Observatorio (OBS*) Journal, 3 (2007), 001-022 1646-5954/ERC123483/2007 001

The Challenge Of User- And QoE-Centric Research And Product Development In Today's ICT-Environment

Lieven De Marez, MICT-IBBT, Ghent University, Belgium

Katrien De Moor, MICT-IBBT, Ghent University, Belgium

Abstract

Within today's ICT environment, trends like a growing convergence and increasing competition, have led to a fast-changing market with an increasing speed of innovation development and shortening product life cycles. Because of the skipping of research stadia, the lack of insight in the end-user expectations, needs, experiences, and of suitable methodologies … the number of failing innovations has increased remarkably. On the other hand, the boom on the supply-side led to an enormeous empowerment of the consumer. Influenced by these trends, a clear evolution towards a more user-centric, 'pull'-driven mentality started to manifest itself from the early nineties on. In this respect, the concept of '*Quality of Experience*'(QoE) started to acquire a central place in today's innovation and technology development literature, as the success of innovations has become highly dependent on the *experience* of the user. This paper focuses on two major challenges 1) '*What is QoE?*: to date, there still exists a lot of inconsistency and confusion about the interpretation and definition of QoE. In order to tackle this challenge a conceptual model of QoE is presented. The second challenge is related to the question 2) '*How should QoE be measured?'* In this respect, an overview of the most important problems is given and a new approach for more user-centric QoE-measurement is proposed.

Contextualisation: '*How come it goes so slowly when it goes so fast*?'

Within today's ICT-environment, technology provides content creators and consumers with a myriad of coding, security, access and distribution possibilities. At the same time, broadband and wireless communication enable access to information and multimedia services from almost anywhere at anytime. From a consumer's point-of-view, the ICT- and multimedia market is characterized by a growing 'convergence' (Servaes & Heinderyckx, 2002, p. 92; Van Cuilenburg, 1998, p. 12; Van Dijk, 1999, p. 9) and an overload of multi-featured devices and applications. From a suppliers' point-of-view, ICT innovation seems to be a paradox. Lennstrand (1998) describes it by the question '*How come it goes so slowly when it goes so fast?*. On the one hand, liberisation and growing convergence resulted in a hypercompetitive, fast changing ICT environment, characterized by an increasing speed of innovation development and shortening product life cycles (Dogson, 2000, p. 19; Gaines, 1998, p. 7; Haddon, 2004, p. 1; Marsden & Verhulst, 1999, p. 1; Van Riel, Lemmink, & Ouwersloot, 2004, p. 348). Poiesz and Van Raaij (2002, p. 32) are using the concept of an '*innovation spiral* to illustrate this: due to the increasing competition, all competitors feel a stronger need to innovate, resulting in more innovation attempts. In this proliferation of innovations, it

has become more difficult to distinguish innovations from each other, as suppliers move swiftly to the next innovation. On the other hand, this environment is typified by a certain slowness: despite the promising prophecies innovations are introduced with, the number of failing innovations increases. As it becomes so difficult to distinguish oneself from the many competitors, more and more innovations get stuck in the chasm between innovators and some early adopters, and the rest of the market. Explanations are often sought in the lack of accurate insight into the end user's expectations, needs and wants at the early development stages, the absence of suitable methodologies, and the skipping of research stadia in the product development process because of time pressure (De Marez, 2006, pp. 142-165; De Marez & Verleye, 2004, pp. 33-34)

Both from a theoretical as well as from a market perspective, the above mentioned trends caused a clear evolution towards a more user-centric mentality or a shift from a 'push' towards a more 'pull'-driven mentality since the early nineties. The success of new products and technologies has become highly dependent on the experience of the user and his perception of the quality of this experience. As we will see further in this paper, concepts like '*Quality of Experience*' (Drogseth, 2005, p. 1; Enterprise Managament Associates, 2002, p. 1) and '*user experience*' (Forlizzi, 2003,

p. 1; Forlizzi & Ford, 2000, p. 419; Hassenzahl & Tractinsky, 2006, p. 91; Wright & McCarthy, 2003, p. 1), which can be framed within this more user-centric mentality, have started to acquire a central place in today's innovation and technology development literature. From a theoretical point of view, the evolution towards a more consumer-oriented paradigm has undoubtedly also been pushed forward by 'untraditional' approaches as Von Hippel's 'Lead User' theory, stating that lead users can serve as a kind of '*need-forecasting laboratory for marketing research'* (Von Hippel, 1986, p. 791).

To date however, most concrete efforts to anticipate for a good user experience remain limited to the 'big players'. Dell installed its 'Customer Experience council' in 1998, in order to scrutinize every aspect of how Dell interacts with its customers (Kirsner, 1999, p. 1). Other examples like Microsoft, providing Xbox 360-'lead users' with developer kits, or Philips - using a community of 'lead users' for betatesting in its leaduser.nl initatiative - illustrate this growing importance of the user's opinion and experience within the development process. Unfortunately, these initiatives remain rather fragmented: users are often not imbedded in a continuous user-centric process. In most cases, they are only involved in one single stage (e.g. usability testing) or only in the final stages of the process (e.g. evaluating) (Haddon et al., 2005, p. 10). As both scholars and practitioners are confronted with the methodological challenge of more accurate user research in order to stimulate real user-centric product development, some important issues need to be tackled.

Within this paper, we will elaborate on the fact that Quality of Experience and its measurement became

crucial aspects in today's competitive ICT enviroment. More specifically, we will focus on two major issues: As there exists much confusion and inconsistency about the definition and interpretation of this concept, we will first focus on the question '*What is Quality of Experience?* The second challenge we try to tackle relates to the question '*How should QoE be measured?*: we will give an overview of today's problems with regard to QoE-measurement and instigate a new approach.

Changed ICT-environment: changed role for the user?

With the growth of technology development, the use of technological devices (for instance ICTs) became widespread. As a result, consumers were faced with an increased opportunity of choice, as more and more innovations were 'fired' at the market. This boom on the supply-side led to an enormeous empowerment of the consumer, who became a demanding, critical and self-conscious stakeholder. This changing 'user role' did not pass unnoticed within the HCI-tradition. During the '70-'80s, the emphasis was on efficiency and functionality: developers and designers concentrated on the way people thought and processed information (Geerts, 2006; Tuomi, 2005,

p. 21). Users' expectations or subjective experiences were no part of the focus. From the late 80's/early 90's onwards however, people were seen as social actors and development/design teams started to recognize the importance of social aspects and dimensions (cfr. origin of participatory design, contextual design, ...) (Geerts, 2006). Since the late 90's, we find ourselves in a situation where computers and technology in general are ubiquitous, and more importance is attached to the home-environment of people, to the influence of culture, emotions, experience, ... (Geerts, 2006).

This gradual 'rise of the consumer' must be framed within the broader context of some global views on technology adoption, development and management. On the level of theories on technology adoption, the diffusionistic paradigm dominated since the early 60's (Rogers, 1995, p. 2003). Due to an increasing number of failing innovations (that could not be explained by the theory) and a lack of attention for the end-user, this technologically deterministic paradigm was countered by user-centered paradigms as the 'social shaping of technologies' and domestication-perspective since the early 90's (Lievrouw, 2002, p. 185; Mackay, 1995, p. 42; Punie, 2000; Silverstone & Haddon, 1992). Recently, more and more authors adopt the 'middle course' of 'interactionism' (Boczowski, 2004; Trott, 2003): a perspective in which the success of technology adoption and diffusion is explained as a continuous synergy between technological and user/societal forces. On the level of technology development and introduction, as we have seen, there was an identical shift from a more R&D-driven 'push'-oriented mentality towards a more (marketing driven) 'pull'-oriented mentality in which the user became the starting point of the technology development

(Rickards, 2003, p. 1095; Trott, 2003, p. 836). But also here, more and more authors are convinced that reality is somewhere in between: in an interaction of push- as well as pull-forces (Bouwman, Van Dijk, Van Den Hooff, & Van De Wijgaert, 2002, p. 45; Crawford & Di Benedetto, 2000, p. 51).

Whereas Quality of Service and technical performance metrics received a lot of attention in the past, *Quality of Experience* is now the new 'magical word'. The increasing importance of the 'user experience' is without a doubt closely related to the above mentioned change to a more consumer-oriented mentality. Kumar (2005, p. 39) illustrates this sharply when he says: '*The consumer is king – and needs high QoE*'. Quality of Experience should not be a goal in itself, but it does have important implications: if you provide your customers with a high QoE, they will be happy and satisfied (Nokia, 2004, p. 3), but if you don't, you will create a '*customer experience gap*' between what they want and what they get (Good, 2001, p. 4). These gaps are usually caused by a lack of insight in the totality of dimensions of a customer's experience. Too often, developers, designers or managers are aware of the importance of the customer's experience, but their approach remains too narrow (in an instrumental way, in terms of optimizing QoS, ...). As a result there often remains an 'experience gap', although the product or service was intended to increase the customer's Quality of Experience. In order to anticipate what the user expects and experiences, he should be involved in the development process. As mentioned earlier , some big players or industries (e.g. gaming industry) already involve users in certain stages of the development process of a new technology or application. But there still remain lot of difficulties concerning the role of the users, the timing (at what stage of the process?), the actual process of involving the users (what Limonard & de Koning (2005, p. 176) call '*the dilemma of user involvement*'), the type of users that should be involved, etc. (Haddon et al., 2005, pp. 9-10). In this respect we can refer to Von Hippel again:

when it comes to market research for novel products, it is the specific category of 'lead users' that is best suited, since their needs represent the future needs of the whole market (Von Hippel, 1986, p. 791). Von Hippel's theory is only one example of involving the user in the NPD process. But in order to measure the user's expectations and Quality of Experience as well as involving him in the development process from the early stages onwards, we first need to tackle the methodological and conceptual challenges that Quality of Experience brings along.

Rise of the user and his '*Quality of Experience*'

Following Pine and Gilmore's 'Experience Economy' (1999), experience has become a USP or '*competitive battleground*' (Kirsner, 1999, p. 1). There has been a shift in value from 'products' to 'experiences' as the customer wants to see his needs fulfilled (Lawer, 2006). In the changed, highly competitive ICT-

enviroment, the consumer has risen as a powerful stakeholder: he became more demanding as the intense competition between the many suppliers of a same functionality allows him to. He can easily switch from one supplier to another when he has a bad experience. His purchase decisions are now mainly based upon his (perceived) Quality of Experience, while the QoS concern of the end consumer has actually become a non-issue (Van Moorsel, 2001, p. 8). In this respect, Jain (2004, pp. 96-97) points out the difference between on the one hand 'innovators' and 'early adopters' and on the other hand the 'mass market': the former will base their purchase or adoption mainly on the technology, functionality and QoS of the product, while '*normal users care more about the problem the product solves and their experience while using it*'. But Quality of Experience is not only important for adoption purposes, it's at least so important for loyalty purposes: good experiences will also promote customer satisfaction and customer loyalty (Kumar, 2005: 37). At the same time, satisfied customers will lead to a positive market perception and will prevent market dilution. All these elements can help the company to create a relative advantage and maintain its competitive edge (Nokia, 2004, p. 3). Munnecke & Van der Lugt (2006, p. 8) take it one step further when they say that user values and experiences are the '*dominant key values in future markets*'. values that should be at '*the very centre of the innovation process'*. Which brings us to one of the main problems: it is clear that delivering good experiences should be a top priority, but how should this be done? And how can it be done in a way that users are closely involved? Or put differently: '*How do we go beyond the simple platitude "focus on the user" and build our products and services in ways that lead to great experiences*?' (Miller, 2005, p. 90). Drogseth (2005, p. 61) describes the problem in terms of cognitive dissonance between what the priorities of technology managers are (QoE, user-centric approach) and what they actually do (QoS, technology-centric approach). According to Mulder and Steen (2005) '*many projects aim to put end-users central and aim to combine multiple perspectives, but very often this ambition is not completely realised. For example: end-users may be invited to react to prototypes only after they are finished*.' Two of the main reasons for not being able to succeed in going beyond this 'platitude' is the lack of a concrete definition and clear conceptualization of the QoE-concept and the lack of a good QoE-measurement approach.

Two challenges

Within the scope of this paper, our first aim is to propose the conceptual model of QoE, that was developed during an ongoing IBBT[1] - project[2] on End-to-end Quality of Experience. This model is intended to serve as a base for a new and approved QoE-measurement approach. A first step towards the construction of the

[1] Interdisciplinary Institute for BroadBand Technology (Founded by the Flemish Governement: www.ibbt.be)
[2] More info on the E2E QoE-project can be found on the project website: https://projects.ibbt.be/qoe/

model consisted of an exploration (desk research, literature study) of the current definitions of QoE and the confusion and diversity in today's approach. At the same time, we made an appeal to a panel of 12 national and international experts on QoE, In order to compose the panel, we used both literature, seminars and conferences. As an expert were considered those that recently published on the QoE topic, or practictioners involved in researching and managing QoE. The panel was consulted by means of an online survey on QoE definitions and statements. In an attempt to tackle the second challenge, we examined how QoE-measurement should be best dealt with in order to make new product development processes more user-centric. To date, this is still not done well enough. Despite big companies doing efforts to involve 'innovators' in different stages of the process, QoE measurement often remains a fragmented and unsufficient effort because of the lack of the necessary insight into the QoE-concept to create a comprehensive measurement approach. An approach in which innovators certainly have an important role to play, on the condition that this is part of an overall process of synergetically combining methods to involve the user.

Challenge 1: QoE conceptualisation, today's problem for QoE measurement

The central question to be answered here is '*What is Quality of Experience exactly*'? And what makes it so different from other related concepts? Compared to the concept of 'Quality of Service', the QoE-concept is of a more recent date. Whether on the application, network, server or device level, QoS has a rich tradition in engineering and developing environments. The 'semantic variant' Quality of Experience only emerged since the late 90's, when the user, his experience and user-centric design became more important (cfr. supra). For a long time the 'quality'-concept (when related to ICT-projects and services) had a very narrow interpretation in terms of technical parameters and performance metrics in other words, and only recently the 'quality for the user (and of his experience)' became more important. In the definition of this more user-centric quality concept of QoE, the narrow technological interpretation often stays dominant however: Kumar (2005, p. 37) for example defines it as '… *the qualitative measure of the daily experience the customer gets when he uses the services he is subscribed to – including experiences such as outages, quality of picture, speed of the high-speed internet service, latency and delay, customer service, etc*, …'. Other authors as O'Neill (2002, p. 1) or Van Ewijk, De Vriendt, & Finizola (2006, p. 1) define QoE in a similar, rather narrow and QoS-alike way.

Parallel with the rise of the user and traditions like HCI, also the increasing popularity of the usability concept found its translation into QoE-definitions (e.g. Nokia's vision on QoE in the context of 'mobile data services' (Nokia, 2004) or Alben (1996)).

Obviously, QoS and usability are key dimensions for a definition of Quality of Experience; but they can not be the only ones. Several authors emphazise the 'multidimensional' character of QoE (Drogseth, 2005, p. 61; Forlizzi & Batterbee, 2004; Gaggioli, Bassi, & Delle Fave, 2003, p. 121; Hassenzahl & Tractinsky, 2006, p. 91; Kirsner, 1999, p. 1). Some stress the importance of the user's '*emotions, expectations, and the relationship to other people and the context of use'* (Arhippainen, 2003, p. 1), while others describe it as a '*subjective and holistic phenomenon, where users construct the eventual experience within the settings afforded by the environment*' (Vyas & Van Der Veer, 2005, p. 1).

Conclusions from the desk research were legio: QoE definitions are often 'too narrow' in terms of QoS and usability, most authors agree on the multidimensional character of the QoE-concept, but there remains much inconsistency about the very (sub)-dimensions QoE is based on. Literature learns that QoE-definitions should also account for dimensions like context, expectations and perceptions, next to the more technologically-inspired QoS dimensions.

An echo of this was found in our expert panel[3]. Among the QoE-definitions of the 12 experts in our panel, we noticed a broad diversity and the same dimensions recurred: multidimensionality, technical QoS-metrics, subjectivity/perceptions, meeting expectations, context and usability.

Returning to the question: how QoE should be approached, it is clear that QoE is more than just the 'instrumental QoS- and technical inspired' concept it often is regarded as (Hassenzahl & Tractinsky, 2006, pp. 92-93; McNamara & Kirakowski, 2005, p. 201). With input from both the desk research as the expert panel, we tried to build a conceptual model, covering the most important QoE dimensions and integrating the formerly too much seperated visions (which was lacking (Wright, McCarthy, 2003, p.1), with the aim of enabling better measurement and understanding of the QoE-concept.. Starting from a model in which all the elements provided by the literature and the different experts were integrated, we ended up with a model consisting of five main building blocks (the conceptual model with all its subdimensions can be found on the next page):

(1) Quality of Effectiveness (~QoS)

This dimension represents the traditional 'Quality of Service' approach on QoE. QoS doesn't equal QoE, but a performant technology or service is in most cases a first prerequisite to achieve it. Therefore, this 'building block' is all about the accuracy and technological performance, at four levels: a) application/service, b) server, c) netwerk, d) device/handset.

[3] The first question in the online survey was an open question in which the experts were asked to define QoE. Next, after the list of statements and the reactions on these statements was completed, the experts had the opportunity to adjust their initial definition.

(2) Usability

The second dimension, usability, is already integrated in many QoE-definitions. In most cases it is however approached in terms of 'behavioural usability': focused on the ease of working, user friendliness, the man-machine interaction (Argogroup, 2006; Nokia, 2004, p. 3; Velthausz, 2005). Often neglected here is the 'emotional usability': the emotions and feelings

of the user when using the device or technology (e.g. '*is the technology user friendly enough for the user to have a good feeling*?'(Gaggioli et al., 2003, p. 127).

(3) Quality of Efficiency

This dimension is meant to cover the subjective character of Quality of Experience. A certain type of interface will be very clear for one user, while it remains very complex for another. Central question here is: '*is the technology working good enough for the user*?' For this dimension, we distinguish between three levels: a) device/handset, b) network and c) application/service. In technical terms, a technology may be performing very well, but at the same time this may not be efficient enough to satisfy the user or meet the user's expectations. In this respect, Jarvenpaa & Lang, (2005, p. 7) point out the fact that '*users' experiences with technology are often paradoxical*.

(4) Expectations

This fourth dimension is included in the conceptual model to enable the measurement of the previous subjective dimension (Quality of Efficiency) in an adequate way. Only when you have an insight in the user's expectations, conclusions can be made about whether a technology is working well or sufficient enough for that user. The degree up to which the expectations are met, will then determine the Quality of Efficiency.

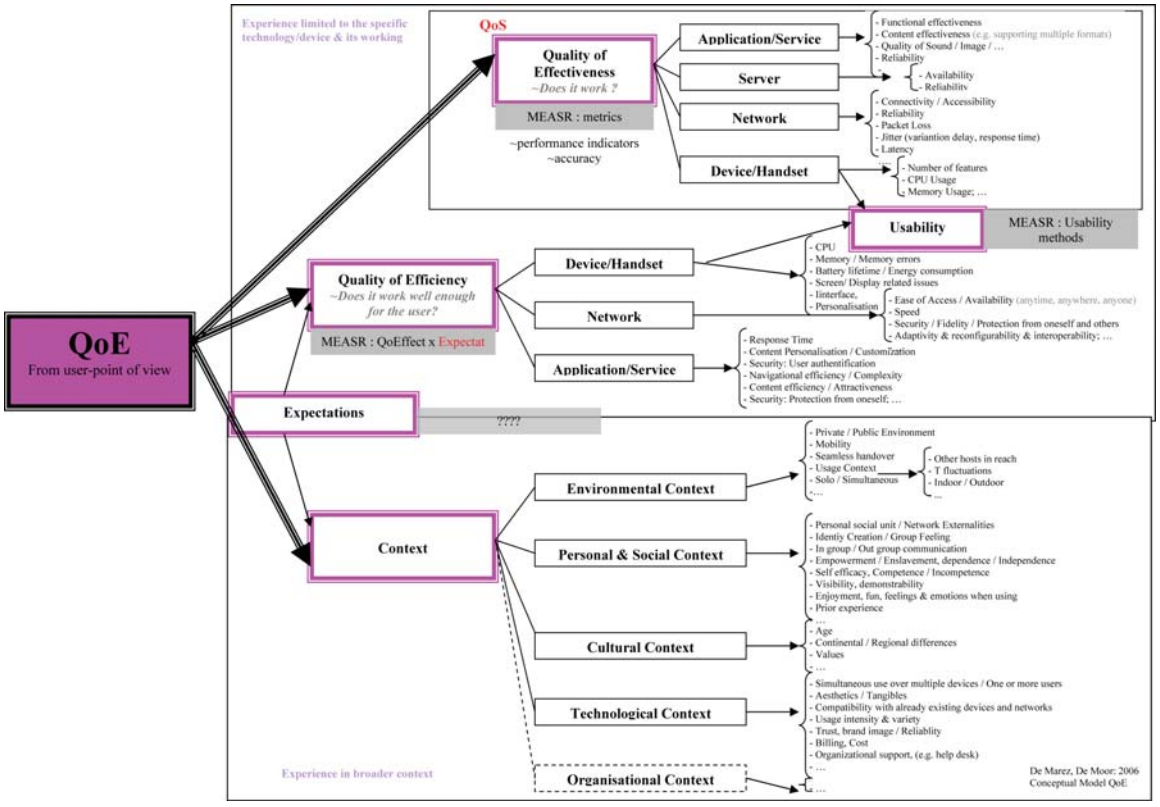
(5) Context

For a comprehensive approach of Quality of Experience, it is also necessary to consider experience in its broader context. Also for this context variable, it is necessary to distinguish between several sublevels. We distinguish between five types of context: a) environmental, b) personal/social, c) cultural, d) technological and e) organisational. The expectations users have, can depend on the context they find themselves in.

With these 5 dimensions, we tried to be complete the model on the level of 'main building blocks', but

referring to the fact that QoE is really a subjective and 'open-ended' matter (Drogseth, 2005, p. 64) it's important to stress that the conceptual model cannot be considered as exhaustive on the level of sudimensions. Summarizing, this proposed model was constructed with the intention to cover not only what the technology does (QoS, performance measurement), but also what people (can) do with the technology, what people want/think to do with it and expect from it, in what context people (intend to) use it, and up to what degree it is meeting their expectations and resulting in an 'end-user happiness'.

Having this conceptual model as a starting point for better QoE measurement, we can move on to the the second question *'How to measure Quality of Experience?'*



QoE-measurement: today's problem

According to Vyas & Van Der Veer (2005, p. 1) the '*era of user experience'* and the rise of Quality of Experience have challenged designers and developers '*to understand human experiences and apply them into the design process*'. Also others emphazise the importance of gaining insight in the user's experiences

and expectations during the NPD-process (Arhippainen, 2003, p. 2; Von Hippel, 1986, p. 791; Vuckovic & Stefanovic, 2006, p. 207), but its practical implemention still shows a lot of shortcomings due to ignorance, questioned credibility and value, market evolutions (cfr. supra), … (Anderson, 2004, pp. 2-3).

To date, a major issue is the technological determinism in the practical approach of Quality of Experience. This can been seen as one of the main reasons for the lack of user involvement. The technological sky is the limit, and there are no concerns about what users want. Developers often wrongly assume that new applications and so called technical optimizations will self-evidently lead to a better experience (Jarvenpaa & Lang, 2005, p. 7). Quality of Experience is usually measured in terms of technical metrics (~QoS), ignoring the fact that the ultimate goal should not be to deliver applications with the most advanced features, but to deliver products that will ensure a good Quality of Experience (Coninx, Luyten, & et al, 2003, p. 17; Empirix, 2001). In today's ICT environment however '*it is no longer sufficient to just deliver products which have technical excellence*'(Bevan, 1999, p. 89). Users should be involved throughout the whole development process (not only in the evaluation phases), and insight in the user's expectations and requirements should even serve as a starting point for the development of a new product or application. We already mentioned the efforts of some of the big players within the ICT environment to involve (lead) users or innovators in the NPD-process in this respect, but once again, we would like to stress that these are rather exceptional cases where users are involved in parts of the process. Secondly, as Quality of Experience often gets a narrow, technical and QoS-alike interpretation, it is mainly measured in terms of technical metrics. Many authors criticize this approach when stressing the multidimensional character of the concept of 'user experience' (Arhippainen, 2003,

p. 3; Buchenau & Fulton Suri, 2000, p. 1; Forlizzi & Ford, 2000, p. 424; Gaggioli et al., 2003, p. 121; Jain, 2004, p. 96). Measuring the subjective dimensions of experience is often skipped or neglected because of the shorter product life cycles, time pressure, budgettary reasons, … (McNamara & Kirakowski, 2005, p. 201), or simply because of ignorance.

This brings us to the problem regarding today's QoE-measurement practices: no consensus about the methods to measure QoE and a lack of knowledge of the existing methods (which (sub)dimensions do they measure? when can they be applied?). For the dimensions that are not measured in the current approach, a reorientation of existing methods and methodological renewal is required. According to Kort, Steen, de Poot, ter Hofte, & Mulder (2005, p. 1) the existing methods are not suited for the intended insights: '*They are too focused on task performance and usability issues, while research interests have changed and broadened to include context and user experience …*'. Indeed, the main measurement-challenge is to go broader then just the performance and QoS-aspects: it's about gaining insight into what the user really experiences, from his own perspective (Arhippainen & Tähti, 2003, p. 27; Ehr, 2003, p. 1).

The identification of the most important problems and issues concerning the measurement of Quality of Experience, brings us to the crucial question: how should QoE be measured?

QoE-measurement: how it should be done?

From the discussion of the conceptual model, we have seen that QoE is a multidimensional concept: five major building blocks were introduced. This means that measuring only one or two dimensions (QoS and usability) is not sufficient: '*Experience does not exist in a vacuum but in dynamic relationship with other people, places and objects. Furthermore, the quality of human's experiences changes over time because different contextual factors influence on it*' (Buchenau & Fulton Suri, 2000, p. 1). Consequently, QoE should be measured in all its dimensions!

Equally important, is the stage in which these measurements occur: the measurement of QoS and QoE traditionally happens 'ex post', after the user has experienced a finished product. More stress should however be put on the expectations 'ex ante'. What is needed is a so-called '*predictive approach'*, that focuses on the user and his QoE from the first phases of the NPD-process onwards (Ishibashi & Tsykin, 2004, p. 135). Arhippainen & Tähti (2003, p. 27) attach a similar value to user research in these early development phases. They see it as necessary condition to gather information about the end-user, his expectations and needs. In this respect, it's also worth mentioning Raina (2006, p. 2), who looks at QoE from a market perspective: in his 'Customer Happiness Mantra', he explicitly underlines the importance of knowing what the user expects (Expectation of Quality, or EoQ). This 'Customer Hapiness Mantra' is *EoQ=QoE*, or in other words, when the expectations equal the experience, your customer will be happy and satisfied. A problem that may arise with these early expectation measurements however, relates to what Limonard and de Koning (2005, p. 176) call the '*dilemma of user involvement*': users cannot always articulate their expectations or predict what they expect to do with certain devices or applications. Innovators and 'lead users' (cfr. Von Hippel) might be very useful user categories here to overcome the familiarity and involvement problems concerning users in the early phases of the development process.

We have seen that the existing measurement approaches and efforts to involve the user, are too fragmented and not well integrated in the whole development process. From the literature and our expert panel, we learned that QoE-measurement can only be successful when it regards an integrated, continuous flow: '*QoE is a journey rather than a destination'* (Enterprise Management Associates, 2002, p. 3). Needs and expectations are influenced by several factors, so what is needed is a continuous, synergetic process. The overall process should consist of several interaction moments with users. This interaction idea is supported by several authors (Arhippainen & Tähti, 2003, p. 27; Corrie, Wong, Zimmerman, & et al, 2003,

p. 1; Forlizzi & Ford, 2000, p. 419), as by the majority of the experts we consulted. The general flow is divided into several stages, as each step of the process raises other questions and requires other methods to gain the necessary insights. Inspired by other authors who opted for a phased approach (Lindgaard, Dillon, Trbovich, & al, 2006, p. 48; Mahadevan, Braun, & Chaczko, 2004, p. 3; Velthausz, 2005, p. 48), we chose to work with the three phases of the new product development-process: 1. prior-to-development and prior-to-launch, 2. post-development and prior-to-launch, 3. post-development and post-launch. Combined with the main dimensions of QoE, taken from the conceptual model of QoE, we propose a more user- and QoE- driven flow in these three phases, measuring five building blocks: Quality of Effectiveness, Usability, Quality of Efficiency, Expectations and Context.

Today's methodologies: suited for the flow?

In order to be able to propose an 'optimal measurement flow' for Quality of Experience at some point, a first and crucial step consisted of a critical screening of the existing methods for QoEmeasurement, and other methods from several disciplines that could be useful for this purpose. Within the scope of the IBBT-project on QoE, this 'screening exercise' resulted in a list of over 60 multidisciplinary methods, both quantitative and qualitative. The following and ongoing step includes the integration of these methods in a QoE- measurement 3x5-matrix, which is made up of the three phases from the NPD-process and the five main QoE-building blocks that were identified previously (cfr. supra). For the plotting of the methods in the matrix, they are judged on their suitedness to measure a specific QoE-dimension and to be applied in a particular phase of the development process.

In first instance this judgement, is based on literature and the consultation of a 'methodological expert panel'. Unlike the expert panel that was consulted in the conceptual phase, the people in the second panel are not necessarily having an expertise in QoE: they are experts in a particular (methodological) field (e.g. working with lead users, usability, participatory design, foresight …). In second instance, the judgment of methodologies is based on empirical findings: in the context of our QoE project, a number of methods to involve users in the process are tested in different case studies (e.g. Playstation 3-case, translation workshops, VoD-case, Videoconferencing-case,…).

Final aim is to come up with optimal solutions for the methodological challenge that QoE is entailing, and to point out those cells where there exists a hiatus, or confusion about how and when a certain method can be used and eventually, to propose a toolset for a user-centric approach to QoE-measurement.

Completing the flow…

In our interpretation of the flow-idea, every decision that has to be taken during the user-centric development process (eg. when to involve users, what type of users should be included, the scope and objectives of every user-centric excercise, the choice of suited methods…) will depend upon the very stage of the development process. In each stage of the process, other Quality of Experience-dimensions (and subdimensions) will namely be emphasized. For instance, during the *prior-to-development and prior-to-launch phase*, involving the user is in many cases considered as unnecessary, or simply skipped because of time pressure or ignorance. Yet as we have seen, a good Quality of Experience equals a match between the actual experience and the expectations before launch. So involving the user in this phase and getting insight in his *expectations* and requirements with regard to the the technology or device, is crucial! Another important dimension here is *context*: how will the environmental, technical, personal & social, cultural… context influence the user's expectations and experiences? For the second phase (*post-development and prior-to-launch*), it is clear that more stress will be on usability testings on the prototype(s), on the Quality of Effectiveness (the technical aspects of the demo(s) or prototype(s) of the technology, device or application) and to a lesser degree also on the Quality of Efficiency (does the prototype/demo work well enough for the user?). In the third phase we mainly situate the traditional *post-measurements*: in this stage, the actual user experience can be measured in all its dimensions (both on a objective and a subjective level).

The ongoing process of integrating the methods into the QoE-matrix is organised as follows: every method is judged on her suitedness to measure one or more subdimensions of QoE and the degree to which she is usable for one or more phases of the development process. Next, the different cells in the matrix, are given a colour: *a green cell* indicates that a suited method was found to measure a particular (sub)dimension at a specific stage of the process (eg. prior-tolaunch). An *orange cell* means that the proposed method could be suited, allthough it still implies some problems (methodological issues, disadvantages from the literature, experiences from own user reseach, …). And finally the *red cells*, represent those QoE-dimensions, for which no solution has been found yet (for that particular stage of the process): a red cell is in other words a hiatus in the methodological 'store' for user-centric product development. As mentioned above, with our own empirical research, we try to evaluate several methods on their suitedness to involve users in the development process and to measure certain QoEdimensions. Within the QoE-project, the case-studies are organised around four common scenarios: VoD, Videoconferencing, 3D-Gaming and networked videosensors.

Case-study Playstation 3 (3D-gaming scenario)

With the release of Sony's newest game console in Europe[4], we invited two groups of users to participate to a qualitative 'game-experience study' in three phases. The first group consists of 5 innovators or 'lead users'[5]. The second group (N=5) consists of more moderate gamers (early adopters – early majority): the participants from this second group all possess a number of game consoles and are very interested in (the launch of) Sony's newest game console, but nevertheless they are not interested in purchasing it right away. Both groups were invited for a PRE-measurement workshop (prior-to-launch) at the beginning of March: with this, we intended to measure their 'expectations' towards the new console *ex ante* and to find out more about their current game-experiences. Within these workshops, a combination of methods and tools was used: brainstorming and free listing, focus group method, prioritising, expectancy value forecasting and image gap. In addition, the first group was invited to participate to a diary study: they were asked to fill in a 'game-experience form' every time they played a game on one of their game-consoles. The second group[6] was invited to come over to test the Playstation 3 in our own test-space. Both groups will be invited once again for a POST-measurement workshop (which will take place in April), to tell us about their experiences with the Playstation 3 console. At these sessions, the user's initial expectations (before launch) and their actual experiences will be compared. We will look for possible 'experience gaps', for differences between the two user groups, assess the experiences from the diaries …and by doing this make an evaluation of all the methods that were used in this case-study[7].

Conclusion

The outline of the changed ICT-environment led us to the evolution towards a more consumer- and user-centric, 'pull'-driven mentality from the early nineties on. In this respect, the concept of '*Quality of Experience*' acquired a central place in the literature, as the succes or failure of new technologies has become highly dependent on the user's experience. As a result, gaining insight in this 'Quality of Experience' can be seen as a necessary condition for delivering good experiences.

We identified two major challenges with regard to QoE. As there exists a lot of inconsistency and confusion about the definition of the QoE-concept in the literature, the first challenge was related to the question: *'What is QoE'?* In order to tackle this challenge, a conceptual model for QoE - consisting of five major building blocks and many subdimensions - was presented. With this model, we aimed to stress the

[4] The European release of the Playstation 3 console took place at March 23, 2007.
[5] We defined 'innovators' or 'lead users' here as people who had already ordered the console well in advance and who usually buy a new game console right ahead after its launch.
[6] This was the group that didn't intend to purchase the Playstation at or immediately after the release.
[7] Results of this study will be available at the time of the conference.

multidimensional and subjective character of the QoE-concept and propose the base for an improved measurement approach for QoE. Another important observation (i.e. the lack of a good measurement-approach) served as the base for our second challenge: to instigate *a new user-centric approach for QoE-measurement*. In this respect, the most important problems were listed and a number of suggestions for a new approach were made: QoE should be measured in all its dimensions, it should regard an continuous, synergetic process, that consists of several interaction moments with users. Only if users are involved throughout the whole development process, their expectations, needs, experiences...can be anticipated, leading to an optimal end-user experience. As we have seen, some big players have already made their first attempts to valorize the above mentioned mentality-shift. From these initiatives, it is clear that innovators and lead users can have an important role to play. They are however still too fragmented, limited to a certain type of users, not well integrated into a whole, continuous user-centric development process... Good measurement also implies choosing the right methods and gaining insight in the strenghts and weaknesses of these methods: we gave an overview of our ongoing methodological research for QoE-measurement, and the integration of methods into a QoE-measurement matrix. As we saw, the judging of the suitedness of methods is based upon literature, a methodological expert panel and our own empirical findings. Final aim here is to come up with optimal solutions for the methodological challenge that QoE is entailing.

It is clear that the product development process in the context of the changed ICT-environment would benefit tremendously from a *real* user- and QoE- centric approach. Doing this means that the user and his experience are placed at the heart of the innovation and development process. Question is now, who dares to take up *this* challenge?

References

Alben, L. (1996). Defining the criteria for effective interaction design. *Interactions, 3*(3), 11-15.

Anderson, R. I. (2004). *Changing the role "User Experience" plays in your business (blog entry)*. from http://www.well.com/~riander/obstacles.html.

Argogroup. (2006). *User Experience Optimization: what it is and why you should care*. from www.argogroup.com/products/about_ueo.

Arhippainen, L. (2003). *Capturing User experience for product design.* Paper presented at the The 26th Information Systems Reseach Seminar (IRIS26), Porvo, Finland.

Arhippainen, L., & Tähti, M. (2003). *Empirical Evaluation of User Experience in Two Adaptive Mobile Application Prototypes*. Paper presented at the Proceedings of the 2nd International Conference on Mobile and Ubiquitous Multimedia, Norrköpig, Zweden (December 10-12, 2003).

Bevan, N. (1999). Quality in use: meeting user needs for quality. *The Journal of systems and software, 49*, 89-96.

Boczowski, P. J. (2004). The Mutual Shaping of Technology and Society in Videotex Newspapers: Beyond the Diffusion and Social Shaping Perspectives. *The Information Society, 20*(4), 255-267.

Bouwman, H., Van Dijk, J., Van Den Hooff, B., & Van De Wijgaert, L. (2002). *ICT in organisaties. Adoptie, implementatie, gebruik en effecten*. Amsterdam: Boom.

Buchenau, M., & Fulton Suri, J. (2000). Experience Prototyping. *Proceedings of UbiComp 2002*, 73-92.

Coninx, K., Luyten, K., & et al. (2003). Human-Computer Interaction: Een seminarie van EDM & VSP. *LUC-nieuws*(april 2003), 25-17.

Corrie, B., Wong, H. Y., Zimmerman, T., & et al. (2003). *Towards Quality of Experience in Advanced Collaborative Environments*. from wwwunix.mcs.anl.gov/fl/flevents/wace/wace2003/material/wace-03-papers/corrie.pdf

Crawford, M. C., & Di Benedetto, C. A. (2000). *New Products Management (6th ed.)*. Bosteon: Irwin McGraw-Hill.

De Marez, L. (2006). *Diffusie van ICT-innovaties: accurater gebruikersinzicht voor betere introductiestrategieën.* Unpublished Doctoral dissertation, Universiteit Gent: Vakgroep Communicatiewetenschappen.

De Marez, L., & Verleye, G. (2004). Innovation diffusion: The need for more accurate consumer insight. Illustration of the PSAP scale as a segmentation instrument. *Journal of Targeting, Measurement and Analysis for Marketing, 13*(1), 32-49.

Dogson, M. (2000). *The Management of technological innovation. An international and strategic approach.* Oxford: University Press.

Drogseth, D. (2005). Business Alignment Starts with Quality of Experience. *Business Communications Review*(march), 60-64.

Ehr, M. (2003). End-User SLAs: Guaranteeing 'real' service levels. *Network World*(07/30/03).
Empirix. (2001). *Assuring QoE on next generation networks*. Whitepaper.

Enterprise Managament Associates. (2002). Quality of Experience: the ultimate business metric. *Product Brief*(August 2002).

Enterprise Management Associates. (2002). Quality of Experience: the ultimate business metric. *Product Brief*(August 2002).

Forlizzi, J. (2003). *A Framework of Interaction and Experience as it relates to the Design of Products and Systems*. from http://goodgestreet.com/experience.home.html.

Forlizzi, J., & Batterbee, K. (2004). *Understanding Experience in interactive systems.*, DIS04 Conference Proceedings, Cambridge, MA.

Forlizzi, J., & Ford, S. (2000). The building blocks of Experience: an early framework for interaction designers. *ACM*, 419-423.

Gaggioli, A., Bassi, M., & Delle Fave, A. (2003). Quality of Experience in Virtual Environments. In G. Riva, F. Davide & W. A. Ijsselsteijn (Eds.), *Being there: concepts, effects and measurement of user presence in synthetic environments* (pp. 122-136). Amsterdam: Ios Press.

Gaines, B. (1998). The learning curves underlying convergence. *Technological Forecasting and Social Change, 57*(1-2), 7-34.

Geerts, D. (2006). *Usability in the 21st century. Lecture at the 1st Humantics Pulse Night* Mediacentrum K.U. Leuven.

Good, C. (2001). *White Paper One: Building a Great Customer Experience to Develop Brand, Increase Loyalty and Grow Revenues*.

Haddon, L. (2004). *Information and Communication Technologies in Everyday Life. A concise Introduction and Research Guide*. Oxford/New York: Berg.

Haddon, L., Mante, E., Sapio, B., Kommonen, K.-H., Fortunati, L., & Kant, A. (Eds.). (2005). *Everyday Innovators: Researching the role of users in shaping ICT's*. Dordrecht: Springer.

Hassenzahl, M., & Tractinsky, N. (2006). User experience - a research agenda. *Behaviour & Information Technology, 25*(2), 91-97.

Ishibashi, K., & Tsykin, M. (2004). Management of enterprise Quality of Service. *Fujitsu Science and Technology Journal, 40*(1), 133-140.

Jain, R. (2004). Quality of Experience. *IEEE MultiMedia, 11*(1), 95-96.

Jarvenpaa, S. L., & Lang, K. R. (2005). Managing the paradoxes of mobile technology. *Information System Management*(Fall 2005), 7-23.

Kirsner, S. (1999). The customer experience. *Fast Company Magazine* (Fall 1999), 1-7.

Kort, J., Steen, M. G. D., de Poot, H., ter Hofte, H., & Mulder, I. (2005). *Studying usage of complex applications*. Paper presented at the Measuring Behavior 2005: the 5th International Conference on Methods and Techniques in Behavioral Research (August 3 - September 2, 2005). from https://doc.telin.nl/dscgi/ds.py/View/Collection-329.

Kumar, K. (2005). A marriage made in QoE heaven. *CED Magazine*(July 2005), 37-39.

Lawer, C. (2006). The logic of co-creation (Weblog entry Chris Lawer). Retrieved February 29, 2006, from http://chrislawer.blogs.com.chris_lawer/2006/02/the_logic_of_co.html

Lennstrand, B. (1998). *Diffusion of information and communication technology to households: how come it goes so slowly when it goes so fast?* Paper presented at the 12th Biennal ITS Conference. from http://www.fek.su.se/home/bl/diffusion/rapidslow.pdf.

Lievrouw, L. A. (2002). Determination and Contingency in New Media Development: Diffusion of Innovations and Social Shaping of Technology Perspectives. In L. A. Lievrouw & S. Livingstone (Eds.), *The Handbook of New Media* (pp. 183-199). London: Sage Publications.

Limonard, S., & de Koning, N. (2005). Dealing with Dilemmas in Pre-competitive ICT Development Projects: The Construction of 'The Social' in Designing New Technologies. In L. Haddon, E. Mante, B. Sapio, K.-H. Kommonen, L. Fortunati & A. Kant (Eds.), *Everyday Innovators: Researching the Role of Users in Shaping ICT's* (pp. 155-167).

Lindgaard, G., Dillon, R., Trbovich, P., & al. (2006). User Needs Analysis and Requirements engineering: Theory and Practice. *Interacting with Computers*(18), 47-70.

Mackay, H. (1995). Theorising the IT/Society Relationship. In N. Heap, R. Thomas, G. Einon, R. Mason & H. Mackay (Eds.), *Information Technology and Society* (pp. 41-53). London: Sage Publications.

Mahadevan, V., Braun, R., & Chaczko, Z. (2004). *Mastering the Mystery through 'SAIQ' Metrics of User Experience in Telecollaboration Business Systems*. Paper presented at the IADIS International Conference WWW/Internet 2004, Oktober 6-9 2004, Madrid.

Marsden, C., & Verhulst, S. (1999). Convergence: A Framework for Discussion. In C. Marsden & S. Verhulst (Eds.), *Convergence in European Digital TV Regulation* (pp. 1-20). London: Blackstone.

McNamara, N., & Kirakowski, J. (2005). Defining Usability: Quality of Use or Quality of Experience? *2005 IEEE Professional Communication Conference Proceedings*, 200-204.

Miller, J. (2005). The User Experience. *IEEE Internet Computing, 9*(5), 90-92.

Mulder, I., & Steen, M. (2005). *Mixed emotions, mixed methods. Conceptualising experiences of we-centric context-aware adaptive mobile services: 'User experience design for pervasive computing'*. Paper presented at the Pervasive Conference, May 11, 2005.

Munnecke, M., & Van der Lugt, R. (2006). *Bottom-up Strategies in Consumer-led Markets.* Paper presented at the 2nd Seville Seminar on Future-Oriented Technology Analysis.

Nokia. (2004). *Quality of Experience (QoE) of mobile services: can it be measured and improved?* White Paper.

O'Neill, T. M. (2002). Quality of Experience and Quality of Service for IP Video Conferencing. *White Papers by Polycom*.

Poiesz, T. B. C., & Van Raaij, W. F. (2002). *Synergetische Marketing. Een visie op oorzaken en gevolg van veranderend consumentengedrag*. Amsterdam: Prentice Hall.

Punie, Y. (2000). *Domesticatie van informatie- en communicatietechnologie. Adoptie, gebruik en betekenis van media in het dagelijkse leven: continue beperking of discontinue bevrijding?* Unpublished Doctoral dissertation, Vrije Universiteit Brussel: Vakgroep Communicatiewetenschappen.

Raina, S. (2006). *Correlating Network Behaviour and Customer Experience*. Presentation at the 3GSM Optimisation Forum, March 29-30, Rome.

Rickards, T. (2003). The Future of Innovation Research. In L. V. Shavinina (Ed.), *The International Handbook on Innovation* (pp. 1094-1100). Oxford: Pergamon, Elsevier.

Rogers, E. M. (1995). *Diffusion of innovations (4th ed.)*. New York: The Free Press.

Servaes, J., & Heinderyckx, F. (2002). The 'new' ICTs environment in Europe: closing or widening the gaps? *Telematics and Informatics, 19*(2), 91-115.

Silverstone, R., & Haddon, L. (1992). The individual and social dynamics of information and communication technologies: present and future (RACE project 2086). Unpublished report for RACE Project 2086. SPRU CICT, University of Sussex, Falmer.

Trott, P. (2003). Innovation and Market Research. In L. V. Shavinina (Ed.), *The International Handbook on Innovation* (pp. 835-844). Oxford: Pergamon, Elsevier.

Tuomi, I. (2005). Beyond User-Centric Models of Product Creation. In L. Haddon, E. Mante, B. Sapio, K.-H. Kommonen, L. Fortunati & A. Kant (Eds.), *Everyday Innovators: Researching the role of Users in Shaping ICT's* (pp. 21-38). Dordrecht: Springer.

Van Cuilenburg, J. (1998). In search of new knowledge for communications design and policy. *Trends In Communication (TIC), 5*, 7-17.

Van Dijk, J. (1999). *The Network Society. Social Aspects of New Media.* London: Thousand Oaks.

Van Ewijk, A., De Vriendt, J., & Finizola, L. (2006). Technology White Paper. Quality of Service for IMS on Fixed Networks.

Van Moorsel, A. (2001, September 16, 2001). *Metrics for the Internet Age: Quality of Experience and Quality of Business.* Paper presented at the Fifth Performability Workshop, Erlangen.

Van Riel, A. C. R., Lemmink, J., & Ouwersloot, H. (2004). High-technology Service Innovation Succes: A Decision-Making Perspective. *Journal of Product Innovation Management, 21*(5), 348-359.

Velthausz, D. (2005). *Onbegrensde Communicatie (Presentatie 21/12/2005)*. from didactiekinf.uhasselt.be/tt/Documents/Seminars2005/FreeBand/set2.pdf.

Von Hippel, E. (1986). Lead users: A Source of Novel Product Concepts. *Management Science 32*(7), 791-805.

Vuckovic, P. M., & Stefanovic, N. S. (2006). *Quality of Experience of mobile services.* Paper presented at the 14th Telecommunication Forum TELFOR, November 21 - 23, 2006. from www.telfor.org.yu/Radovi/03_RK_04.pdf.

Vyas, D., & Van Der Veer, G. C. (2005). *Experience as 'meaning': creating, communicating and maintaining in real-spaces.* Paper presented at the workshop 'spaces, places & experience', at Interact 2005, Italy.

Wright, P., & McCarthy, J. (2003). Feature: A framework for analyzing user experience, summery of 'Making sense of Experience'. In A. Monk, M. Blythe & C. Overbeeke (Eds.), *Funology: From usability to enjoyment*. AA Dordrecht: Kluwer.