iPhone has many of the properties of a generative technology. Apple's application store enables innovation not previously possible, application development is easy to master and it is accessible for the general public. However, the adaptability of the technology has limitations and can only happen within the scope defined by Apple. And this is perhaps the most important feature of the Internet, where so many new usages have flourished. But even if the iPhone does not fulfill this criterion, it still has managed to facilitate innovation with the 25,000 applications in the store as of March 2009[2].

In many ways, the iPhone is an innovative mix of generativity and usability. Where the Internet in itself provides no substantial offering in addition to no barriers for setting up new services (Zittrain 2008), the approach of iPhone is to offer a platform where innovation unfolds under the supervision of Apple where superior usability is secured through centralized control. This illustrates that also this generation of mobile phones are a part of the history of telephony as a monopoly technology and a world that is more regulated than the Internet world. While we have seen bundled and proprietary models being defeated by the Internet approach, this is seemingly not the case with the mobile phone. The iPhone is designed with user preferences as priority number one. Apple have managed to take the advantage of being in more or less full control and thus delivering smooth working solutions for particular purposes based on innovations by external actors. The iPhone does not have fewer features than other phones, and new features are easy to acquire while existing ones are easy to access and not hidden in complex hierarchies of menus.

7 CONCLUDING REMARKS

In this paper, we have discussed iPhone, Android as well as other kinds of mobile phones and illustrated how they balance between usability and generativity. Norman's description of technologies developing towards appliances seems not to fit the development of the mobile phone. Rather than becoming appliances, today's mobile phones are results of the combination and coming together of different and previously independent technologies and features in a process of 'convergence'. Even if we observe what we may call 'convergence', the result is not one universal type of mobile phones, but different types of mobile phones with different strengths and weaknesses. They are intended for different purposes, different parts of the user population, in different ways inviting independent innovators to participate in their further development and to a varying degree offering usability. Through our discussion of the mobile phone, we have shown the importance as well as the complexity of the relationship between usability and generativity.

The usability and the generativity debate have been going on independently. A key argument in this paper is that these elements are important as well as interrelated and should therefore not be treated as independent. We cannot design for open innovation without influencing usability, and assuring

[2] http://digital.venturebeat.com/2009/03/17/app-store- 25000-apps-800-million-downloads/

usability will necessarily come at the cost of openness. Our discussion has also shown that usability and generativity not completely mutually exclusive. Providing 'absolute' generativity will necessarily happen at the cost of usability, and vice versa. At the same time, pragmatic combinations like the iPhone show that a certain degree of generativity and usability still is possible to offer in combination. Our discussion has also pointed at a tradeoff between on the one hand serving users and on the other hand the innovators. Focusing on the users, usability will be of key importance; focusing on the needs of innovators, generativity is the key. At the same time, different users and different innovators will have different needs. Thus, even if iPhone has found its niche, there is indeed a need for different mobile phones serving other innovators' and users' needs.

In a fragmented mobile phone world, we may ask whether thinking usability and innovation at the same time really is the most optimal design approach. A tradeoff will only deliver second best solutions related to facilitating innovation and usability. Mobile phones will necessarily have to develop struggling with these inherent tensions. With dedicated handsets for usability for the majority of the user population, and more open and innovative handsets for the early adopters, we can serve different needs independently. This is also an issue of having a short term or a long term design strategy. In the short term, usability is an important differentiator for the users. In the longer term, users will require the technology to develop (but not in a way that will mess up their daily life) and independent entrepreneurs need spaces for innovation where they can develop new features. With such a perspective, the iPhone falls short of offering a room for more radical innovations, while the Android initiative may prove to be more open.

While the mobile handset field is becoming more complex for the innovators who seek to use the mobile phone as infrastructure for innovation, innovators are also likely to get better access and thus a wider range of possibilities to play, tamper and work with. As for now, the most immediate challenge is how to move innovations on from open and flexible platforms into more structured and usable forms. While the ongoing cyber law discussion is pointing at the costs of being outside and restricting the contribution of independent innovators, our discussion also points to the importance of centralized control to serve usability needs. While Apple has managed to establish the most innovative platform today, we do not believe that there will be only iPhones in the future. As new mobile phone manufacturers like Google are launching similar as well as more open initiatives, we are very likely to see new and fruitful combinations of usability and generativity in the future.

We should be cautious not only discussing technology in terms of usability and generativity. In this paper, we have focused on the individual's relationship to the device as the factor that leads to widespread use and innovation. For example, there is also a social dimension to this, and social pressure may go beyond usability. SMS is one example of this where the usability is awful, but the social pressure is huge. We should also be cautious about the idea that every technology can and should become as generative as the Internet. In particular, different technologies will rely differently on user generated innovations. We may learn important lessons from the Internet, but it is not likely that any other technology will take the same proportion when it comes to openness for innovation.

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