Student Award 2003

... on the shop floor again

Winning Contribution

Pervasive Retail as a Means of Enhancing Consumers Shopping Experience

Author: Panos Kourouthanassis

ECR Europe
Academic Partnership

ECR journal
International Commerce Review

Abstract

This paper investigates pervasive retail information system effects on consumers' shopping experience within supermarkets. Following the outcomes of an exploratory study, a prototype pervasive retail information system was implemented and installed in a Greek supermarket. Loyalty club members were invited to use the system and provide feedback on its effects on their traditional shopping experience within the store. The research revealed that pervasive retail information systems can provide a more entertaining and efficient shopping trip compared to the conventional way of shopping, and thus generate new shopping experiences for shoppers. Moreover, the research identified that pervasive retail information systems encompass several value adding elements that can enhance the four core ECR initiatives namely assortment, promotion, new product introduction, and replenishment.

1. Introduction

ECR represents the most successful initiative that streamlines the grocery supply chain by reducing channel costs and improving inventory controls within and between all levels of the grocery distribution channel while simultaneously improving customer satisfaction (Joint Industry Project for Efficient Consumer Response, 1994; Hoffman et al, 2000). To this end, over the past years ECR focused on the definition of best-practice strategies and techniques aiming at streamlining core supply chain management processes namely replenishment, promotion, assortment and new product introduction.

Still, ECR was not originally conceived solely as a business practice to streamline supply chain management processes. Retailers expected that the indirect beneficiary of these initiatives will be the end consumer (the "C" in the ECR equation). Indeed, retailers assume that the automation of the aforementioned processes will eventually lead to increased consumer satisfaction within the retail outlet due to elimination of out-of-stock conditions, increased product availability within the store, better assortment and so on. This assumption is partially true since consumer behaviour within the store can be positively (or negatively) affected by these factors. Nevertheless, these benefits are simply not enough for nowadays consumers: consumers seek new shopping experiences.

The sociodemographic changes in nowadays consumer market (such as increased number of dual-income, single-parent and technology-familiar households and the shift from market segments to individual consumers to name but a few) have significantly altered shoppers' expectations and demands during their traditional shopping experience (Kim, 2002). Consumers seek efficiency during their shopping trip to be provided – if possible – in an entertaining way (Burke, 1997) which will result to an increased satisfaction from a pleasant shopping experience (Kim, 2002). These expectations have been raised even more given the fact that consumers' shopping experience is negatively affected by a number of store-related factors which include – but are not limited to – ambience (temperature, scent, music and so on) (Baker et al, 1976; Donovan et al, 1982; Bruner, 1990; Fried et al, 1979; Gorn, 1982; Yalch et al, 1990; Aylott et al, 1998; Grayston, 1974; Milliman, 1982), service quality (Siu et al, 2001; Aylott et al, 1998), store image (Levy et al, 2001; Curhan, 1973; Corstjens et al, 1983) and situational elements (such as crowding, time and budget availability by the consumers and so on) (Donovan et al, 1982; Eroglu et al, 1990; Eroglu et al, 1986; Hui et al, 1991; Fram, 1992; Fram et al, 1990; Fram et al, 1994; Park et al, 1989; Stokols, 1972; Levy et al, 2001). All these lead to consumer dissatisfaction mainly through the form of increased levels of stress for the supermarket shopper (Aylott et al, 1998) and may result to create a new form of supermarket shopper: apathetic shoppers;

people who have no interest in, or actively dislike, shopping and appear to endure rather than enjoy the whole experience (Reid et al, 1996).

A shopping experience can be driven toward the maximization of efficiency or toward entertainment (Lewison, 1997, p. 138). Having identified this trend, ECR has introduced two projects (Consumer Value Management and Consumer Enthusiasm) attempting to alert the FMCG value chain regarding these changing customer needs (ECR Europe, 1999). As Corsten (2000) highlights, these projects derived from the experience that profitable growth could no longer be generated by consumer satisfaction or consumer loyalty but only by creating consumer enthusiasm. It is therefore imperative that the FMCG value chain actors should jointly discover the actual consumer needs and implement new shopping experiences.

In this paper, we argue that pervasive retail information systems could constitute the driver for enhancing consumers' shopping experience within supermarkets. Our argument derives from the implementation and testing of a prototype pervasive retail information system in a Greek supermarket. In effect, our trials revealed that pervasive retail information systems enhance several dimensions of the shopping experience namely entertainment, shopping efficiency, budget monitoring, time pressure, information search, check-out problems, and promotions overload. The following section presents briefly the nature of pervasive retail information systems along with the functionality and overall technical approach of the implemented prototype. Section 3 presents the way shoppers perceived pervasive retail information systems as a means to enhance their shopping experience within the supermarket. Finally, section 4 concludes with a critical appraisal of pervasive retail information systems.

2. The nature of pervasive retail information systems

2.1 Introduction

Pervasive retail information systems originate from ubiquitous computing principles defined by Weiser (1991) as an interrelation of people and environments augmented with computational resources providing information and services when and where needed. In order to set the boundaries for pervasive retail information systems in supermarkets let's consider the following real-life application scenario (figure 1):

Sally wants to go to the supermarket. She prepares her shopping list comprising all the products she wants to buy but instead of writing them down to a piece of paper, she uploads the list to a specific web page of her preferred supermarket. Later on, she arrives to the supermarket and picks up a specially modified trolley equipped with a display device and a scanning device. She uses her loyalty card to log in the system, which welcomes her and presents her the shopping list she uploaded before her visit to the store. Sally starts to pick up products placing them into the trolley following her usual route. Each time she places a product in the trolley, the display device automatically (a) presents its name, amount and item price, (b) updates the total quantity and (c) erases it from the reminding shopping list. During her trip, Sally decides to try a new product that she has never tested before. Since Sally is on a diet she can continuously trust the system to provide her with information regarding the nutrition value or even the ingredients of any of the products she has placed in her trolley. Furthermore, Sally can get informed about every promotional activity in the supermarket through a dedicated area in the display device of the trolley. Of course, since the system knows Sally's profile, all promotions are personalized. Moreover, if Sally selects a product that has a promotion

attached she gets instantly informed about the promotional rule that should be satisfied in order to activate that promotion.

At the same point, Sally remembers to purchase that new razor blade that her husband asked for. Although she does not know the exact location of that particular product, she has the opportunity to ask the system about its location. The system displays a map of the supermarket and a path which Sally should follow in order to navigate herself to the respective product. In addition, she can constantly monitor her current location in the store.

When Sally has finally completed her shopping, she goes to the cashier to pay. Nevertheless, she does not need to wait at queues since her trolley knows exactly what she has purchased and how much the trolley's contents cost. To this end, it transmits the total amount to the cashier which issues a receipt. The only thing that Sally has to do is select her payment method. Cash or Credit Card?

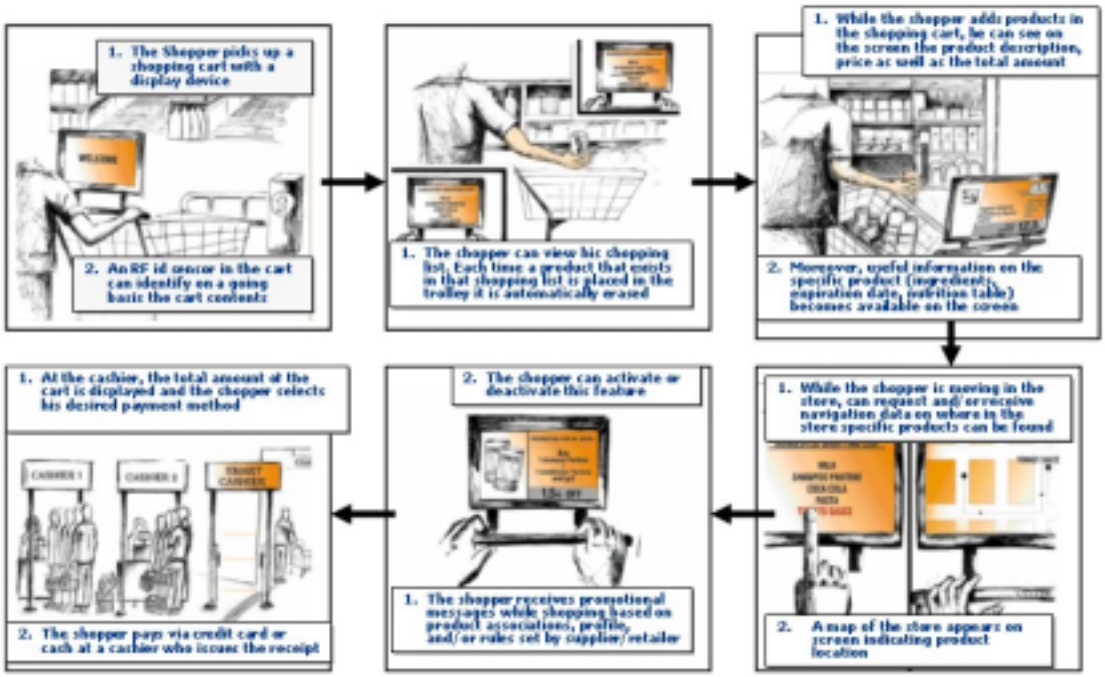

Figure 1: A conceptual scenario of a pervasive retailing application

Is the aforementioned scenario feasible? Considering the fact that recent developments in technology provide pervasive retail information systems designers with a variety of alternative technical solutions that could address each problem during the design and implementation phases, we could argue that at some time we might pick-up these intelligent trolleys and navigate through the store in order to conduct our shopping. In effect, IBM has introduced pervasive computing in the context of retail (Buckhardt et al, 2001; IBM Corporation; Lawrence et al, 2001) and the concept was further developed by the project ALBATROS (Trigueros, 1999) while AT&T Bell Laboratories introduced pervasive retailing applications in supermarket environments in the form of a Personal Shopping Assistant (Asthana et al, 1994). Still, all of these attempts, representing the first generation of pervasive retail information systems, were primarily technology driven rather than consumer driven aiming at augmenting consumers' shopping experience per ce.

2.2 MyGROCER: A Second Generation Pervasive Retail Information System

The MyGROCER concept follows the scenario described above. Our intention was to develop an intelligent trolley that could support the shopper throughout his/her entire supermarket visit. From the beginning of the design phase we tried to incorporate the shoppers' actual requirements for such a system. Indeed, supermarket shoppers represent a target group that can't be easily profiled. In particular, they represent people with diversity in age, culture, values, familiarity with technology and so on. Therefore, the selection of the appropriate technology solutions would greatly influence the level of acceptance for MyGROCER. The two main challenges that we faced during the design and implementation of the system referred to (a) the *specification of a natural interface* enabling a seamless interaction of the shopper with the system and (b) the specification of a *product scanning mechanism* that would minimize the involvement by the shopper. We will briefly discuss our approach since a detailed technical analysis has already been provided in (Kourouthanassis et al, 2002).

Regarding the system user interface, we had to take into account the familiarity of shoppers with technology. To this end, we decided to embed a touch-screen device on the shopping cart enabling the shopper to interact with MyGROCER. Five distinct interface areas have been designed in order to facilitate shoppers' perception of MyGROCER available options (figure 2):

- *A "Shopping Cart Contents" area* which presents the products (namely name, amount, quantity and unit price) that are currently inside the shoppers' trolley
- *A "Shopping Cart Total" area* which presents the total amount of the products inside the trolley and the total reductions deriving from a promotional activity
- *A "Reminder Shopping List" area* which presents the products (or product categories) that the shopper has indicated he/she wants to purchase
- *A "Promotions" area* (activated when the "View Promotions" button is pressed) which presents the available promotions for the particular shopper based on his/her profile and past consumption behaviour
- *A "Product / Promotion Information" area* which displays either additional information on each product (such as nutritional value, recepies and so on) or on each promotion (conditions that should be satisfied for a promotion to be activated).

Fehler! Es ist nicht möglich, durch die Bearbeitung von Feldfunktionen Objekte zu erstellen.

Figure 2: MyGROCER User Interface. Top-Left: Shopping Cart Contents Area; Bottom-Left: Reminder Shopping List / Available Promotions Area; Top-Right: Shopping Cart Total Area; Bottom-Right: Product / Promotion Information Area

Furthermore, the concept of MyGROCER required the shopping trolley to be able to automatically scan the products placed in it. The most common technology used to scan supermarket products is barcode scanning which is available to almost every cashier in nowadays supermarkets. Furthermore, multiple commercial solutions have been introduced which empower the shoppers to scan themselves the products they purchase using a hand-held barcode scanning device. Nevertheless, this solution requires significant involvement on behalf of the shopper and conceals severe security concerns (in terms of thefts) if the retailer does not take any security precautions at check-out. Our research has led us to select Radio Frequency Identification (RF-Id) technology as the ideal solution for this requirement. RF-Id technology as a barcode replacement is a rather new concept which led several researchers to examine it from both the business and technical perspective mainly as a solution for efficient inventory / warehouse management (Brewer et al, 1999; Kourouthanassis et al, 2001; Smaros et al, 2000; Furness et al, 2000) due to its increased production and installation cost. However, recent advantages in RF-Id technology have reduced cost to a point where RF-Id systems may be used in consumable applications such as supermarket products identification (Agarwal, 2001). The benefits of RF-Id technology in comparison to barcodes can be summarized to (a) transparent

data capturing for the shopper (no line-of-sight is required between the tag and the reader), (b) efficient operation in hostile environments (excessive dust, moisture, dirt and so on), (c) unique product identification and (d) provision of Electronic Article Surveillance (anti-theft) capabilities (Kourouthanassis et al, 2002; Agarwal, 2001).

Our initial approach was to install multiple RF-readers inside the shopping trolley in order to support full coverage of its total volume (80x40x60 cm). Nevertheless, due to impervious technical and business difficulties (increased power requirements, RF-signal absorption by the material of the shopping trolley, and increased total cost) we decided to install just one RF-reader on top of the trolley. To this end, the shopper would have to place each product he/she purchases in the range of the RF-reader in order to "scan" it. Although this solution resembles the existing self-barcode scanning mechanisms, it offers significant benefits both to the shopper (there is no requirement to search for the barcode label in order to scan it) and the retailer (security / anti-theft precaution). The prototype shopping trolley is depicted in figure 3.

Figure 3: MyGROCER prototype trolley implementation

3. Shoppers' perceptions of pervasive retailing applications

3.1 Introduction

Evaluating pervasive retail information systems and their impact on a specific target group is extremely difficult and costly since real supermarket shoppers should be exposed to a fully operational, reliable and robust application operating in the real context (Abowd et al, 2000). Nevertheless, in the case of pervasive retail information systems, our experience showed that users *should participate* in the development of the application from the very beginning. The reason stems from the following perspective:

1. Early testing contributes to the verification of end-user acceptance, overall system usefulness and feedback on system design (Abowd et al, 2002).
2. A potential commercial launch of such a system would require significant investments by the interested retailer thus, an "informal" Return-Of-Investment (ROI) assessment would be extremely important.
3. Differences in shoppers' culture and expectations exist not only from country to country but also from supermarket to supermarket. Just take into account the different supermarket types based on their size and marketing policy: traditional stores, discount supermarkets, hypermarkets,

supercenters and so on. Shoppers select their preferred outlet based on their generic consumer behaviour. For example, price sensitive shoppers would prefer discount supermarkets while recreational shoppers would most likely visit hypermarkets due to their larger assortment. Thus, in each case different service requirements would emerge for a pervasive retail information system.

In our project, we conducted a two-phase evaluation of how MyGROCER affects consumers' shopping experience. The first evaluation occurred during the design phase of the system through the conduction of extensive focus groups with real supermarket shoppers. The second evaluation occurred during the pilot operation of the system when supermarket shoppers used MyGROCER to conduct part of their shopping in ATLANTIC, a Greek supermarket (for more information on the project participants please refer to the acknowledgement at the end of this paper). The following sub-sections discuss in details the methodology followed and the findings of these two evaluation phases.

3.2 Research Methodology

We generated the following seven research hypotheses in order to evaluate the effects of pervasive retail information systems on the shopping experience:

- **Hypothesis 1:** Pervasive retail information systems provide an effective mechanism for consumers to monitor their *budgeting*
- **Hypothesis 2:** Pervasive retail information systems streamline the *check-out process* enabling consumers to wait less time at cashiers
- **Hypothesis 3:** Pervasive retail information systems provide increased *effectiveness* on the overall shopping trip
- **Hypothesis 4:** Pervasive retail information systems provide a more *entertaining* shopping experience compared with the traditional environment
- **Hypothesis 5:** Pervasive retail information systems minimize *information search costs* for supermarket products
- **Hypothesis 6:** Pervasive retail information systems increase *promotions effectiveness* during the supermarket visit
- **Hypothesis 7:** Pervasive retail information systems reduce the sense of *time pressure* for supermarket shoppers

Our research approach is illustrated in the following figure:

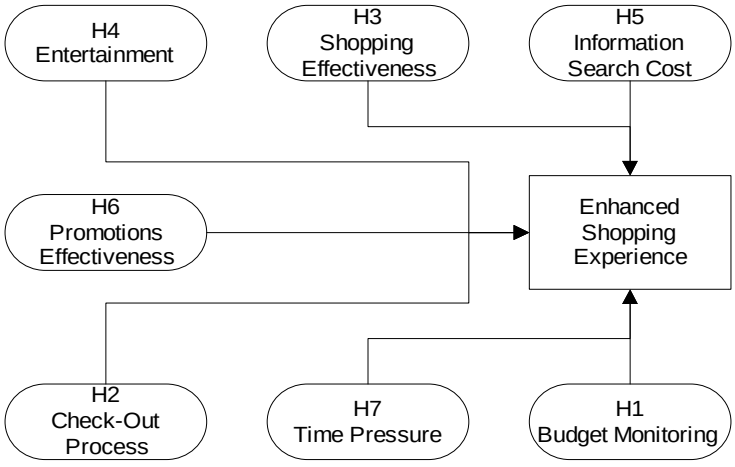

Figure 4: Decomposition of the shopping experience into seven distinct elements

Having generated the research hypotheses, effort was placed on identifying the respective data collection instruments to effectively measure these hypotheses. To this end, we selected to follow a focus-group approach for the initial evaluation of MyGROCER (exploratory evaluation), while the second evaluation was performed through questionnaires.

3.3 Phase I Exploratory Evaluation

The first evaluation of MyGROCER ran over a one-week period during May 2001 in Athens, Greece. Our objective was on one hand to understand how shoppers perceive the new proposition on their customary way of shopping and on the other hand to identify potential barriers of acceptance in all levels (social, legal, family, etc) in order to anticipate problematic issues and take timely corrective action. To this end, we constructed a paper mock-up of the system in the form of concept sketches (presented in figure 1) which were shown to 4 focus groups comprising 48 total shoppers. We decided to follow a qualitative research approach since we were interested in exploring consumers responses to MyGROCER's usage scenarios and the specific services offered. A quantitative research ran at a later stage and will be discussed in detail in the following sections.

Two groups comprised couples of 25-37 and 38-50 years old while the remaining two groups comprised women of 25-34 and 35-50 years old respectively. We invited consumers that were responsible for the household supermarket shopping and relatively familiar with technology due to the fact that we could not demonstrate at the time a working prototype of the system. A moderator orchestrated each session displaying the concept sketches and encouraging the participants to talk about their thoughts, feelings and reactions to this material, as well as to express their beliefs concerning how these scenarios could influence their attitudes and overall shopping experience.

MyGROCER received substantial interest and appeal by most respondents. In particular, respondents' intentions towards the suggested services were high; especially when it was made known to them that the traditional way of shopping will initially co-exist with the "modern" one, respondents felt relieved in the sense of being offered another shopping option in addition to the current situation. In effect, most of them expressed the opinion that MyGROCER will constitute the "shopping of the future". The perceived benefits of MyGROCER on the participants' "traditional shopping experience" referred to conducting shopping faster, easier, and at better value for money. In particular, the following features proved to be more attractive:

- *Constant awareness of the total cost of the shopping cart contents.* This benefit appeared to be one of the stronger ones, as it facilitates shoppers to keep control over their total expenditure. In addition, shoppers outlined that it may protect them from embarrassment at cases when they could run short of cash and would have to deduct items at the cashier.
- *On screen appearance of complete and accurate description of products.* Shoppers perceived this feature as a possible solution to the reported problem of incorrect or non-existing information on products packaging or on supermarket shelves. Moreover, the appearance of information such as the expiration date, nutritional value and so on was also highly appreciated.
- Ability to *compare the value of similar products* simply by scanning them.
- *Personalized, targeted promotions fitting the shoppers' profile.* This feature was very highly appreciated – especially by promotions' sensitive shoppers – since most of them perceived that they will save money and time during shopping, as they will be notified about promotions which are of their personal interest, instead of looking for them on their own.

- *The in-store navigation system*. This feature appeared impressing and very practical in saving time from asking store employees to locate products.
- *The smart check-out and the ability to bypass queues and reduce waiting time* which was the feature that received the highest appreciation by the respondents.

Table 1 presents some key verbatims of the participants for each examined hypothesis.

Examined Construct	**Participants Verbatims**
H1: Budget Monitoring	• "Protects from overspending" • "You avoid getting off budget"
H2: Check-Out Process	• "Very convenient" • "Saves time" • "Less frustrating"
H3: Shopping Effectiveness	• "Very convenient" • "Can't miss usual needs" • "Even when there is mo employee to assist you, you can find what you are looking for. It guides you!"
H4: Entertainment	• "Has fun" • "Really advanced" • "Great! It's like a game"
H5: Information Search Cost	• "No need to write a shopping list" • "You can't forget. The list is programming, reminding" • "Gives information needed to select brands i.e. price, ingredients, expiration date, sub-totals"
H6: Promotions Effectiveness	• "Won't miss interesting offers" • "Allows to select better value" • "This is very good, because you do not have to search for promotions on supermarket shelves for hours"
H7: Time Pressure	• "Saves time and effort from searching" • "You never get lost in the supermarket and you do not waste time searching especially when you are in a rush"

Table 1: Focus Groups Participants' Opinions

However, several MyGROCER features were treated with considerable skepticism. In particular personalized provision of information and promotions raised a debate among the participants. A significant proportion was particularly concerned about the collection of personal data. This reaction was triggered mainly by the eponymous customer identification during the login process and the provision of a shopping list based on their past consumption patterns and of personalized promotions. Another barrier to acceptance lied in the fact that the overall shopping experience seemed to point towards a hi-tech, fully standardized life-style. As a result, the concept of personalization appeared patronizing and much too rationalized, but also limiting the experience of being human. Indeed, the majority of the participants rejected the possibility of a computer system capable to successfully predicting their exact wishes and further, some were offended by this suggestion. Nevertheless, the majority suggested that the service provider empowers the shoppers to select the level of personalization that the system offers. In particular, some shoppers suggested that the system should include an option of anonymous usage in order to provide just an enhanced in-store shopping facility.

Conclusively, protection of their privacy and personal data was of paramount importance to the survey participants.

The aforementioned observations led us to redefine the original concept of MyGROCER. First of all, we included an option for the shopper to deactivate personalization in promotions should he/she desires. Secondly, we revised the suggested shopping list to include only the products that the shopper provides the system with over the Internet. Still, we decided to keep the login feature in order to enable tracking of each user's session.

3.4 Phase II Quantitative Evaluation

The second evaluation of MyGROCER spammed over a two-week in-field trial during September and October 2002 (Athens, Greece – ATLANTIC supermarket). 60 loyalty club members of ATLANTIC participated in the trial ranging from 25-65 years old. We decided to invite only loyalty club members due to the privacy concerns raised during the focus groups survey. Loyalty club members have already given permission to the supermarket to use their personal information in order to receive better value such as discounts, product gifts and so on thus, they represented an ideal group in order to test the full functionality of MyGROCER.

Since we were unable to accommodate the entire supermarket to MyGROCER concept due to the research orientation of our approach (a commercial approach would require the attachment of an RF-tag to each product and the creation of a substantial number of specially modified trolleys), we prepared the trial environment in terms of (i) selecting the appropriate products that would participate in the trial, (ii) preparing a specially modified corridor inside the participating supermarket (iii) preparing the technical infrastructure to support the trial and (iv) invite the trial participants. We invited the participants through phone interviews where we also collected their demographic data. The total response rate was over 50%. The majority of the participants (85%) belonged to the age range of 30-54 years old, while 77% of the participants were female. The level of education was high with over 71% of the participants having university or higher education. Regarding familiarity with information technology, 66% were relative familiar with PCs while 15% had never used personal computers before.

The execution of the trial was organized in a sequence of three distinct steps. Initially, the trial participants were shown the system functionality by an assigned facilitator (10 minutes). After the end of the system demonstration, shoppers were prompted to use the system on their own (10-15 minutes). The shoppers were able to purchase the products that were displayed in the MyGROCER corridor (including the promotions that were displayed by the system). Following their interaction with the system, the participating shoppers completed a questionnaire evaluating the effect of the system on their traditional shopping experience. Unreliable questions were removed from the respective constructs through the use of the Cronbach Alpha reliability test. The questionnaire was previously tested for any usability problems by a representative set of ATLANTIC personnel (17 in total). Finally, normality tests indicated that non-parametric tests should be used for the examined constructs due to normality violation. The analysis of the questionnaires using the Wilcoxon Signed Ranks non-parametric test indicated that pervasive retail information systems statistically enhance the traditional shopping experience on all the examined hypotheses namely entertainment, shopping effectiveness, information search costs, check-out process, time pressure, budget monitoring and promotions effectiveness (Table 2).

Alternative	Normality Test	Means	Wilcoxon Signed	Findings

Hypotheses	(Kolmogorov – Smirnov)		Ranks Test			
H1 (Budget Constraints)	Conventional: MyGROCER:	.019 .000	Conventional: MyGROCER:	3.12 4.53	Z = -5.581 Asymp. Sig. = .000	Pervasive retail systems facilitate shoppers to monitor more effectively their budgeting
H2 (Check-Out Process)	Conventional: MyGROCER:	.001 .000	Conventional: MyGROCER:	2.48 4.72	Z = -6.435 Asymp. Sig. = .000	Pervasive retail systems appear to streamline the check-out process enabling supermarket shoppers to wait less time in queues at cashiers
H3 (Shopping Effectiveness)	Conventional: MyGROCER:	.000 .000	Conventional: MyGROCER:	3.66 4.49	Z = -3.915 Asymp. Sig. = .000	Pervasive retail systems make the overall shopping experience more efficient compared to the traditional environment
H4 (Entertainment)	Conventional: MyGROCER:	.002 .000	Conventional: MyGROCER:	3.11 4.30	Z = -5.251 Asymp. Sig. = .000	Pervasive retail systems appear to contribute to the creation of an enjoyable and entertaining shopping experience
H5 (Information Search)	Conventional: MyGROCER:	.074 .000	Conventional: MyGROCER:	3.24 4.50	Z = -5.304 Asymp. Sig. = .000	Pervasive retail systems organize and present information regarding supermarket products in a more efficient way than the traditional environment
H6 (Promotions Effectiveness)	Conventional: MyGROCER:	.018 .000	Conventional: MyGROCER:	3.31 4.29	Z = -4.597 Asymp. Sig. = .000	Pervasive retail systems appear to enhance promotions effectiveness in the supermarket environment
H7 (Time Pressure)	Conventional: MyGROCER:	.000 .000	Conventional: MyGROCER:	2.48 4.17	Z = -5.696 Asymp. Sig. = .000	Pervasive retail systems appear to reduce the sense of time pressure for supermarket shoppers

Table 2: Comparison of consumers' shopping experience between the conventional and MyGROCER shopping environment

In particular, Greek shoppers evaluated their shopping experience using MyGROCER as amusing and pleasant (with over 70% characterizing it as exciting), while 78% of them stated that MyGROCER enables them to monitor effectively the products in their shopping cart while at the same time, organize better their supermarket purchases. Furthermore, 85% of the participants stated that MyGROCER saves them time to search for additional information or promotional offers regarding the products they want to purchase.

Although the prototype was not fully integrated with the supermarket cashiers, Greek shoppers identified that the use of MyGROCER will improve the "traditional" check-out process while almost all of them stated that they expect to wait less at the cashiers using such a system. An interesting observation derives from the fact that 89% of the trial participants stated that waiting less time in the

cashiers using MyGROCER would influence their decision to shop at a certain supermarket. Furthermore, Greek shoppers perceived that MyGROCER improves the effect of time pressure within the supermarket since over 80% responded that MyGROCER offers them more time to conduct their shopping while at the same time reduces the sense of time pressure and contributes to hurry less in the supermarket.

Regarding the continuous monitoring of the shopping cart's total value, 93% of the participants stated that MyGROCER can contribute to monitor more effectively their budgeting during supermarket purchases and that such a system allows them not to spend more money than they have available. Finally, Greek shoppers evaluated that MyGROCER improves promotions effectiveness within the supermarket. Indeed, 87% of the participants responded that MyGROCER presents in a clear and centralized way the promotions of the products that interest them while at the same time organizes product promotions in an efficient way.

3.5 Limitations of our research

The basic limitation of the present study is that the system has not been used in a completely real environment and for a substantial time period. We tested the system on one supermarket corridor, using a subset of the supermarket assortment and giving the opportunity to the participants to use the system for a fraction of their supermarket trip (no more than 10 minutes each). Although the trial resembles a "real shopping visit", we feel that in order to articulate the actual effects that pervasive retail information systems impose on consumers shopping experience, we should continuously observe the behaviour of selected test subjects for a substantial time period. We should also acknowledge that since Greek shoppers were never exposed to similar innovative shopping schemes, their high appreciation of MyGROCER might derive from the fact that they consider it simply a new gadget rather than an actual mechanism that might facilitate supermarket shopping.

4. Discussion: Managerial Implications of Pervasive Retail Information Systems

This paper presented the potential of pervasive retail information systems as a means of enhancing consumers shopping experience within supermarket environments. This observation derived from an exploratory survey and an in-field trial of a prototype pervasive retail information system. The outcomes of our research revealed that pervasive retail information systems can provide a more entertaining and efficient shopping trip compared to the conventional way of shopping thus, generate new shopping experiences for nowadays shoppers.

Although there are still several challenges to the wider commercial deployment of pervasive retail - especially those relating to issues of personal identity, security and privacy but also standardisation and engineering - the results of our research indicate that consumers would accept the introduction of pervasive retail information systems when they become financially viable. Our research revealed that the issue of trust and privacy is extremely important considering the fact that we constantly need information regarding the consumers' current location in-store, past consumption patterns, household information, demographic data and so on in order to provide fully personalized services. An initial critical appraisal of this situation would indicate that application designers must make some compromises on the extent they offer personalized services. Traditionally, data protection legislation in most EU countries prohibits the capture and storage of any person-related data and only allows exceptions for clearly defined purposes after which the data must be destroyed. In our case, we allowed consumers to deactivate the provision of personalized services and at the same time participate to the system without providing their full set of personal information. However, this is not

the solution to the general problem of trust and privacy. We expect that users will eventually be willing to adopt such applications only if they perceive that they are getting better shopping experiences in return for letting go some of their privacy.

Moreover, we need to identify a viable economic and business model. This is the most important reason why such applications have not been already deployed in real environments and remain in prototype forms. Several questions still need to be answered: Who will be the owner of the application? What will be the role of the product supplier? What are the indirect benefits of pervasive retail information systems to the FMCG value chain? How can these systems be integrated with retailers' legacy systems? What about RF-Id costs and who will pay for the tags? What about standardization issues? Is it possible for such applications to generate revenue? Will the consumers use them? Will the consumers pay for them? To this end, extensive and continuous market research is demanded in order to identify (a) appropriate target groups that will use such systems and (b) the most feasible revenue models that would ensure break-even for the potential investors.

At this time-frame, we feel that the early adopters of such innovative solutions comprise time-starved shoppers that are relatively familiar with technology (depending on the implementation of the shopping cart and the level of scanning transparency it provides), purchase a substantially large shopping list, and have planned their shopping trip beforehand (thus, view supermarket shopping mainly as a routine, replenishment activity). Similarly, the retailers that would initially provide this solution consist of large supermarkets / hypermarkets which are in need to monitor on a real-time basis their POS data including out-of-stock and out-of-shelf conditions and aiming at reducing the total thefts in their store. Given this profile, pervasive retail information systems could be used as an extension to their existing loyalty programmes due to the fact that (i) supermarkets are expected to initially invite their loyalty customers to use the system since they represent a controlled group that can provide feedback regarding the actual system use and (ii) supermarkets already possess the initial set of data (demographics and past consumption behaviour) required by such systems in order to provide their full set of services to the consumers.

Finally, we should stress out that pervasive retail information systems can provide significant benefits to the FMCG value chain. In effect, although ECR has always tried to embrace consumers, its initiatives have never actually *reached* them in a way that they become a real stakeholder, part of the ECR vision for an optimized value chain. Pervasive retail information systems empower retailers to "work with consumers"; make them an indistinguishable part of their operations. Fully extending ECR to the consumer will emerge as one of the most fruitful ways for retailers and their suppliers to cut costs, open up new revenue streams, and build closer, more trusting relationships with their customers (Mitchell, 2001). The following table highlights the value adding elements of pervasive retail information systems on the four core ECR initiatives.

ECR initiatives	Value-adding elements of pervasive retail information systems
Efficient assortment	• Real-time information provision regarding the products' lifecycle within the retail outlet (placement on the shelf, number of removals / replacements by each shopper, actual purchase) • Real-time information provision regarding each shopper's shopping trip (and correspondent patterns) within the retail outlet • The aforementioned information can lead to the generation of the optimal store layout based on the actual preferences of the supermarket shoppers
Efficient promotion	• Personalized promotions based on past consumer behaviour and in-store navigation patterns • Real-time monitoring of promotions effectiveness (impressions, actual purchases) • Collaborative placement of promotional strategies within the retail outlet taking into

	account retailers' POS data
Efficient product introduction	• Identification of shoppers emerging needs through the continuous monitoring of their behaviour within the retail outlet • Continuous monitoring of shoppers perceptions on new product introductions (e.g. number of times a shopper – or a cluster of shoppers – has removed the product from the shelf or placed it in his/her trolley)
Efficient product replenishment	• Elimination of out-of-shelf / out-of-stock conditions (real-time monitoring of remaining product quantity on-shelf, efficient inventory management within the store) • Efficient forecasting of future demand taking into account the actual product lifecycle within the retail outlet

Table 3: Impact of pervasive retail information systems on ECR initiatives

Regarding technology availability, we should stress out that the latest developments on wireless technologies (WLANs, Bluetooth and so on) have significantly reduced networking costs to an affordable level. Furthermore, although we have used RF-Id as the core scanning technology of our solution, we could argue that the same set of services can be provided using barcodes, but compromising the issue of security during check-out. As a conclusion, pervasive retail information systems may comprise the first attempt of fully working with the consumers evolving the traditional loyalty programmes to actual relationship based solutions; working on the shop floor together, solving common problems and co-creating.

Acknowledgment

MyGROCER project has been partially funded by the European Commission under the Information Society Technologies (IST) Programme. MyGROCER is a joint effort between: *POULIADIS ASSOCIATES CORPORATION*, *NOKIA CORPORATION.*, *ATMEL HELLAS, UNISYS BELGIUM, HELSINKI UNIVERSITY OF TECHNOLOGY, ATLANTIC S.A., PROCTER & GAMBLE HELLAS S.A.* and ELTRUN-*Athens University of Economics & Business.*

References

Abowd G. D. and Mynatt E. D. (2000), "Charting Past, Present and Future Research in Ubiquitous Computing", *ACM Transactions in Computer-Human Interaction*, vol. 7, no. 1, pp. 29-58

Abowd G. D., Mynatt E. D. and Rodden T. (2002), "The Human Experience", Pervasive Computing, vol. 1, no. 1, pp. 48-57

Agarwal V. (2001), "Report: Assessing the benefits of Auto-ID technology in the consumer goods industry", Auto-ID Centre, available online at: http://www.autoidcenter.org/research/CAM-WH-003.pdf

Asthana R., Cravatts M. and Krzyzanowski P. (1994), "An indoor wireless system for personalized shopping assistance", in the *Proceedings of IEEE Workshop on Mobile Computing Systems and Applications*, Santa Cruz, California, IEEE Computer Society Press, pp. 69-74

Aylott R. and Mitchell V. W. (1998), "An exploratory study of grocery shopping stressors", *International Journal of Retail and Distribution Management*, Vol. 26, No. 9, pp. 362-373

Baker J. (1986), "The role of the environment in marketing services: The consumer perspective", in J. A. Czepeil, C. A. Congram and J. Shanahan (Eds.), *The Services Challenge: Integrating for Competitive Advantage*, American Marketing Association, Chicago, IL, pp. 79-84

Brewer A., Sloan N. and Landers T. (1999), "Intelligent Tracking in Manufacturing", Journal of Intelligent Manufacturing, vol. 10, pp. 245-250

Bruner G. C. (1990), "Music, mood and marketing", *Journal of Marketing*, October, pp. 99-104

Buckhardt J., Henn H., Hepper S., Rindtorrff K. and Schaeck T. (2001), "Pervasive Computing", Addison-Wesley

Burke R. R. (1997), "Do you see what I see? The future of virtual shopping", *Journal of the Academy of Marketing Science*, vol. 25, no. 4, pp. 352-360

Corstjens M. and Doyle P. (1983), "A dynamic model for strategically allocating retail space", *Journal of Operational Research Society*, vol. 34, no. 10, pp. 943-951

Curhan R. C. (1973), "Shelf space allocation and profit maximization in mass retailing", *Journal of Marketing*, vol. 37, July, pp. 54-60

Corsten D. (2000), "Implementing the new logic of consumer value", ECR Academic Report 2000: ECR in the third Millenium, pp. 54-59

Donovan R. J. and Rossiter J. R. (1982), "Store atmosphere: An environmental psychology approach", *Journal of Retailing*, Vol. 58, Spring, pp. 34-57

ECR Europe (1999), "Consumer Value Measurement", by Price Waterhouse Coopers / Roland Berger & Partner

ECR Europe (1999), "How To Implement Consumer Enthusiasm – Strategic Consumer Value Management", by Roland Berger & Partner

Furness A. (2000), "Machine readable data carriers – A brief introduction to automatic identification and data capture", *Assembly Automation*, vol. 20, no. 1, pp. 28-34

Fried R. and Berkowitz L. (1979), "Music hath charms …and can influence helpfulness", *Journal of Applied Social Psychology*, vol. 9, no. 3, pp. 199-208

Gorn G. J (1982), "The effects of music in advertising on choice behavior: A classical conditioning approach", *Journal of Marketing*, vol. 46, Winter, pp. 94-101

Grayston D. (1974), "Music while you work", *Industrial Management*, vol. 4, June, pp. 38-39

Hoffman J. M. and Mehra S., (2000), Efficient Consumer Response as a supply chain strategy for grocery businesses, International Journal of Service Industry Management, Vol. 11, No. 4, pp. 365-373

IBM Corporation, Project Smart Pad

Joint Industry Project on Efficient Consumer Response (1994), An ECR Best Practices Report. Report available from Grocery Manufacturers of America, Washington, DC.

Kim Y. K. (2002), "Consumer Value: An Application To Mall and Internet Shopping", *International Journal of Retail and Distribution Management*, vol. 30, no. 12, pp. 595-602

Kourouthanassis P., Koukara L., Lazaris C. and Thiveos K. (2001), "Last Mile Supply Chain Management: MyGROCER Innovative Business and Technology Framework", in the *Proceedings of the 17th International Logistics Conference*, pp. 264-273

Kourouthanassis P., Spinellis D., Roussos G. and Giaglis G. M. (2002), "Intelligent Cokes and Diapers: MyGROCER Ubiquitous Computing Environment", in the *Proceedings of mBusiness 2002 Conference*, pp. 150-172

Lawrence, Almasi G. S., Kotlyar V., Viveros M. S., Duri S. S. (2001), "Personalization of Supermarket Recommendations", *Data Mining and Knowledge Discovery*, 5, pp. 11-32

Levy M. and Weitz B. A. (2001), "Retailing Management", 4th Edition, McGraw-Hill

Lewison D. M. (1997), "Retailing", 6th Edition, Prentice Hall

Milliman R. E. (1986), "Using background music to affect the behavior of supermarket shoppers", *Journal of Marketing*, vol. 46, Summer, pp. 86-91

Mitchell A. (2001), "Extending ECR to the consumer", *ECR Journal*, Summer, vol. 1, no. 1, pp. 69-79

Reid R. and Brown S. (1996), "I hate shopping! An introspective perspective", *International Journal of Retail and Distribution Management*, Vol. 24, No. 4, pp. 4-16

Siu N. Y. M. and Cheung J. T. H. (2001), "A measure of retail service quality", *Marketing Intelligence and Planning*, Vol. 19, No. 2, 2001, pp. 88-96

Smaros J. and Holmstrom J. (2000), "Viewpoint: Reaching the consumer through e-grocery VMI", *International Journal of Retail and Distribution Management*, vol. 28, no. 2, pp. 55-61

Trigueros C. (1999), "ALBATROS: Electronic tagging solutions for the retail sector", Informatica El Corte Inglés

Weiser M. (1991), "The Computer of the 21st Century", *Scientific American*, vol. 265, no. 3, pp. 66-75

Yalch R. and Spangenberg E. (1990), "Effects of store music on shopping behaviour", *Journal of Consumer Marketing*, vol. 7, no. 2, Spring, pp. 55-63