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Do Point of Sale RFID-Based Information Services Make a Difference? Analyzing Consumer Perceptions for Designing Smart Product Information Services in Retail Business

FLORIAN RESATSCH, UWE SANDNER, JAN MARCO LEIMEISTER AND HELMUT KRCMAR

A b s t r a c t

The increase in RFID implementation in retail allows the development of smart product information applications. However, literature describes only a few evaluations of RFID retail applications with real consumers. The question that arises is, whether such theoretically possible user-centric ubiquitous computing applications meet user needs and, if so, what method is best to investigate this? For our investigation, we developed a mobile phone application prototype based on Near Field Communication (NFC) to obtain product information at the Point of Sale (PoS). Following the ideas of Davis and Venkatesh (2004) and Abowd *et al.* (2005) with an extended pre-prototype approach for application development and evaluation, we conducted two focus groups (10 consumers, 10 sales assistants). While participants considered the NFC technology innovative and very easy to use – the need for further information at the PoS was low and varied between product categories. Our approach found that user opinions about paper-based concepts and real prototypes were different from the findings of Davis and Venkatesh (2004). This paper is the first to evaluate a smart information product system with an existing prototype and real consumers, as well as sales personnel. The findings contribute to the theory of ubiquitous computing by proposing a modified approach to evaluating user acceptance and to refining information system requirements for RFID-based smart products. The findings also reflect the response of sales personnel to RFID penetration in shops, suggest how mobile services can add user benefits, and help in the selection of what is the most beneficial information to present at the PoS.

Keywords: Ubiquitous computing, ubiquitous commerce, RFID, smart products, product information service, NFC

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INTRODUCTION

While consumers use the Internet as an easily accessible source of product information at home or at work, this information is not easy to access at purchase time. In part, this is because many purchases are ad hoc, that is, made through searching for a close match to a perceived need or made on impulse. Thus, the consumer must rely on the expertise, skill and trustworthiness of sales assistants in providing viable product information at the Point of Sale (PoS). Lack of knowledge and information about a product can make this purchase decision difficult (Aßmann 2003, Bettmann 1973, Kaas 1994, Mitchell 1992, Mitchell and Boustani 1994). Useful information, such as user-generated product ratings, product reviews, or opinions from friends and family would be a great help at purchase time. Radio Frequency Identification (RFID) could be a solution to this problem as it can be designed to bridge the offline and online world. The recent increase in RFID implementations enables the development of user-centred ubiquitous computing (ubicomp) applications – by merging physical products and information products into so-called 'smart products' (Loebbecke and Palmer 2006, Maass and Filler 2006, Mattern 2005). 'Smart products' and smart product information services are sought to help lower negative influences on purchase decisions, such as uncertainty and making shopping a more positive experience. However, the questions are: Will these theoretically possible user-centric ubicomp applications meet user needs? Are they worth the effort? Or are they only useful for specific types of products? What are the perceived benefits of additional product-related RFID-based information services at the PoS?

In order to shed light on these questions and on the field of smart product information services, we applied an extended pre-prototype evaluation approach as a variation of Davis and Venkatesh (2004). We designed a prototype – the 'Mobile Prosumer' (MP) – a mobile phone application for delivering relevant product information at the PoS. The MP aggregates content from various online sources for display on a mobile phone using Near Field Communication (NFC). Based on marketing literature (Meffert 2005), we conceptually determined what product information would be relevant to the consumer and how improved access to this product information might change their customer experience and thereby facilitate the purchase. Then we evaluated the prototype in two stages using two focus groups, one containing consumers and one, professional sales personnel.

This paper proposes an extended prototype development and evaluation approach that helps to define requirements for information systems innovations in which users have had no prior experience. The findings also illustrate where the use of RFID-customer support in stores might be useful and how smart product information services benefit the shopping experience. In closing we outline implications for the future development of smart product information services.

BACKGROUND AND RESEARCH QUESTIONS

The possibility to use data on RFID chips attached to objects is referred to as the 'internet of things' (Gershenfeld *et al.* 2004, Leimeister and Krcmar 2005, Mattern 2003a, 2003b, 2005).

RFID was first introduced to retail businesses in order to optimize delivery logistics, solve out-of-stock problems and improve the supply chain (Fleisch *et al.* 2005, Fleisch and Mattern 2005, Fleisch and Thiesse 2007, Loebbecke and Palmer 2006, Mattern 2005, Murphy-Hoye *et al.* 2005, Resatsch *et al.* 2007a). The use of RFID tags that provided information both for retailers and consumers alike is now under consideration (Novak 2005, Parkinson 2004). Here, the concept of ubiquitous computing (Ubicomp) enters the domain of retail and commerce (Loebbecke and Palmer 2006, Roussos 2005, 2006, Roussos and Moussouri 2004, Roussos *et al.* 2002 Strüker *et al.* 2004, Weiser 1991, 1993). Developing an ubiquitous RFID infrastructure on item level that is directly usable by consumers could yield a better understanding of the technology and increase its perceived value (Resatsch *et al.* 2007a). Yet, it is unclear whether individuals want this type of detailed product information in real shopping situations. To answer this question, it is important to look first at the difference between online and offline shopping.

Differences in online and offline shopping

Offline shopping (Cox and Rich 1964, Dowling and Staelin 1994, Prus and Dawson 1991, Punj and Staelin 1983, Tauber 1972) differs from online shopping for a variety of reasons (Degeratu *et al.* 2000). Search costs are less online with different search dynamics being used for different types of goods (Alba *et al.* 1997, Johnson *et al.* 2004, Shapiro and Varian 1999). Among all other positive attributes of online shopping (y Monsuwé *et al.* 2004), the reduced effort for product searches and the amount of information available on the product desired are good reasons for consumers to shop online.

Similar to the difference in product search and assessment experience off- and on-line (Chiang and Dholakia 2003), purchases also differ in search qualities, determinable before the purchase, experience qualities, known only after the purchase, and credence qualities that are difficult to judge even after the purchase (Aßmann 2003, Adler 1996, Darby and Karni 1973). While available online, missing product information at the (offline) Point of Sale (PoS) in terms of search and

experience qualities poses problems with the consumer decision process, creating, in particular, higher uncertainty. Recent trends in using personal social networks and community-based or automatic recommendation systems also are found to improve the overall online purchase experience (Eck *et al.* 2007, Heath *et al.* 2006). However, these improvements support online shopping decisions, but are not yet easily available in real life at the PoS.

Smart products – Bridging the gap between offline and online information? Smart products – products that share information with consumers – are designed to combine the online and offline world. They give physical store operators in today's world of intense online shopping the possibility to compete with online retailers by providing direct access to the online information (Maass and Janzen 2007, Roussos 2005, Smith *et al.* 2003). Smart products communicate with the consumer and also enable new ways of interaction (Fleisch *et al.* 2005). Whereas today's in-store products provide only static information, future smart products may provide information about their journey to their current location (e.g. multiple countries of origin), information about their ingredients (e.g. news articles on problems with a particular supplier) and possibly some embedded intelligence that determines the customer's needs (e.g. the types of difficulties others have had in assembling the product). Smart products can also act as a process interface and information source for retailers (e.g. How many times the product has been picked up by customers) (Fleisch and Thiesse 2007, Fleisch *et al.* 2005).

Convergence effects of RFID and end-user devices, such as Near Field Communication (NFC) – the combination of mobile phone and RFID reader and tag, open up further a new field of customer service (Resatsch *et al.* 2007b, Riekki *et al.* 2006). A smart product information service, in this context, will be defined as an application that uses the data from the RFID-tagged product to provide Internet services related to the product. Smart product information services, naturally, will provide, retrieve and display differing types of information depending on the product (Levin *et al.* 2003). However, if such RFID-based smart products are to play a role in future retail scenarios, they must be technically feasible and provide a benefit to consumers.

Technical feasibility depends on the common usage of user devices that will interact with smart products, relevant software on both the user device and its supporting infrastructure, network access and the availability of relevant content. Middleware needs to be developed that integrates the Internet product information with the product (Maass and Janzen 2007). Because of the massive penetration of mobile phones, the mobile phone could serve as the ubiquitous user device for interacting with smart products (Jalkanen 2005, Kaasinen 2005, Rukzio 2007, Välkkynen *et al.* 2003, Välkkynen *et al.* 2006). With growing NFC penetration (ABI Research 2007), it is likely that smart product information services will become more prevalent.

In the area of pervasive retail systems, the following applications have been already developed and partly evaluated: RFID-based application myGrocer (Kourouthanassis and Roussos 2003), the mobile device and barcode-based AURA system (Smith *et al.* 2003) and conceptual applications for socially-conscious practices (Novak 2005) have been investigated. Although the authors claim user benefits, it is not clear if consumers and retailers will really respond to these systems. Benefits for consumers could be: First, in terms of search, the user should be able to quickly discover available online information, e.g. comparable products plus rich descriptions of its use and limits; In terms of experience, the user should be able to learn from others how well-liked the product was, how long it lasted, etc.; and in terms of credence, the user should be able to find out how the company treated returns, failures, etc. These benefits could make purchase decisions easier. However, no widespread use of a smart product information service exists.

Figure 1 shows where smart product information services could potentially extend online shopping convenience to the PoS in terms of the different product qualities (i.e. search, experience, credence).

Research questions

In summary:

- Relevant information about most products exists independent from the real product (virtual world vs. physical world).
- While the Internet is a common information source, consumers at the Point of Sale (PoS) rely upon the expertise, attitudes and trustworthiness of sales assistants to obtain relevant product information
- PoS purchase decisions are thus, difficult and may increase the perceived feeling of uncertainty because of the lack of sufficient product information
- Missing entirely at the PoS is significant information about other's experiences with the product

We propose that the ubiquitous cell phone and smart products can be combined in a system that will provide this information to the customer at PoS. However, since retail shopping is both an impulsive, affective and cognitive process, it is not clear exactly what information to present to the consumer or how to present it.

Thus, our main research questions are:

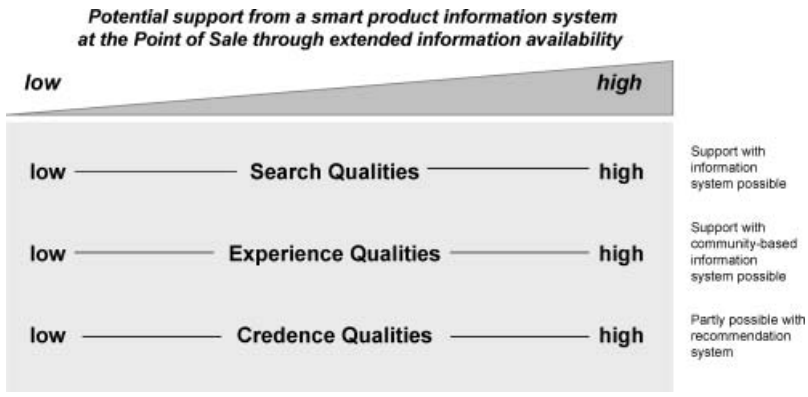

Figure 1. Product qualities and their relation to potential support from a smart product information system at the PoS (see Adler, 1996 and Aßmann, 2003 on qualities)

- What is considered relevant and useful information at PoS for the consumer?
- Does a user know how to effectively use such a service?
- Will customers perceive the smart product information services as useful?
- Will sales assistants perceive the smart product information services as useful?
- Will there be differences in perceived usefulness of smart product information services depending on product categories? and
- Will customers and sales assistants be willing to use smart product information services?

To help answer these questions, we develop a vertical prototype of a smart product information system – the 'Mobile Prosumer', collect data from user groups, examine the evidence and draw conclusions for smart product information systems.

RESEARCH METHODOLOGY – PROTOTYPING IN THE CONTEXT OF UBICOMP

Buchenau and Suri (2000) describe the use of experience prototypes to evaluate the user experience of new products in a 'low fidelity' fashion (Buchenau and Suri 2000). Because ubicomp is computing within a user's changing environment and no longer attached to the desktop, new approaches are needed to determine user needs at a very early stage of application development (Abowd *et al.* 2002). Abowd *et al.* (2005) developed the so-called 'paratype' as a form of experience prototyping. The paratype leverages real life situations (Iachello *et al.* 2006) and combines event-contingent experience sampling with experience prototyping. Paratypes are a way of interaction ('-type') with a technology which is evaluated alongside ('para-') real-world experience (Iachello *et al.* 2006). They are a good starting point for discussing prototyping in Ubicomp.

Davis and Venkatesh (2004) used the Technology Acceptance Model (TAM) as a basis for their research on early user integration with pre-prototype testing. They found that accurate attitudes of a user towards a new system could be captured even before hands-on use of a prototype (Davis, 1986, 1989, Davis *et al.* 1989).Their findings indicated that user acceptance could be assessed at this early stage of system development, that is, stimuli in the form of non-interactive pre-prototypes could yield good approximations of user perceptions (Davis and Venkatesh 2004).

As smart product information services are not yet commonly available (Resatsch *et al.* 2007a), we applied and reframed the pre-prototype user acceptance testing into our early evaluation cycles as is shown in Figure 2. The initial idea is evaluated and leads to a refined idea. Next, a low fidelity prototype is built and evaluated to determine refined use case(s) for the system. A working prototype incorporates the results of the previous evaluations and is tested in the field, resulting in a refined prototype which is close to the final product. In the original paper of Davis and Venkatesh (2004), the 'refined prototype' is shown as its own stage in the development cycle (see Figure 3). Because this stage is a smaller iteration of the working prototype it is included in the 'working prototype' stage leading to the final product. Therefore we use four stages as opposed to Davis and Venkatesh's five.

We take the approach of Sandner *et al.* (2006) and discuss the initial application idea with colleagues based on an actor, technology, product and strategy outlook model (Sandner *et al.* 2006). This led to a stable concept of the application that can be shown on slides or papers. As noted earlier, paper evaluation, if conducted appropriately, should readily determine the later acceptance of a system to be distributed within an organization (Davis and Venkatesh 2004). However, in the case of ubicomp which is outside the organizational context and embedded in a highly personal and social milieu, we hypothesize that the non-functional prototype is not sufficient to give individuals an adequate

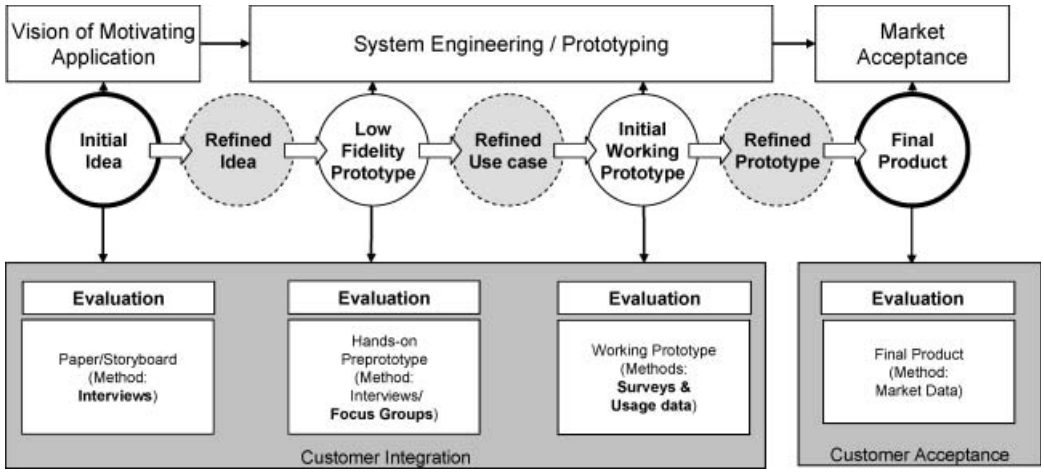

Figure 2. Extended pre-prototype approach for ubicomp application development and evaluation

understanding of how they will later interact with the system. Therefore, we have developed a usable low fidelity or hands-on prototype, following the 'paratype' idea (Abowd *et al.* 2005). Contrary to the paratypes which evaluate artefacts in real life situations, our approach is one in which the interaction is fully simulated on a low fidelity pre-prototype evaluated in focus groups with real consumers. This evaluation is part of actor-based technology-acceptance research (Rogers 1995, Davis *et al.* 1989). The results of the low fidelity prototype evaluation build the basis for an initial working prototype. The key factors of ubicomp system engineering, such as situatedness, openness, locus of control and interactivity need to be included in this simulation (Zambonelli and Parunak, 2002). The initial working prototype extends the low fidelity prototype to an almost final product with all use cases and design requirements implemented. The working prototype should then be evaluated on a broader scale. Quantitative data collection is important in this stage. With a working prototype, it is possible to quantitatively evaluate an artefact according the paratype approach of examining a real life setting in situ. Based on this version, the last stages in product

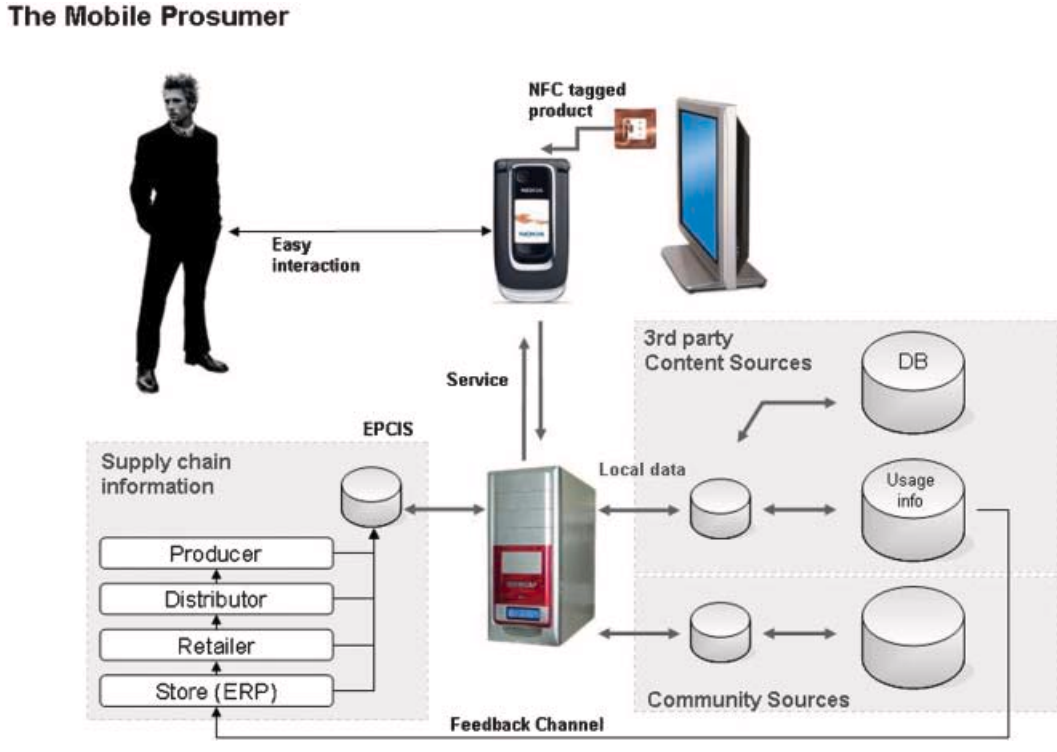

Figure 3. Mobile Prosumer – Conceptual application overview

development is another evaluation and fix iteration to a final product. The final stage is the market delivery of the final product where user acceptance can be measured by sales.

The above described approach is new to the field, because it provides a guideline for the evaluation of ubicomp prototypes in combination with software development and user-integration. The model also adopts Shneiderman and Rose's social impact statement on user interaction with new applications (Shneiderman and Rose 1996). In this paper, this extended pre-prototype approach is tested from the initial idea to the low fidelity prototype with the design of the Mobile Prosumer, a smart product information system.

RESULTS: APPLYING THE EXTENDED PRE-PROTOTYPE APPROACH TO THE MOBILE PROSUMER

Initial idea

In 2006 we started the first discussions on a smart product information system, aware of the rising potential of the then upcoming RFID/NFC technology (Resatsch *et al.* 2006). Figure 3 shows the desired application overview including a connection to an EPCIS[1] system. The user touches any NFC-tagged product with his NFC-enabled phone, a GPRS connection is established and various data is aggregated about the touched product and shown on the phone display. A feedback channel provides information on the product's supply chain.

The initial idea was to give consumers an increased awareness of the goods they buy – whether the products contain ecologically unacceptable ingredients (e.g. genetically modified food) or the manufacturer producing the product violates humanitarian labour principles (e.g. uses child labour or unpaid prisoners) similar to Novak (2005). In line with our development plan, we used storytelling to explain the design and discussed it with experts to capture advice on the initial idea. Quickly we discovered that most decisions associated with product alerts were already known by concerned buyers. For instance, a person who wants to buy fair trade products, is already aware of brands that match his or her social concerns, e.g. via Fair trade[2] or by checking the certification label on a product. Similar to ethical decisions, providing credible allergy information through web sources is likely to be difficult. Food allergies are dangerous and individuals may rightly be too cautious to trust an electronic source. They are more likely to check with their doctor first, and also to read the ingredients label on the product. For these reasons, the initial idea was refined to that of providing comparative pricing and user experience information for specific kinds of products.

Refined idea

We further refined our ideas using characteristics of the product that might impact the need for information. For example, some products involve a higher degree of collective information gathering (e.g. talking to friends and family about a purchase) and others involve no information gathering (e.g. automatic decisions on products that are always bought, such as toothpaste).

We created product categories to match these product attributes (see Figure 4) and used these categories to classify our product list (Meffert 2005). To see how this classification works, consider the product, wine. Wine is a convenience good with a low degree of collective decision making and is likely to be part of a consumer's existing purchase behaviour.

Low fidelity prototype

The low fidelity prototype is shown in Figure 5 with a wine bottle and attached NFC tag. The prototype had four use cases: 1) A detailed product description; 2) a recommendation system ('What your friends think'); 3) an expert information display with a rating system ('Experts opinion'); and 4) an order form ('Order larger amounts'). The product description use case follows rules about what additional product information needs to be provided (for example, if the product label is in another language) so that the product information is relevant and not redundant. The recommendation system use case provides recommendations based on similar purchases of others (search qualities). The expert information use case provides an evaluation of the product compared to other similar ones (experience qualities) and the order form use case provides price information and how the particular wine or other wines may be obtained.

Compared to studies of AURA (Sousa and Garlan 2002), myGrocer (Roussos *et al.* 2002) or the Future Store Initiative (Loebbecke and Palmer 2006) we used a low fidelity prototype on our user population according to the approach recommended by Davis and Venkatesh (2004). We conducted this evaluation using a focus group.

EVALUATION

Focus groups are a form of group interview facilitated by an individual who is expert in managing group interactions. The method is useful for exploring people's knowledge and experiences (Kitzinger 1994, 1995). Focus group interviews are particularly suited for obtaining several perspectives about the same topic (Gibbs 1997). Depending on the area of research, the sample size of focus groups ranges from six to ten

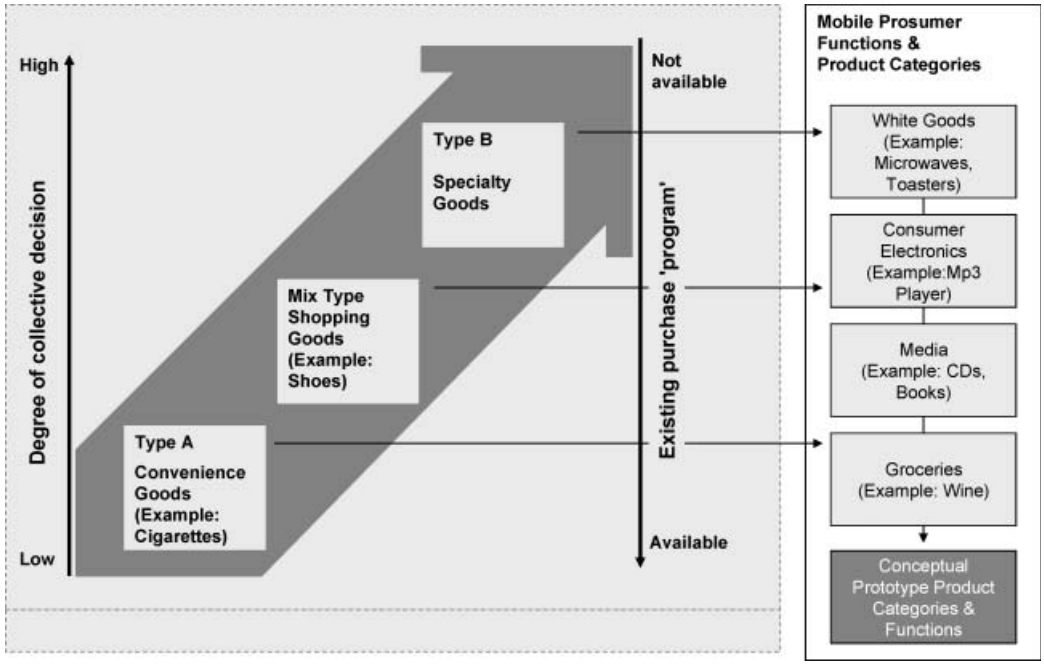

Figure 4. Deduction of test product categories for the refined prototype based on the purchase decision model of Ruhfus (1976), Meffert (2005)

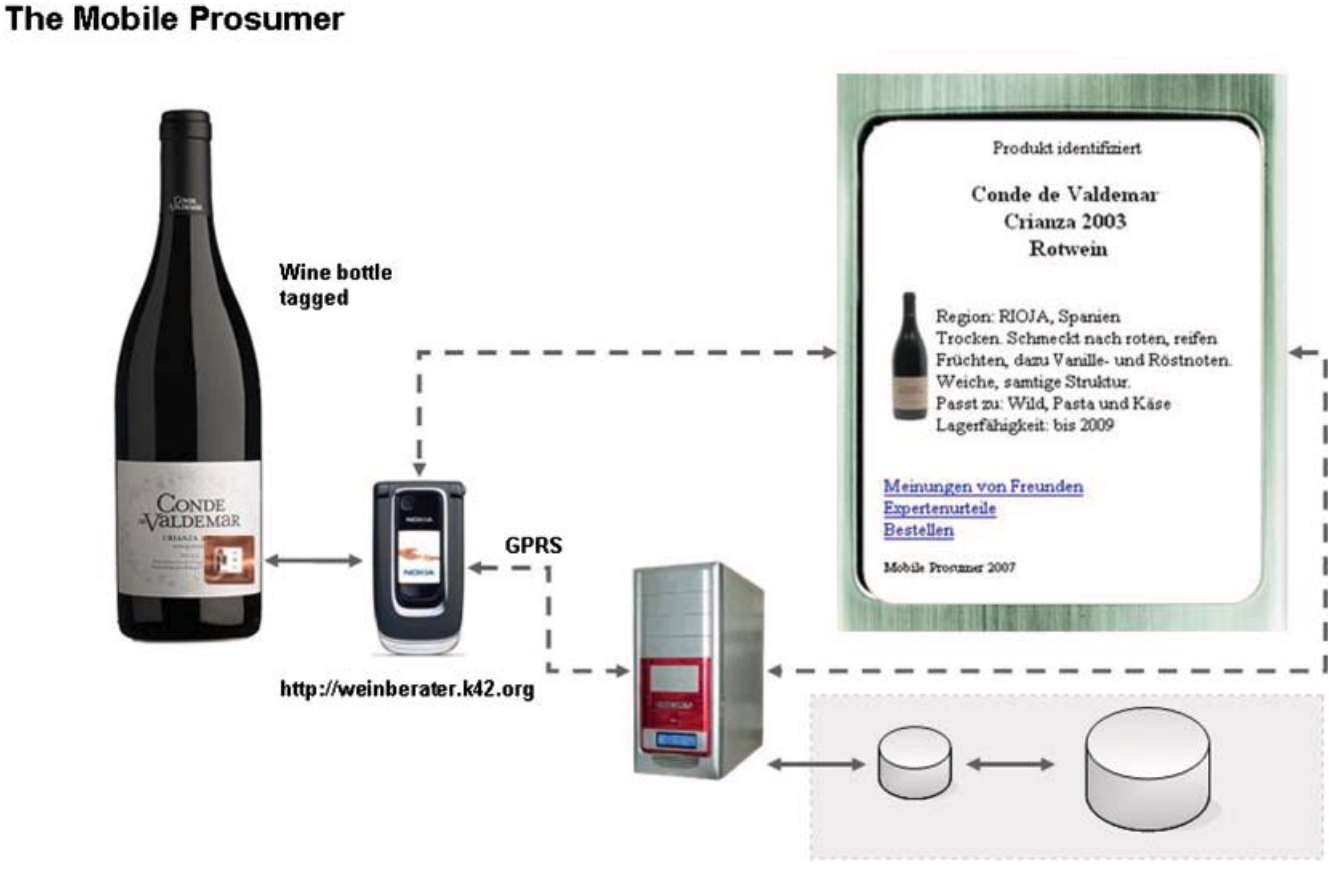

Figure 5. Low fidelity prototype of the Mobile Prosumer
Source: wine bottle © Conde de Valdemar

Table 1. Research methodology

Element	*Details*
Research framework	Qualitative analysis/Focus group
Method of data collection	Two focus groups with moderator
Period	21 September 2006
Duration	120 minutes for each focus group
Measuring method	Video recording, transcription, word count and evaluation
Universe	Consumers (group 1) and sales assistants (group 2)
Sample type	Telephone pre-test questionnaire and screening. Buyers and sellers of groceries, consumer electronics, white goods and media.
Sample size	n=20 (10/10)

members (Kitzinger 1995, Powell and Single 1996). For our focus group, we chose a sample of ten people from two different populations; customers and retail personnel. Methodological information is shown in Table 1.

The consumer sample ranged in age from 18 to 25 (Digital natives – young people who grew up with modern technology and the Internet) and 40 to 60 (Digital immigrants – people who came into contact with information technology at a later point in life) with a half/half distribution (Prensky 2001a). Digital natives were of interest, because they have learned to interact with new media from a very young age and are used to the interaction. Digital immigrants, however, needed to adapt to modern technologies and may perceive their benefits differently (Prensky 2001a, 2001b). Each group consisted of equal numbers of males and females. Sales personnel participants were selected according the products they directly sold in their store. Desired product groups were wine, consumer electronics, media and white goods. Each focus group was video recorded and speech was transcribed afterwards. The sales personnel group was asked the same questions and viewed the same material/prototype.

To avoid biased opinions based mostly on the roughness of the prototype, we followed our pre-prototype approach: The low fidelity prototype was shown after a paper-based concept was described. We then combined both evaluations.

The following sections describe the results of our focus groups in three core sections: Experiences and attitudes towards shopping in the four product categories (consumer electronics, white goods, media, groceries), the paper-based concept evaluation and the low fidelity prototype evaluation.

Both focus groups – Experiences and attitudes towards shopping

In general, participants felt that shopping is often stressful because of an overwhelming range of products to choose from, difficulties in finding the right product, and unsatisfying checkout situations. Limited time, too many people and high temperatures were also considered stress factors. The consumers disliked the insufficient number, availability, qualifications, and expertise of sales clerks. These findings are similar to those mentioned in the study of (Aylott and Mitchell 1998), although Aylott and Mitchell focused on grocery shopping. Non-food shopping was perceived as more stressful to the participants, whereas shopping for food happens as a matter of routine and is considered less stressful. Consumers said that they typically shop at the same collection of stores and usually know where to find grocery products.

We found evidence that consumers are not happy with their overall shopping experience, but content with the current shopping process. They regard additional information on products as beneficial only to a certain extent and consider this information to be highly dependent on the particular product group. Uncertainty and information overload play a role, however, these deficits seem to be different for each product category. Online research was common among all participants and used to increase knowledge about price and availability of products before purchase.

To sum up, food and smaller white goods are routinely bought and consumers felt that the amount of money involved in their purchase is not high enough to warrant additional information searches. In contrast, consumer electronics are intensively researched online, but final decisions are also made because of the look and feel of the product. Difference between digital natives and digital immigrants was evident, with the digital natives actively using online recommendation systems and collaborative filtering systems. It was easy to imagine digital natives conducting such searches at PoS. Between the group of consumers and the group of sales assistants, it became obvious, that there are deeply rooted differences in perceptions. Sales personnel perceived themselves as very knowledgeable and capable of providing good service, whereas all consumers claimed that sales personnel are rarely there when needed and, even if available, some are not helpful. Because of this perceptual gap between the two groups, it seems likely that a smart product information system could address these problems.

Paper-based concept test – focus group 1: Consumers

> I would welcome such a system. Everybody carries a mobile phone anyway

> I could touch something with my mobile phone, receive information and conveniently read it while walking
> (Quotes from participants)

Following the collection of the participant's experiences and attitudes towards shopping, a paper-based concept evaluation took place. Supported by a slide that briefly introduced a smart product information service coupled to a mobile phone, both focus groups first discussed the concept. Immediately after a positive reaction, concerns arouse around the trustworthiness of the information: It was not clear to the focus group which providers of information would be selected for the phone displays. Up-to-datedness of the information especially when it involved prices was also treated sceptically. Scepticism was stronger among the digital immigrants (DI). All consumers indicated that price comparisons were a useful service.

Although the use of RFID technology has been heavily discussed in the news media in terms of issues regarding privacy and data security (Resatsch *et al.* 2007a), participants had no major concerns about privacy threats. Some consumers were more concerned that the products would become more expensive when equipped with the RFID tag. Overall, both men and digital natives were more attracted by the Mobile Prosumer concept.

Paper-based concept test – focus group 2: Sales personnel

Apparently sales persons do not want consumers to have too much product information. They were afraid of becoming obsolete. Furthermore, they suggested that more information would only make clients more confused and insecure. Finally, they expressed a strong concern that a bad consumer review online would make it extremely difficult for a sales person to then sell the product.

Summary

The paper-based concept evaluation did not indicate that Mobile Prosumer would provide clear benefits to consumers. Contrary to our expectations that additional product information would prove to be immediately valuable to consumers, the consumer focus group participants did not rate the service as expressed on paper as very valuable. We believe that this is because it was not easy for our participants to grasp possible new ways of using such a system for product purchase decisions. It is only after using a smart product information system or viewing other people using it, that a consumer can begin to see how such a system might integrate into their shopping patterns. Similarly, it would have been difficult for users to imagine the type of information seeking that now occurs on the Internet before its incipiency. In essence, consumers need to see multiple instantiations of the RFID technology to begin to understand and value its benefits. For this reason, we next evaluated the low fidelity prototype through a hands-on experience wine purchasing scenario.

Low fidelity prototype evaluation

> This will be the future. We will have programmable tags
>
> For searching and finding something in stock, it would be great
> (Quotes from participants)

The actual low fidelity prototype in the hands-on pre-prototype evaluation was considered more valuable to the consumers than the paper based concept. The previously described participants used a Nokia 6131 NFC-enabled phone with the Mobile Prosumer (MP) application. The product to be examined was a bottle of wine with an NFC tag. Below we summarize the general responses to this product by each focus group:

Low fidelity evaluation – focus group 1: Consumers

- The MP was perceived to be a reasonable support for purchasing high-quality products by some of the consumer respondents. They saw a benefit only if all products were equipped with the NFC/RFID tags. The success and practicability of the MP clearly depends on the amount of information available on the Internet. Contrary to our expectations that our example would indicate the value of providing price and product quality data, the focus group participants responded differently. They questioned both the validity and credibility of the information sources used in the low fidelity prototype. However the relevance of information (if believed) to product purchase was considered very important.

Other findings were:

- A general concern from consumers that sales personnel might become obsolete.
- Privacy was of no concern to participants except for one respondent.
- The NFC technology was considered innovative, very easy to use and a good way to retrieve information about products.
- A product information system should be available for all products in a product group.
- The product information service must be highly trustworthy.

In addition, digital native participants tended to understand the information power of the MP more than their digital immigrant counterparts. Overall, the comprehension of the basic capabilities of the MP was higher after the demonstration with the low fidelity prototype and the general acceptance of the system was higher.

Low fidelity evaluation – focus group 2: Sales personnel

- The sales assistant group considered the MP appropriate for providing simple information. They viewed it as an instrument of pre-selection and felt that it could readily answer a customer's frequently asked questions. They indicated that this would be a positive benefit for consumers who did not want sales personnel interaction.
- As a merchant information system, the group considered the RFID technology to be highly useful. They felt that such a system used by sales personnel to determine out-of-stock availability would be more useful than the consumer oriented MP.

For both groups it was clear that a technological solution would not substitute for the expert knowledge from a sales assistant. They felt that technological solutions can readily lead to information overload unless displays are smart enough to only show truly relevant information.

DISCUSSION: RFID-BASED SMART PRODUCT INFORMATION SERVICES AT THE POINT OF SALE

Below we summarize the evidence found for our stated research questions.

What is considered relevant and useful information at PoS for the consumer?

This question was addressed many times throughout the study. It was found that the smart product information system was seen as useful only for more expensive longer lasting products, such as washing machines. The focus group participants agreed that collaborative filters might be useful, nevertheless, in practice they preferred product evaluations from known contacts, i.e. friends and family members.

Does a user know how to effectively use such a service?

Sales personnel considered the cognitive load of choosing between too many product variations was already too high for the average consumer. Similarly, consumers felt overwhelmed by the excess of similar products. They felt that additional information, rather than helping could add to the already confusing array of choices. Again, younger consumers seemed to have fewer problems handling the overabundance of information and choices. The case of what exactly is 'relevant' product information at PoS needs to be further investigated and quantitatively evaluated.

Will customers perceive the smart product information services useful?

The various prototypes and iterations show that that RFID-based product information services can have a perceived benefit to consumers, but only if several basic principles are applied:

- only relevant, valid and trustworthy information be provided;
- mechanisms be put in place to ensure customers that the information is valid and trustworthy;
- younger user groups be targeted (digital natives); and
- all possible products be tagged and services provided (even those services that hurt e.g. price comparison)

Unfortunately, the last comment, that of price comparison, might be difficult to realize in the retail industry.

Will sales assistants perceive the smart product information services as useful?

From the sales assistant perspective, the low fidelity prototype was not considered beneficial. Sales personnel do not want consumers to have too much product information – only items such as answers to 'Frequently Asked Questions.' The sales assistants were afraid of becoming obsolete. In addition, they felt that having more information would make their clients even more insecure about their purchase decisions. On the other hand, a system that targeted the needs of sales personnel, such as in-stock-information or new product information would be of interest.

Will there be differences in perceived usefulness of smart product information services depending on product categories

Generally, within the experience goods category there was a difference between long-term use products and those with shorter life-cycles. For example, toasters and microwaves had less information needs than washing machines. Consumer electronics, in contrast, involved intensive online/offline behaviour. Also, because they

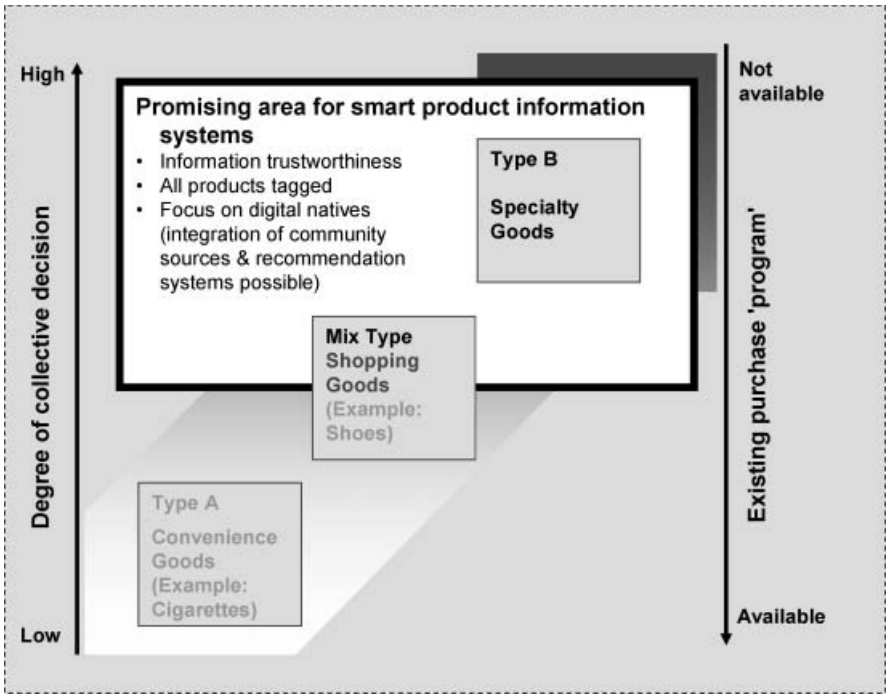

Figure 6. Mapping the study results on the purchase decision model

are less routinely bought, they are more valid choices for the application of smart product information services than say groceries.

Will customers and sales assistants be willing to use smart product information services?

The interface technology was broadly accepted by both sets of focus group participants. The use of NFC as an interaction technology was considered very easy and simple.

Contrary to the expected concern about privacy and data security, this wasn't an issue for any of the groups. Others have indicated that privacy issues need to be addressed with ubiquitous services (Galanxhi and Nah 2005), but, in our case, these issues were not as relevant. Only when directly asked, both groups indicate minor concerns.

Our initial research question, 'Can ubicomp applications be used to meet individual information needs?' was not clearly answered with our instantiation of a smart product information service. The ability to compare prices and access other opinions on a product are part of an overall product purchase decision, but these problems are now solved with prior Internet searches and by querying sales assistants. In those cases when shopping is routine, additional information was not regarded as needed or beneficial. The MP system provided more perceivable benefits for the technically savvy individuals. Others stated that they would use the MP because they felt that the introduction of mobile phones reading RFID tags was an unstoppable development. The primary stressors in offline shopping were those of physical discomfort, e.g. high or low temperatures, crowds, etc. maybe a starting point for a variation of classic shop concepts. Some participants stated that they would only use a smart product information service in specific cases, e.g. when buying expensive products – but only if all products were tagged. For these reasons, smart products, targeting younger generations, need to be quick and easy to use and should be introduced into specific product segments only.

CONCLUSIONS AND FUTURE RESEARCH

Figure 6 maps the purchase decision model mentioned in the introductory section of this paper to the evidence found in this research. For products that use a higher degree of collective decision making and have less routine purchasing, the need for smart product information systems increases.

Not all, but some specialty goods and also Mix Types are more promising areas. This includes experience products, as well as products that are not purchased regularly.

We define a set of product attributes mentioned in our focus groups that appear to be relevant to the need for PoS information. These are product life span, degree of collective decision making attached to product, and the information intensity (amount of information needed to make a decision) of the product. If these values are high,

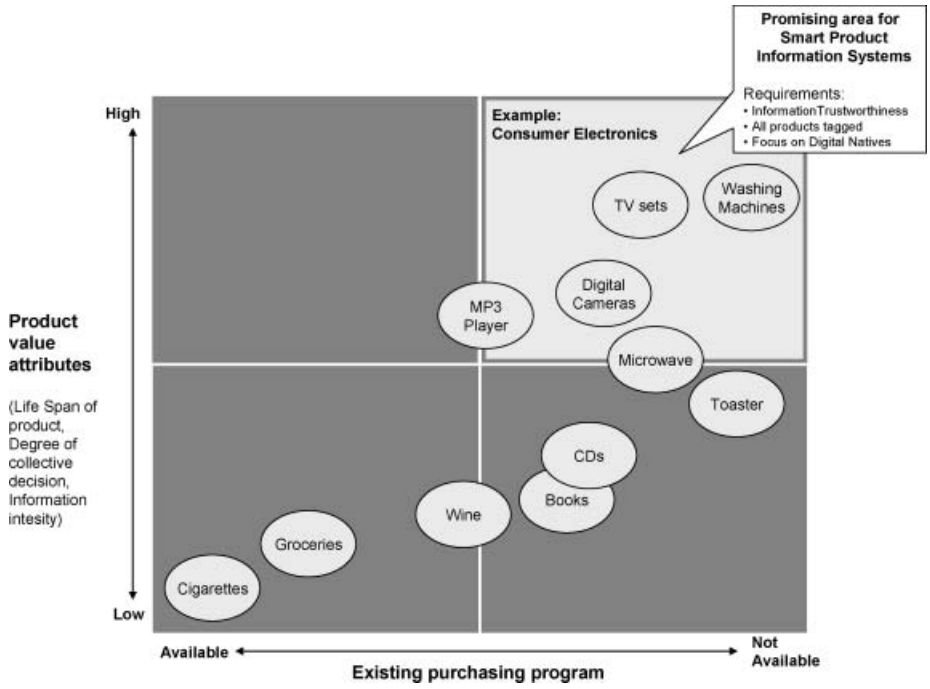

Figure 7. Proposed product value – purchase behaviour – matrix (PVPB) for smart product information systems with example products

PoS information is considered useful. Figure 7 shows a proposed product-value purchase-behaviour matrix that indicates the most promising areas for the introduction of smart product information systems. The matrix maps the routineness of the purchase against an aggregate of the product-value attributes and lists example products in this space.

Implications

This research on information services for smart products directly affects B2C developments and user-centred applications in the retail industry.

The first and most important consideration is to determine what product information is relevant for different consumer types in each product category. Information relevance differs for digital natives vs. digital immigrants and therefore PoS information systems need to return different types of information for these two groups. Decision support systems (Kindberg and Fox 2002, Shim *et al.* 2002) and semantically supported information systems (Maass and Filler 2006) may help to determine the right degree of information provision.

Another challenge is the design of IT-supporting components, be it on the organizational (operator, etc.) or technical level (certificates, etc.) to assure validity and credibility of information sources. This poses a challenge for generating trustworthy information because third party providers are used.

We also found differences between our extended pre-prototype approach and what was expected based on current literature. We therefore note that it is important to test ubicomp systems with real users in situations external from research laboratories and student groups. Few retail ubicomp prototypes have been tested outside student environments (Roussos 2006, Roussos *et al.* 2002, Välkkynen *et al.* 2006), while most were tested in the research lab environment with fellow researchers. In our case it became clear that any test with only digital native type graduate students could have led to biased positive results. Our results illustrate the importance of real users being involved in evaluations.

Our approach showed that: 1) the opinions of participants about the paper-based concept test and actual product test with a prototype were different contrary to the quantitative findings of Davis and Venkatesh (2004); 2) the extended user acceptance framework for ubicomp applications adapted from the findings of Davis and Venkatesh (2004) and Abowd (2005) is capable of first letting users discuss paper-based concepts and then testing the prototype to determine any differences between responses to the conceptual idea and the prototype; and 3) the findings also show the benefit of this research approach and provide new insights into the design of smart products in retail sales, in general.

Further findings and implications are:

- The usage of the very easy to use NFC technology as a method of interaction has had a perceived positive influence on the acceptance of the system. We do not know to what extent this trivial usage of the mobile phone NFC system added to a positive evaluation of the overall system, but we assume that this might have an effect on intentions to use an

innovative information system at PoS – similar to prior research on hedonic information systems (van der Heijden 2004).
- Either all products or at least all products within a specific product group need to be tagged to provide visible benefits for consumers – this is difficult to realize in a real business environment. What to tag and how much to tag add additional complexity to the introduction of smart product systems.
- It may be beneficial for retailers to focus on applications that target sales personnel. Such applications are cheaper to implement, easier to install and easier to manage. In addition, the information needs of sales personnel can be clearly determined (a direct feedback channel, more product information updates). Also, there is no issue with information trustworthiness if the publisher of the information is the retailer itself.
- Finally. it became evident in the study, that the consumer and the retailer both want to make the customer shopping experience as pleasurable and easy as possible. Whether it is ubicomp or some other retail innovation, it is the human being, the user, in the middle of things that is the important consideration – a fact even more important for application developers and a good reason to use pre-, proto- and paratypes in an early development stage.

This paper is first to evaluate a smart information product system with an NFC prototype and real consumers, as well as sales personnel. Its findings contribute to the theory of ubiquitous computing by proposing an extended pre-prototype evaluation approach that helped to define the requirements for user-centred RFID-based information systems and determined user acceptance. The research also helped practitioners in retail to discuss the increasing RFID penetration in shops and has demonstrated how mobile services can play a role in adding user benefits to such systems. In addition, it provided a rough overview of which information poses more benefit than others.

Limitations

The study had several limitations. The results are the outcome of only two focus groups although the sales personnel also argued as consumers from time to time. To strengthen the research findings, at least four focus groups made up of consumers should be run. Although both groups seemed to be a good fit in terms of participants, there is some possibility of group thinking occurring, although groups were formed from individuals who did not know each other. The results should also be checked in a quantitative way, e.g. via a survey according our next step in the extended pre-prototype approach. Another methodological limitation was the laboratory setting. To really evaluate the pre-prototype in the paratype sense, the participants should be questioned in a real-life store.

Furthermore the prototype test was carried out by passing it from one user to the next. Some users may have been afraid to make a mistake using the system and therefore did not fully try out the system's features. In addition, when the first people began discussing the system, others had not yet tried the prototype, thus some comments were made before actual system use, possibly biasing results. Additionally, we did not control for cultural background/factors that might have influenced the respondents.

Future research

An obvious first step for future research can be found in the methodological area. Is our finding, that the perception of the service was different between paper-based and actual prototype a singular event, and is this the case in other ubicomp settings as well? A second consumer focus group with a similar setup should be conducted to test this.

A next research step is already stated in our extended pre-prototype approach in phase three: the working prototype evaluation in real life. A quantitative study is needed to identify possible underlying causes for the behavioural intentions for using smart product information systems.

Future research also needs to further detail approaches to user-centred design and acceptance models for ubicomp applications. Is our approach meeting the needs of ubicomp researchers? Are there other product groups that might make interesting domains for smart product information services? Overall the field of smart products is very promising for both research and practice, but it needs much more research attention to shed light on to these issues.

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Notes

1. Electronic Product Code Information System (EPCIS)
2. Sources are: www.fairtrade.net, www.fairtradefederation.org - accessed 9 December 2007.

References

ABI Research (2007) 'Near Field Communication', available from: http://www.abiresearch.com/products/market_research/Near-Field_Communications_(NFC).

Abowd, G. D., Hayes, G. R., Iachello, G., Kientz, J. A., Patel, S. N., Stevens, M. M. and Truong, K. N. (2005) 'Prototypes and Paratypes: Designing Mobile and Ubiquitous Computing Applications', *Pervasive Computing* 4: 67–73.

Abowd, G. D., Mynatt, E. D. and Rodden, T. (2002) 'The Human Experience [of Ubiquitous Computing]', *Pervasive Computing* 1: 48–57.

Adler, J. (1996) *Informationsökonomische Fundierung von Austauschprozessen,* Wiesbaden: Gabler.

Alba, J., Lynch, J., Weitz, B., Janiszewski, C., Lutz, R., Sawyer, A. and Wood, S. (1997) 'Interactive Home Shopping: Consumer, Retailer and Manufacturer Incentives to Participate in Electronic Markets', *Journal of Marketing* 61: 38–53.

Aßmann, J. (2003) *Der Einfluss computeranimierter Produktpräsentationen auf die Validität von Konzepttests. Eine informationsökonomische Analyse alternativer Präsentationsformen,* Berlin: Wissenschaftlicher Verlag.

Aylott, R. and Mitchell, V.-W. (1998) 'An exploratory study of grocery shopping stressors', *International Journal of Retail & Distribution Management* 26(9): 362–73.

Bettmann, J. R. (1973) 'Perceived Risk and its Components: A Model and Empirical Test', *Journal of Marketing Research* 10: 184–90.

Buchenau, M. and Suri, J. F. (2000) 'Experience prototyping', *DIS 2006,* New York: ACM.

Chiang, K. P. and Dholakia, R. R. (2003) 'Factors Driving Consumer Intention to Shop Online: An Empirical Investigation', *Journal of Consumer Psychology* 13: 177–83.

Cox, D. F. and Rich, S. U. (1964) 'Perceived Risk and Consumer Decision-Making: The Case of Telephone Shopping', *Journal of Marketing Research* 1: 32–9.

Darby, M. R. and Karni, E. (1973) 'Free Competition and The Optimal Amount Of Fraud', *The Journal of Law and Economics* 16(1): 67–88.

Davis, F. (1986) 'A Technology Acceptance Model for Empirically Testing New End-user Systems: Theory and Results', PhD Thesis, Cambridge, MA.

Davis, F. D. (1989) 'Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology', *MIS Quaterly* 13(3): 319–39.

Davis, F. D., Bagozzi, R. P. and Warshaw, P. R. (1989) 'User Acceptance of Computer Technology: A Comparison of Two Theoretical Models', *Management Science* 35(6): 982–1003.

Davis, F. D. and Venkatesh, V. (2004) 'Toward Preprototype User Acceptance Testing of New Information Systems: Implications for Software Project Management', *IEEE Transactions on Engineering Management* 51(1): 31–46.

Degeratu, A. M., Rangaswamy, A. and Wu, J. (2000) 'Consumer Choice Behavior in Online and Traditional Supermarkets: The Effects of Brand Name, Price, and Other Search Attributes', *International Journal of Research in Marketing* 17(1): 55–78.

Dowling, G. R. and Staelin, R. (1994) 'A Model of Perceived Risk and Intended Risk-Handling Activity', *The Journal of Consumer Research* 2: 119–34.

Eck, D., Lamere, P., Bertin-Mahieux, T. and Green, S. (2007) 'Automatic Generation of Social Tags for Music Recommendation', *Advances in Neural Information Processing Systems* 20.

Fleisch, E., Christ, O. and Dierkes, M. (2005) Die betriebswirtschaftliche Vision des Internets der Dinge', in: E. Fleisch and F. Mattern (eds) *Das Internet der Dinge,* Berlin: Springer, pp. 3–37.

Fleisch, E. and Mattern, F. (eds) (2005) *Das Internet der Dinge – Ubiquitous Computing und RFID in der Praxis: Visionen, Technologien, Anwendungen, Handlungsanleitungen,* Berlin: Springer.

Fleisch, E., Mattern, F. and Billinger, S. (2003) 'Betriebswirtschaftliche Applikationen des Ubiquitous Computing. Beispiele, Bausteine und Nutzenpotentiale', in: H. Sauerburger (ed.) *Ubiquitous Computing*, HMD 229 – Praxis der Wirtschaftsinformatik, dpunkt, 5–15.

Fleisch, E. and Thiesse, F. (2007) 'On the Management Implications of Ubiquitous Computing: An IS Perspective', in: H. Österle, J. Schelp and R. Winter (eds) *Fifteenth European Conference on Information Systems*, St. Gallen, Switzerland, pp. 1929–40.

Galanxhi, H. and Nah, F. F.-H. (2005) 'Privacy Issues in the Era of Ubiquitous Commerce', *Proceedings of the Americas Conference on Information Systems (AMCIS 2005)*, Omaha, USA, AISeL: 1926–34.

Gershenfeld, N., Krikorian, R. and Cohen, D. (2004) 'The Internet of Things', *Scientific American* October: 76–81.

Gibbs, A. (1997) 'Focus Groups', *Social Research Update* 19: 1–4.

Heath, T., Motta, E. and Petre, M. (2006) 'Person to Person Trust Factors in Word of Mouth Recommendation', *Proceedings of the CHI 2006 Workshop on Reinventing Trust, Collaboration, and Compliance in Social Systems (Reinvent06)*, Montreal, Canada: ACM Press.

Iachello, G., Truong, K. N., Abowd, G. D., Hayes, G. R. and Stevens, M. M. (2006) 'Prototyping and Sampling Experience to Evaluate Ubiquitous Computing Privacy in the Real World', *Proceedings of ACM Conference on Human Factors in Computing Systems (CHI 2006)*, Montréal, Québec, Canada: ACM Press: 1009–18.

Jalkanen, J. (2005) 'User-initiated Context Switching Using NFC', *Proceedings of the IJCAI05 Workshop on Modeling and Retrieval of Context (MRC2005)*, Edinburgh, Scotland: CEUR Workshop Proceedings.

Johnson, E. J., Moe, W. W., Fader, P. S., Bellman, S. and Lohse, G. L. (2004) 'On the Depth and Dynamics of Online Search Behavior', *Management Science* 50(3): 299–308.

Kaas, K. P. (1994) *Ansätze einer institutionenökonomischen Theorie des Konsumentenverhaltens,* München: Forschungsgruppe Konsume und Verhalten.

Kaasinen, E. (2005) 'User Acceptance of Mobile Services – Value, Ease of Use, Trust and Ease of Adoption', Espoo, Finland, Tampere University of Technology.

Kindberg, T. and Fox, A. (2002) 'System Software for Ubiquitous Computing', *Pervasive Computing* 1(1): 70–81.

Kitzinger, J. (1994) 'The Methodology of Focus Groups: The Importance of Interactions between Research Participants', *Sociology of Health and Illness* 16(1): 103–21.

Kitzinger, J. (1995) 'Qualitative Research: Introducing Focus Groups', *British Medical Journal* 311: 299–302.

Kourouthanassis, P. and Roussos, G. (2003) 'Developing Consumer-friendly Pervasive Retail Systems', *Pervasive Computing* 2(2): 32–39.

Leimeister, J. M. and Krcmar, H. (2005) 'Das Internet der Dinge', *Menschen und Informationstechnik (m&it)* 3: 39–41.

Levin, A. M., Levin, I. P. and Heath, C. E. (2003) 'Product Category Dependent Consumer Preferences for Online and Offline Shopping Features and Their Influence on Multi–channel Retail Alliances', *Journal of Electronic Commerce Research* 4: 85–93.

Loebbecke, C. and Palmer, J. W. (2006) 'RFID in the Fashion Industry: Kaufhof Department Stores AG and Gerry Weber International AG, Fashion Manufacturer', *MIS Quarterly Executive* 5(2): 15–25.

Maass, W. and Filler, A. (2006) 'Towards an Infrastructure for Semantically Annotated Physical Products', in: C. H Hochberger and R. Liskowsky (eds) *Informatik 2006,* P–94 of *Lecture Notes in Informatics, P-94,* Berlin: Springer, pp. 544–9.

Maass, W. and Janzen, S. (2007) 'Dynamic Product Interfaces: A Key Element for Ambient Shopping Environments', *Proceedings of 20th Bled eConference eMergence: Merging and Emerging Technologies, Processes, and Institutions*, Bled, Slovania.

Mattern, F. (2005) 'Die technische Basis für das Internet der Dinge', in: E. Fleisch, and F. Mattern (eds) *Das Internet der Dinge–Ubiquitous Computing und RFID in der Praxis*, Berlin: Springer Verlag, pp. 39–66.

Mattern, F. (2003b) Vom Verschwinden des Computers – Die Vision des Ubiquitous Computing, in: F. Mattern (ed.) *Total Vernetzt*, Berlin: Springer, pp. 1–41.

Mattern, F. (2005) 'Ubiquitous Computing: Schlaue Alltagsgegenstände. Die Vision von der Informatisierung des Alltags', Bulletin SEV/VSE, 19: 9–13.

Meffert, H. (2005) *Marketing – Grundlagen marktorientierter Unternehmensführung,* Wiesbaden: Gabler.

Mitchell, V.-W. (1992) 'Understanding Consumers' Behaviour: Can Perceived Risk Theory Help?', *Management Decision* 30(2): 26–31.

Mitchell, V.-W. and Boustani, P. (1994) 'A Preliminary Investigation into Pre- and Post-Purchase Risk Perception and Reduction', *European Journal of Marketing* 28(1): 56–71.

Murphy-Hoye, M., Lee, H. L. and Rice, J. B. J. (2005) 'A Real-world Look at RFID', *Supply Chain Management Review* 7(1): 18–26.

Novak, J. (2005) 'Ubiquitous Computing and Socially-Aware Consumer – Support Systems in the Augmented Supermarket', *Proceedings of the First International Workshop on Social Implications of Ubiquitous Computing (UbiSoc 2005)*, Portland, Oregon, USA.

Parkinson, J. (2004) 'RFID: U.S. Consumer Research Findings', Workshop on RFID, Washington, DC, USA, US Federal Trade Commission RFID Workshop.

Powell, R. A. and Single, H. M. (1996) 'Focus Groups', *International Journal of Quality in Health Care* 8(5): 499–504.

Prensky, M. (2001a) 'Digital Natives, Digital Immigrants', *On the Horizon* 9(5): 1–6.

Prensky, M. (2001b) 'Digital Natives, Digital Immigrants, Part II: Do They Really Think Differently?', *On the Horizon* 9(6): 1–6.

Prus, R. and Dawson, L. (1991) 'Shop 'til You Drop: Shopping as Recreational and Laborious Activity', *Canadian Journal of Sociology/Cahiers canadiens de sociologie* 16(2): 145–64.

Punj, G. N. and Staelin, R. (1983) 'A Model of Consumer Information Search Behavior for New Automobiles', *The Journal of Consumer Research* 9: 366–80.

Resatsch, F., Aßmann, J., Schildhauer, T. and Michelis, D. (2007) 'Start a Grassroots RFID Initiative! The Relevance of Communication and Showcases on the Success of RFID', *Proceedings of the 8. Internationale Tagung Wirtschaftsinformatik (WI 2007)*, in: A. Oberweis, C. Weinhardt, H. Gimpel, A. Koschmider, V. Pankratius and B. Schnizler (eds) *eOrganisation: Service, Prozess, Market-Engineering,* Karlsruhe: Universitätsverlag, pp. 37–54.

Resatsch, F., Karpischek, S., Hamacher, S. and Sandner, U. (2007b) 'Mobile Sales Assistant – NFC for retailers', *Proceedings of MobileHCI 2007*, 9–12 September, Singapore.

Resatsch, F., Karpischek, S. and Michelis, D. (2006) 'Mobile Prosumer', *NordiCHI 06 Workshop Near Field Interactions With the Internet of Things* Proceedings, Oslo: Timo Arnall.

Riekki, J., Salminen, T. and Alakärppä, I. (2006) 'Requesting Pervasive Services by Touching RFID Tags', *Pervasive Computing* 5(1): 40–6.

Rogers, E. M. (1995) *The Diffusion of Innovations*, New York: Free Press.

Roussos, G. (2005) 'Consumers and Ubiquitous Commerce', *Proceedings of Ubiconf 2004*, London: Birkbeck University.

Roussos, G. (2006) 'Enabling RFID in Retail', *Computer* 39(3): 25–30.

Roussos, G. and Moussouri, T. (2004) 'Consumer Perceptions of Privacy, Security and Trust in Ubiquitous Commerce', *Personal and Ubiquitous Computing* 8(6): 416–29.

Roussos, G., Tuominen, J., Koukara, L., Seppala, O., Kourouthanasis, P., Giaglis, G. and Frissaer, J. (2002) 'A Case Study in Pervasive Retail', Proceedings of the 2nd International Workshop on Mobile Commerce, Atlanta: ACM Press: 90–4.

Ruhfus, R. E. (1967) *Kaufentscheidungen von Familien*, Wiesbaden: Betriebswirtschaftlicher Verlag Gabler.

Rukzio, E. (2007) 'Physical Mobile Interactions: Mobile Devices as Pervasive Mediators for Interactions with the Real World', *Fakultät für Mathematik, Informatik und Statistik,* München: Ludwig-Maximilians–Universität München, retrieved 4 April 2008 from: http://www.comp.lancs.ac.uk/~rukzio/publications/diss2006_physicalmobileinteractions_EnricoRukzio.pdf.

Sandner, U., Leimeister, J. M. and Krcmar, H. (2006) 'Business Potentials of Ubiquitous Computing', in: E.-M. Kern, H.-G. Hegering and B. Brügge (eds) *Managing Development and Application of Digital Technologies,* Berlin: Springer.

Shapiro, C. and Varian, H. R. (1999) *Information Rules,* Boston: Harvard Business School Press.

Shim, J. P., Warkentin, M., Courtney, J. F., Power, D. J., Sharda, R. and Carlsson, C. (2002) 'Past, present, and future of decision support technology', *Decision Support Systems* 33(2): 111–26.

Shneiderman, B. and Rose, A. (1996) 'Social Impact Statements: Engaging Public Participation in Information Technology Design', *Proceedings of Computers and the Quality of Life '96*, Philadelphia, PA, ACM: 90–6.

Smith, M., Davenport, D. and Hwa, H. (2003) 'AURA: A Mobile Platform for Object and Location Annotation', *Fifth International Conference on Ubiquitous Computing (UbiComp 2003)*, Seattle, Washington: Springer.

Sousa, J. P. and Garlan, D. (2002) 'Aura: an Architectural Framework for User Mobility in Ubiquitous Computing Environments', *Proceedings of 3rd IEEE/IFIP Conference on Software Architecture*, Montreal, Canada, IEEE/IFIP.

Strüker, J., Sackmann, S. and Müller, G. (2004) 'Case Study on Retail Customer Communication Applying Ubiquitous Computing', *Proceedings of IEEE International Conference on E-Commerce Technology*, Washington, DC, USA: IEEE Computer Society.

Tauber, E. M. (1972) 'Why Do People Shop?', *Journal of Marketing* 36(4): 46–9.

Välkkynen, P., Korhonen, I., Plomp, J., Tuomisto, T., Cluitmans, L., Ailisto, H. and Seppä, H. (2003) 'A User Interaction Paradigm for Physical Browsing and Near-object Control Based on Tags', *Proceedings of the Physical Interaction Workshop on Real World User Interfaces (Mobile HCI '03)*, Udine, Italy: 31–4.

Välkkynen, P., Niemelä, M. and Tuomisto, T. (2006) 'Evaluating Touching and Pointing with a Mobile Terminal for Physical Browsing', *Proceedings of the 4th Nordic Conference on Human-Computer Interaction: Changing Roles*, Oslo, Norway, ACM: 28–37.

Van der Heijden, H. (2004) 'User Acceptance of Hedonic Information Systems', *MIS Quarterly* 28(4): 695–704.

Weiser, M. (1991) 'The Computer for the 21st Century', *Scientific American* 265(3): 94–104.

Weiser, M. (1993) 'Some Computer Science Issues in Ubiquitous Computing', *Communication of the ACM* 36(7): 75–84.

y Monsuwé, T. P., Dellaert, B. G. C. and De Ruyter, K. (2004) 'What Drives Consumers to Shop Online? A Literature Review', *International Journal of Service Industry Management* 15(1): 102–21.

Zambonelli, F. and Parunak, H. V. D. (2002) 'From Design to Intention: Signs of a Revolution', *Proceedings of the First International Joint Conference on Autonomous Agents and Multiagent Systems: Part 1*, Bologna, Italy, ACM: 455–6.