European Journal of Information Systems (2009) 18, 541–552

www.palgrave-journals.com/ejis/

Consumer acceptance of RFID-enabled services: a model of multiple attitudes, perceived system characteristics and individual traits

Katerina Pramatari and Aristeidis Theotokis

ELTRUN, Department of Management Science & Technology, Athens University of Economics & Business, Athens, Greece

Correspondence: Katerina Pramatari, ELTRUN, Department of Management Science & Technology, Athens University of Economics & Business, 47A Evelpidon & 33 Lefkados Str., 113 62, Athens, Greece.
Tel: +30 210 8203663;
Fax: +30 210 8203664

Abstract
The introduction of emerging technologies in retailing and their infusion in the service encounter necessitates research to better understand consumer attitudes towards the usage of technology in service delivery systems. The capability of Radio Frequency Identification (RFID) technology to automatically and uniquely identify products makes this technology promising as an enabler of innovative consumer services. However there is limited research on how consumers perceive the RFID-enabled service systems. The authors develop and empirically test a model that focuses on consumer attitudes towards technology-based services. Based on the pre-prototype user acceptance framework and using RFID as a focal technology, the proposed model includes a hierarchy of three distinct consumer attitudes: towards the general service concept, towards the general technology-based service application and towards the RFID-enabled service. Perceived system characteristics as well as personality traits are included in the model. The partial least squares method of structural equation modelling is used to analyse 575 questionnaires collected in two consumer surveys in Greece ($n = 173$) and Ireland ($N = 402$). The results of the study show that consumer attitude towards RFID-enabled services in retailing can be modelled as a confluence of multiple attitudes. The results also indicate that perceived system-related factors – such as performance and effort expectancy – as well as individual traits – such as technology anxiety and information privacy concern – affect consumer attitude towards technology-based and RFID-enabled services, respectively.
European Journal of Information Systems (2009) **18,** 541–552.
doi:10.1057/ejis.2009.40; published online 17 November 2009

Keywords: technology-based services; ubiquitous computing; RFID; retailing; consumer behaviour

Introduction

The emergence of new technologies, such as Radio Frequency Identification (RFID), mobile computing, GPS tracking, and smart cards provide retailers with a great opportunity to offer innovative customer services (Burke, 2002). As a result, consumers are now faced with a myriad of technology-based service delivery options, where they do not directly interact with service firm employees.

From an IS perspective, these applications belong to the greater IS umbrella of ubiquitous or pervasive computing (Weiser, 1991). From a marketing perspective, these services have been labelled as technology-based self-services

Received: 1 December 2008
Revised: 27 August 2009
2nd Revision: 5 October 2009
Accepted: 6 October 2009

(TBSS) and are defined as technological interfaces that allow customers to use a service independent of direct service employee involvement (Meuter *et al*., 2000; Dabholkar & Bagozzi, 2002; Meuter *et al*., 2005; Reinders *et al*., 2008). Examples of TBSS include touch screens in department stores and information kiosks at hotels, automated teller machines, as well as off-site options, such as Internet-based services, or automated phone systems, such as phone banking.

RFID is considered to be an important technological building block of these applications (Spiekermann, 2007; Rothensee & Spiekermann, 2008) because of its ability to automatically and uniquely identify objects. In the retail industry, where millions of different products exist and consumers demand more information, RFID is the most prominent candidate technology for enabling in-store consumer information services, such as the smart shelf that informs consumers about product characteristics (for some examples of RFID-enabled consumer services see relevant reports of the Metro Future Store, www .futurestore.org).

With the tremendous investment required in terms of both time and money to design, implement, and manage RFID-enabled services, it is critical for firms to understand whether consumers would be willing or not to use them. Although a large number of business reports and anecdotal evidence suggest that RFID raises consumer privacy concerns (Ohkubo *et al*., 2005), there is limited or no research on how consumers formulate their attitudes towards RFID-enabled services.

Using the context of retailing, this research is designed to explore these critical attitudinal factors that influence customer intention to use RFID-enabled services. By decomposing consumer perceptions into three different levels of attitudes, we hypothesise that *consumer attitude towards RFID-enabled services* can be modelled as a function of *consumer attitude towards the technology-based application,* which in turn is affected by the *consumer attitude towards the service concept*.

Using an experimental design, we present to consumers three different service scenarios in hierarchical order:

1. The *general service concept,* without any information about the interface technology used,
2. the *general technology-based service,* without any information about the infrastructure used to support it, and
3. the *RFID-enabled service,* including the information that RFID tags are used to support the technology-based service.

Furthermore, we include in our model perceived system characteristics, such as *performance* and *effort expectancy,* as well as consumer characteristics, namely *technology anxiety* and *information privacy concern (IPC)*. In order to empirically validate the proposed model, we exploit the scenario and survey methodology and data are collected from 600 consumers in Greece and Ireland, so as to capture any cross-country differences.

The paper is structured as follows: the next section draws upon extant theory to develop the research hypotheses; the following sections then discuss the research methodology, evaluate the psychometric properties of the various constructs used in the study and present the results. The concluding section provides a discussion of the results, implications for research and practice, and limitations of the study.

Background and research model

Consumer attitude towards RFID-enabled services

Consumer acceptance is considered to be a focal theme for the application of new technologies in retail services. The IS literature provides insights on user acceptance of technology (Davis *et al*., 1989; Rogers, 1995; Venkatesh *et al*., 2003), while service marketing researchers study customer attitude towards TBSS. In a nutshell, individual personality characteristics (Bateson, 1985; Zeithaml & Gilly, 1987; Dabholkar, 1996; Meuter *et al*., 2000; Parasuraman, 2000; Bobbitt & Dabholkar, 2001; Dabholkar & Bagozzi, 2002; Curran *et al*., 2003; Dabholkar *et al*., 2003; Meuter *et al*., 2003; Curran & Meuter, 2005; Meuter *et al*., 2005; Simon & Usunier, 2007), service and technology characteristics (Curran *et al*., 2003; Curran & Meuter, 2005; Meuter *et al*., 2005; Im *et al*., 2007; Simon & Usunier, 2007; Theotokis *et al*., 2008), as well as situational factors (Dabholkar, 1996; Dabholkar & Bagozzi, 2002) have been proposed as antecedent factors that affect customer perceptions of technology-based service delivery.

Although RFID is a promising technology to be exploited as a supporting infrastructure for different consumer services, there are few studies that investigate RFID from the consumer perspective (Loebbecke & Huyskens, 2008). However, business facts, and some initial reports indicate that RFID is a technology associated with negative consumer reactions, due to privacy and ethical issues that arise from RFID applications in the retail sector (Eckfeldt, 2005; Günther & Spiekermann, 2005; Ohkubo *et al*., 2005).

Attitude is one of the critical factors in explaining human behaviour. Attitude can be defined as *a learned disposition to respond in a consistently favourable or unfavourable manner with respect to a given object or behaviour* (Fishbein & Ajzen, 1975, p. 132). A person's attitude towards an object X influences his/her intention to perform certain behaviour related to the object X, which in turn leads to actual behaviour relating to X (Fishbein & Ajzen, 1975; Ajzen, 1985). For this reason, a number of theories applied in the IS context (for example theory of reasoned action and theory of planned behaviour), which attempt to explain the attitude humans hold towards objects and their behaviours, are used to predict IT usage (Venkatesh *et al*., 2003).

In the marketing literature, research regarding the relevance of attitudes towards targets has found that

there may be more than one relevant attitude(s) for a given situation and that attitudes, and ultimately behavioural intentions, develop sequentially or in a hierarchical fashion (Eagly & Chaiken, 1993). These authors also suggest that, when faced with the presence of multiple attitudes, some attitudes towards specific targets will come to mind before others, thus creating an order within the hierarchy.

In parallel, Davis & Venkatesh (2004), in their pre-prototype user acceptance framework, propose that user perceptions about a system can be predicted if we know user perceptions about the general system concept, which describes what the final system is designed to do, that is its intended functionality. This approach has also been exploited by other researchers for the evaluation of RFID-enabled services (Resatsch *et al*., 2008).

Combing these theories from the marketing and the IS research fields, we formulate the following hypotheses:

H1: *Attitude towards a general retail service concept will positively influence attitude towards this service concept applied as a technology-based service.*

H2: *Attitude towards a technology-based service will positively influence attitude towards this service when supported by RFID technology.*

The effect of perceived system characteristics

Diffusion and technology adoption research has a rich history and has been studied in a wide range of fields (for a comprehensive review, see Rogers, 1995). Within the adoption literature, several constructs have received widespread attention. Perceptions of innovation and system characteristics have been shown to predict adoption behaviours, such as trial or commitment.

Several technology acceptance models and theories, such as the Unified Theory of Technology Usage and Acceptance proposed by Venkatesh *et al*. (2003), support that effort expectancy – or ease of use – and performance expectancy – or perceived usefulness – affect user attitude towards technology usage. More specifically, effort expectancy (Venkatesh *et al*., 2003) is defined as the degree of ease associated with the use of the system. Three constructs from earlier models capture the concept of effort expectancy: perceived ease of use, complexity, and ease of use. Performance expectancy (Venkatesh *et al*., 2003) is defined as the degree to which an individual believes that using the system will help him or her attain gains in job performance. The constructs from different models that pertain to performance expectancy are: perceived usefulness, extrinsic motivation, job fit, relative advantage, and outcome expectations.

Based on the existing literature on technology-based services and the unified theory of technology acceptance (Venkatesh *et al*., 2003) we formulate the hypotheses:

H3: *Effort expectancy will positively affect consumer attitude towards technology-based services.*

H4: *Performance expectancy will positively affect consumer attitude towards technology-based services.*

The role of technology anxiety and IPC

Literature on the adoption of TBSS shows that previous experience with TBSS in general increases the likelihood of consumers trying out new TBSS options (Meuter *et al*., 2005). Moreover, several researchers propose that consumer attitude towards new technologies can be operationalised as a personality characteristic (Parasuraman, 2000). *Technology Anxiety* (TA), for example, is a construct proposed by Meuter *et al*. (2003) and expresses the ability and willingness of customers to use technologies. TA focuses on a user's state of mind about general technology tools. Technology anxiety is based on the narrower construct of computer anxiety, defined as 'the fear, apprehension and hope people feel when considering use or actually using computer technology' (Cambre and Cook, 1985; Scott and Rockwell, 1997). This anxiety is characterised by 'excessive timidity in using computers, negative comments against computers and information science, attempts to reduce the amount of time spent using computers, and even the avoidance of computers in the place where they are located' (Doronina, 1995). In the study of Meuter *et al*. (2003), technology anxiety has been found to be the most influential individual predictor of technology-based service usage. Results of this study indicate that as TA increases the use of TBSS decreases. In our study, we use the construct of technology anxiety as a predictor of consumer attitude towards the RFID-enabled service. As there is established support that TA affects consumer attitude towards the general technology-based service, in this study we would like to investigate the effect of this personality characteristic on the unexplored attitude towards the RFID technology, which is new to the consumer behaviour literature. We thus formulate the following hypothesis:

H5: *Technology Anxiety will negatively affect consumer attitude towards RFID-enabled services.*

During the past decade, the issue of information privacy has drawn considerable attention among researchers in disciplines such as law, public policy, marketing, organisational behaviour, and IS. *Information privacy* refers to 'the claim of individuals, groups, or institutions to determine for themselves when, how, and to what extent information about them is communicated to others' (Westin, 1967, p. 7). *IPC* refers to an individual's subjective view of fairness within the context

of information privacy (Campbell, 1997). To understand the complexity of individuals' privacy concerns, Smith *et al*. (1996) conducted a series of studies in order to develop a new multidimensional scale, called concern for information privacy (CFIP), designed to capture individuals' concerns about organisational information privacy practices. The CFIP scale consists of 15 items and reflects four dimensions of IPCs. These four dimensions, pertaining to personal data, are: collection of data, unauthorised secondary use, improper access, and errors. Using this scale, they were able to demonstrate that consumers' privacy concerns negatively influence their willingness to carry on relationships with online companies. Other studies have shown that one's tendency to worry over information privacy will influence how the person perceives a specific situation in which an online marketer requests personal information (i.e. trust and risk beliefs). More specifically, consumers with high IPC are likely to be low on trust beliefs and high on risk beliefs.

Consistently with the theory or reasoned action, which suggests that individual characteristics influence salient beliefs (Fishbein & Ajzen, 1975; Ajzen, 1991), and with previous studies suggesting that RFID raises consumer privacy concerns (Günther & Spiekermann, 2005), we formulate the next hypothesis:

H6: *Information Privacy Concern will negatively affect consumer attitude towards RFID-enabled services.*

Figure 1 shows the conceptual model of the present study.

Research methodology

In order to test our hypotheses, a survey approach was followed, targeted to consumers of supermarket stores. Data were collected in the beginning of 2008. The retail industry was selected because of its history of technology usage in the service encounter, as well as the promising RFID applications that have emerged in this industry. This context allows the model of multiple attitudes to be tested. In order to measure consumer attitude towards the general service concept, the general technology-based service and the RFID-enabled service we used the scenario and survey approach. This approach is also recommended for capturing the user evaluation insights during the design of new services (Resatsch *et al*., 2008). A dynamic pricing information service was used as the basis of our service scenarios. The practice of dynamically

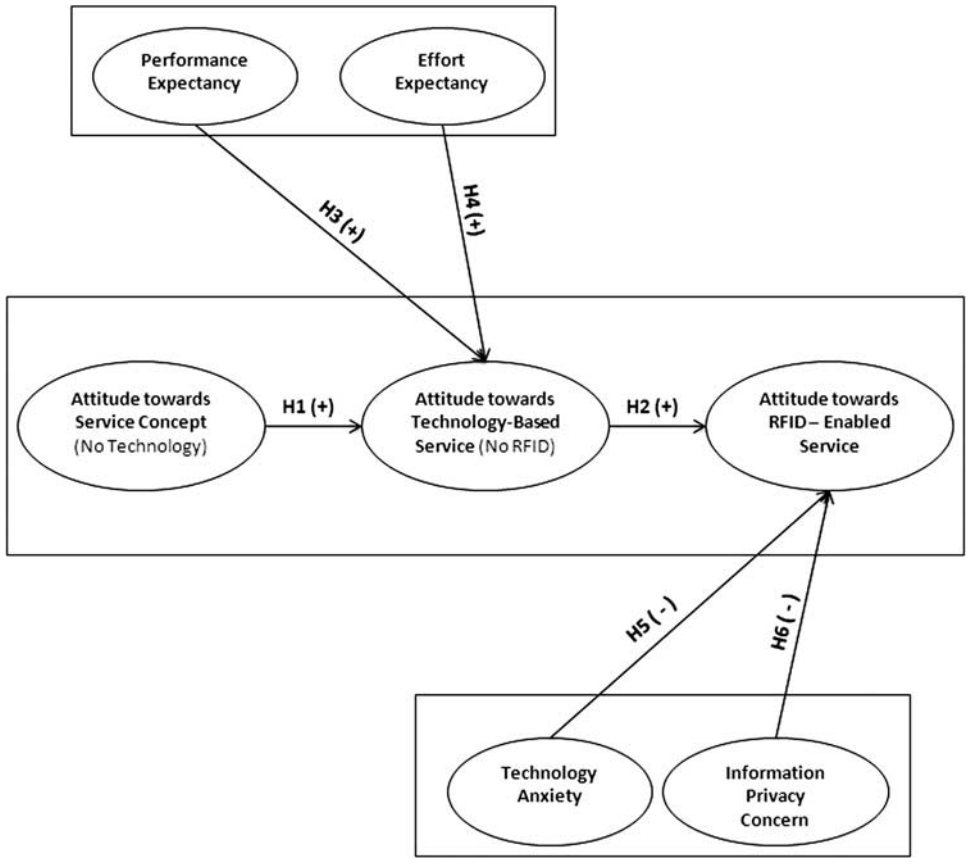

Figure 1 The research model.

pricing perishable products (dairy, meat and poultry, vegetables etc.) based on their current expiration date is already used in grocery stores (Tsiros & Heilman, 2005; Theotokis *et al.*, 2008). Based on this practice, the dynamic pricing information service uses a technology interface in the foreground, to inform consumers about the dynamic product prices, and RFID technology in the background, to uniquely identify product instances and associate them with the right price. These features make the specific service particularly relevant to our study. In the following section we describe the methodological issues of the study.

Research design

Among the various applications of RFID technology, a promising one is dynamic pricing (Spiekermann, 2007). By using the possibility to uniquely identify product instances, retailers may offer different prices for the same product based on unique product characteristics, such as the product expiration date. The term '*expiration date*' (Tsiros & Heilman, 2005) is used hereafter to denote any of the 'sell by', 'best before', and 'use by' dates used for food dating. Dynamic pricing is partly used by retailers today, as a practice to reduce waste, by manually attaching price-off stickers on products with short expiration dates and often moving them to a special store section. RFID technology has the potential to automate this process and make it efficient for a broader range of product categories. Furthermore, in a recent consumer survey conducted in Greece and Germany (Pramatari and Huchzermeier, 2007) consumers have shown high preference for dynamic pricing as a retail service concept.

In order to examine our research hypotheses, we use the dynamic pricing information service as the context of our research. Three different descriptions of the dynamic pricing information service were presented to consumers in a sequence.

First, the general description of the dynamic pricing service was presented to respondents, without giving any information about the way the service is applied – that is with or without the use of technology (General Service Concept).

Then respondents were asked to read a visualised scenario of a technology-based application of dynamic pricing without getting any information whether RFID technology is used or not. This scenario described how a touch screen or electronic shelf labels would be used to inform consumers about dynamic product prices. For a version of this scenario see Appendix A (General Technology-Based Service).

Finally, consumers were informed that, in order to get the service described in the previous scenario, an RFID tag should be attached to the product. Moreover, they were informed that this tag could potentially give someone the possibility to know what they have purchased (RFID-enabled Service).

After each of the three descriptions, consumers were asked to express their attitude. Moreover, after the scenario of the technology-based service, the performance and effort expectancy were measured. In the final phase, the respondent's psychographic and individual characteristics, including technology anxiety and IPC, were asked. Furthermore, after describing each scenario, interviewers asked respondents to rate, on a seven-point scale, how realistic did they find the scenario (Dabholkar & Bagozzi, 2002). Realism checks have shown that the scenarios were considered highly realistic, with a mean rating of 5.9 on a seven-point scale. Table 1 provides an overview of the research design.

Data collection and sample

The data collection took place in supermarket stores in Greece and Ireland, for two weeks in each country. The researchers 'intercepted' respondents in supermarket stores, employing a face-to-face personal interviewing method. Data were collected during different time slots, so as to ensure a representative cross-section of shoppers. A total of 402 and 173 completed questionnaires were collected in Ireland and Greece, respectively. In terms of gender, age, and marital status, the sample was representative of supermarket shoppers in each country, as indicated by retail managers of five supermarket chains from Greece and Ireland (see Appendix B).

Table 1 Research design

	Purpose	*Stimuli*	*Measures*
Phase 1	Presentation of the general service concept	Verbal description about the dynamic product information service (context, features etc.)	Attitude
Phase 2	Presentation of the IT-based application supporting the service	Visualised scenario of an IT-based in-store application of the dynamic product information service using an LCD touch screen or electronic shelf tags	Attitude Performance Expectancy Effort Expectancy
Phase 3	Presentation of the RFID-enabled service	Additional information to the previous scenario that RFID tags are attached to every product	Attitude
Phase 4	Demographics and Individual Characteristics	—	Age, Gender Technology Anxiety Information Privacy Concern

Measures

We have adapted the measures employed in the present study from the extant literature. Seven-point and five-point – for Greece and Ireland, respectively – bipolar semantic differential scales, with endpoints of good/bad, like/dislike, were used for all the attitude measures. These scales were used to assess attitudes towards each of the three service scenarios (the general service concept, the general technology-based service and the RFID-enabled service). Performance expectancy and effort expectancy were measured with a three-item scale, adapted to the retailing context from Venkatesh *et al*. (2003). Technology anxiety was measured with a two-item scale, based on Meuter *et al*. (2003). Finally, for IPC two items from the collection subscale of Smith (1996) were used (see Table 3). The collection subscale of IPC was chosen because of its relation to the fears for unauthorised data collection brought to consumers by RFID technology (Günther & Spiekermann, 2005). Responses were given on a seven-point and five-point Likert-type scales – for Greece and Ireland, respectively, with the endpoints being *strongly disagree* and *strongly agree*. The small number of indicators used for each construct could be a limitation of our study. However, the satisfactory levels of measurement validity and internal consistency, that results show, alleviate this limitation. Moreover, the scenario and survey procedure we have followed calls for parsimonious measurement scales in order to avoid respondents' fatigue.

Results

A structural equation modelling approach was used to measure relationships proposed by our research model. This method was applied as it tests structural and measurement models and provides a complete analysis for interrelationships in a model. A variance-based, partial least squares (PLS) method was chosen over covariance-based methods, such as LISREL, as it supports both exploratory and confirmatory research. The SmartPLS software was used (Ringle *et al*., 2005). PLS does not generate an overall goodness-of-fit index (as with LISREL), so model validity is assessed by examining structural paths and R^2 values. Bootstrapping was performed to test statistical significance of each path coefficient using *t*-tests. We estimated the significance of the parameters on the basis of 1000 bootstrapped samples (White *et al*., 2003). We chose not to pool the samples from the two countries together, so as to explore model differences, if they exist, across countries. Therefore, we conducted two separate analyses, one for each country. Descriptive statistics of the constructs from the two countries are shown in Table 2, adjusted to a seven-point Likert scale (from a five-point scale originally for Ireland) for comparison purposes, although it is not always possible to compare scales of different length based on a simple mathematical transformation (Colman *et al*., 1997, p. 356).

Assessments of measures

We tested our measurements for internal consistency, convergent and discriminant validity, employing the testing system recommended by Fornell & Larcker (1981). Internal consistency of our constructs is acceptable, as all the reliabilities – as measured by Cronbach's α indicator – exceed the 0.70 guideline that Nunnally (1978) recommends. According to Gefen & Straub (2005), convergent validity is shown when each of the measurement items loads with a significant *t*-value on its latent construct. Typically, the *P*-value of this *t*-value should be significant at the 0.05 α protection level at least. As shown in Table 3, *t*-values for all loadings (based on the bootstrap procedure) make them significant at the 0.05 level. Finally, discriminant validity is shown when the PLS indicators (a) load much higher on their hypothesised factor than on other factors (own-loadings are higher than cross-loadings), and (b) when the square root of each factor's Average Variance Extracted (AVE) is larger than its correlations with other factors (Gefen & Straub, 2005).

We performed these tests using the PLS confirmatory factor analysis procedure. All items load well on their respective factors, which are much higher than all cross-loadings. Second, as shown in Tables 4 and 5, the square root of all AVE's is much higher than all other

Table 2 Descriptive statistics for the two countries

Constructs	*Descriptive Statistics*			
	Greece		*Ireland (adjusted to seven-point scale)*	
	Mean	*SD*	*Mean*	*SD*
Attitude RFID	4.25	2.03	4.98	2.00
Attitude TBS	5.50	1.45	4.66	2.06
Attitude Service	5.23	1.75	5.11	1.61
Performance Expectancy	5.31	1.51	4.37	1.60
Effort Expectancy	5.30	1.39	5.00	1.44
Technology Anxiety	2.58	1.53	2.53	1.29
Information Privacy Concern	5.53	1.54	5.08	1.72

Table 3 Constructs, items, and loadings for the two countries

Construct	*Measurement Item*	*Loading Greece*	*Loading Ireland*
Attitude RFID			
	Like – Dislike	0.97**	0.96**
	Bad – Good Idea	0.97**	0.96**
Attitude IT-Application			
	Like – Dislike	0.97**	0.97**
	Bad- Good	0.97**	0.97**
Attitude Service			
	Like – Dislike	0.97**	1.0
	Bad – Good	0.97**	—
Performance Expectancy			
	This service is very useful	0.95*	0.79**
	This service makes me more efficient when shopping	0.95*	0.84**
	This service makes shopping easier	—	0.89
Effort Expectancy			
	This service is complex	0.80**	0.68*
	I find this service easy to use	0.91**	0.88*
	I can easily understand and use this service	—	0.88*
Technology Anxiety			
	I have avoided technology because it is unfamiliar to me.	0.85*	0.86*
	I have difficulty understanding most technological matters	0.96*	0.91*
Information Privacy Concern			
	It usually bothers me when companies ask me for personal information.	0.92*	0.97*
	I'm concerned that companies are collecting too much personal information about me	0.87*	0.67*

**$P<0.01$, *$P<0.05$.

Table 4 Reliability, correlation matrix, and average variance extracted – Greece

	Cronbach's α	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1. Attitude RFID	0.94	0.94						
2. Attitude Service Concept	0.95	0.16	0.95					
3. Attitude IT-based service	0.94	0.29	0.44	0.94				
4. Effort Expectancy	0.66	0.28	0.20	0.51	0.74			
5. Information Privacy	0.76	−0.20	0.00	0.08	0.07	0.81		
6. Performance Expectancy	0.91	0.32	0.22	0.71	0.41	0.05	0.91	
7. Technology Anxiety	0.82	−0.30	−0.20	−0.34	−0.33	−0.03	−0.21	0.83

Note: The diagonal elements represent the AVE and the off-diagonal the correlations.

cross-correlations. These results support that there is discriminant validity, according to the test of Fornell & Larcker (1981).

Structural model

Figures 2 and 3 show the results of the PLS analysis for each country, respectively. All path coefficients of the hypothesised causal links are significant ($P < 0.05$) for Greece. This means that all of the hypotheses of the present study are confirmed for Greece. Approximately 63 % of the variance in attitude towards the technology-based service and 18 % of the variance in attitude towards the RFID-enabled service is captured by the variables in the model.

For Ireland, all but two causal paths are significant at the 0.05 level. However, the effect of technology anxiety and IPC on the attitude towards the RFID-enabled service is significant at the 0.1 level. This means that **H1–H4** are accepted for Ireland, but **H5** and **H6** are rejected.

Discussion and conclusions

Discussion

A primary outcome of this study is that it has demonstrated that consumer attitude towards RFID is dependent on consumer attitude towards the service concept and the specific technology-based service that RFID is intended to support.

Table 5 Reliability, correlation matrix, and average variance extracted – Ireland

	Cronbach's α	*1*	*2*	*3*	*4*	*5*	*6*	*7*
1. Attitude RFID	0.93	0.94						
2. Attitude Service Concept	1.00	0.24	1.00					
3. Attitude IT-based service	0.94	0.41	0.40	0.94				
4. Effort Expectancy	0.77	0.31	0.09	0.37	0.68			
5. Information Privacy	0.67	−0.12	−0.15	−0.05	−0.12	0.70		
6. Performance Expectancy	0.80	0.40	0.32	0.68	0.44	−0.03	0.71	
7. Technology Anxiety	0.72	−0.16	−0.10	−0.15	−0.36	0.10	−0.13	0.78

Note: The diagonal elements represent the AVE and the off-diagonal the Correlations.

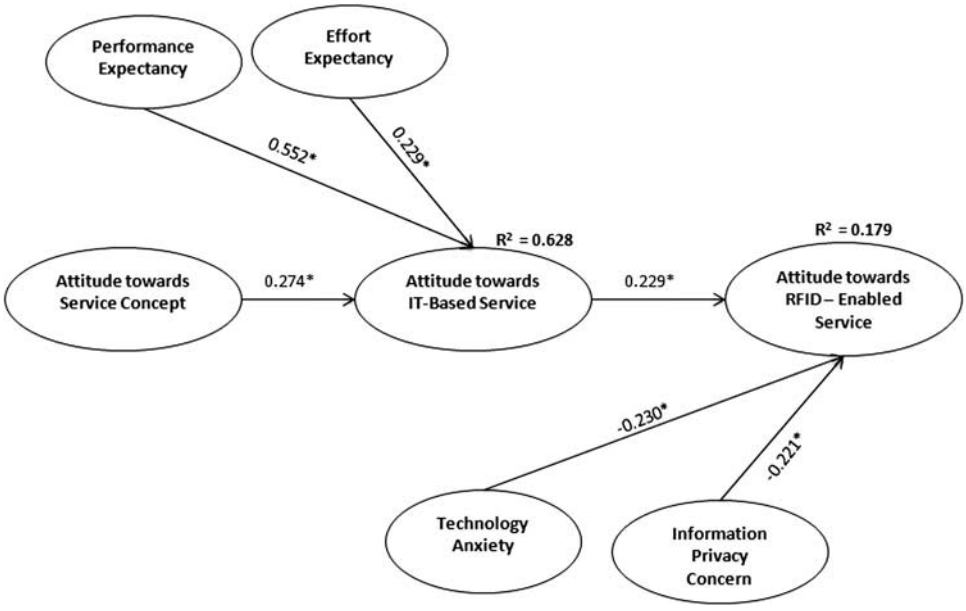

Figure 2 PLS structural model – Greece
*N*ote: $*P<0.05$.

The results confirm the research hypotheses regarding the effect of different attitudes on the attitude towards RFID-enabled services in both countries. This further implies that even a controversial technology, such as RFID, for which consumer's privacy concerns have been expressed, may be accepted, if used to support services that are appreciated by consumers. Moreover, performance expectancy and effort expectancy have been found to have a significant effect on consumer attitude towards the technology-based service. This is also confirmed in both Greece and Ireland. However, the effect of individual characteristics, that is technology anxiety and IPC, varies between the two countries. While they are significant for Greek consumers they are marginally significant for Irish. A possible explanation for this may be that Irish consumers are more familiar with the dynamic pricing service concept, which is manually applied by Irish retailers for several years now. Furthermore, cultural characteristics, such as trust-propensity, trust towards the government, fears of 'big-brother watching us', positive attitude towards the technology overall etc., may be able to explain this difference, but additional research is required in order to draw more concrete conclusions.

All-in-all, this research contributes to the IS literature in three-ways: (1) It develops and empirically tests a conceptual model that includes a hierarchy of consumer attitudes towards the initial service concept, the technology-based application and the RFID-enabled service, utilising the pre-prototype user acceptance framework; (2) It considers individual traits – such as technology anxiety and IPC – and perceived system characteristics – such as performance and effort expectancy – as antecedents of attitude towards technology-based applications and RFID-enabled services; and (3) It empirically tests the conceptual model in two different European countries.

Overall, this research is an important extension to the literature, because the hierarchical order of different attitudes has yet to be fully considered in the adoption

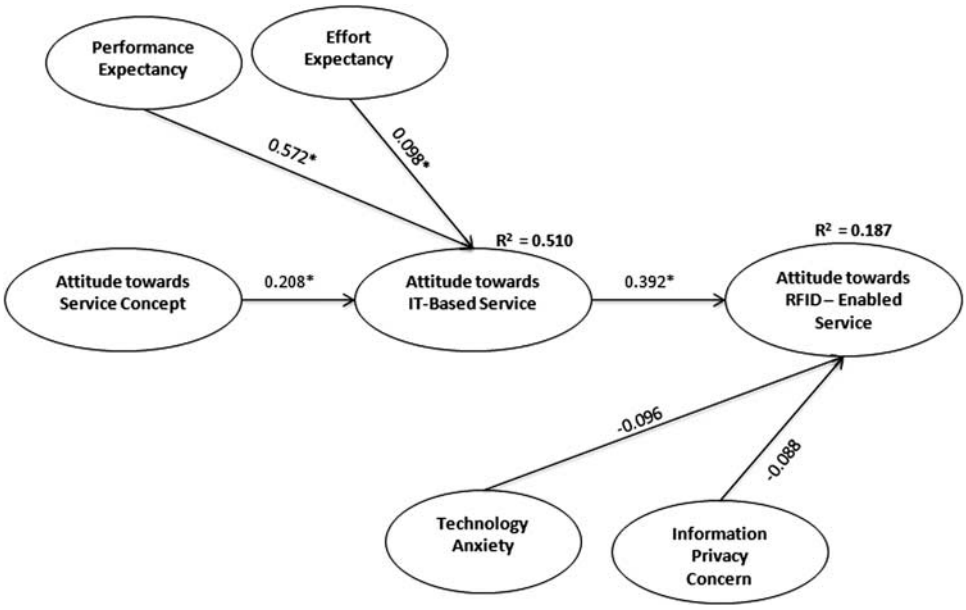

Figure 3 PLS structural model – Ireland
*N*ote: *$P<0.05$.

research. In addition, it introduces the notion of the general service concept in the IS evaluation research. Specifically, it proposes and empirically tests – in the RFID case – that consumers' opinion about a system is affected by their opinion about the general service concept that this system is designed to support.

Managerial implication

This research has implications for retail and service managers as well. Imagine a firm that intends to introduce a new in-store RFID-enabled service, in order to gain competitive advantage. Consumers' reactions towards the final service can be predicted by capturing consumers' reactions towards the general service concept and the specific technology-based service. The company should proceed and invest in the RFID infrastructure to support the service only if the targeted consumer groups react positively to these scenarios. Of course, financial and other managerial aspects should also be taken into account before any IT investment.

Furthermore, consider an industry with multiple technology-based service options available, such as banking or retailing. The services consumers are highly favourable to are the main candidate services for the employment of RFID. Positive attitudes towards these services, as currently implemented, are a predictor of positive attitudes towards RFID. Unfortunately, the reverse scenario is also true. If consumers have unfavourable attitudes towards a technology-based service option, the introduction of RFID has high probability to fail. Á number of system characteristics and personality traits of the target consumers should also be taken into account before the design and implementation of such services.

Limitations and future research

This research has several limitations that are opportunities for future research. On one hand, a scenario approach may be viewed as making the findings less applicable to the real world. On the other hand, brand, situation, and context factors in a field setting are usually uncontrollable (Dabholkar & Bagozzi, 2002). Using a realistic scenario that the respondents can easily imagine themselves in, allows the researcher to control treatments and test outcomes effectively.

Although this study helps clarify the theoretical linkages of attitudes and their relation with RFID-enabled services, a great number of unanswered questions, relating to the use and management of RFID, still remain open. This is the reason why the variance explained by our model, although significant, is still low. As the purpose of this study was to suggest and test a hierarchical model for RFID-enabled services in two countries, a lot of commonly used antecedent factors have been excluded from the model. For example, having organised salient attitudes into this framework, it now becomes important to further explore additional factors that affect these attitudes. Of course, the system characteristics and individual traits that this study explores are important and have been found to affect consumer attitudes. However, a number of other relevant variables, such as trust to technology, need for interaction with an employee, satisfaction and service quality could be hypothesised to affect consumer attitude towards RFID. Moreover, situational factors such as perceived crowding or social anxiety (Dabholkar & Bagozzi, 2002) could be included in an attitudinal model of RFID. In any case, further exploratory research

is needed in order to explore the unexplained variance of the dependent variable.

Another important factor that could be investigated, when studying the adoption of technology-based services, is the level of customer-technology interaction. In the case of the dynamic product information service, for example, a company could use either shelf tags or information kiosks or even mobile devices in order to communicate the dynamic price changes to consumers. However, the amount of customer-technology contact that is required in each case differs significantly (Theotokis *et al.*, 2008). Therefore, the technology contact that a service requires is a characteristic that can be specified during the service development and design and could be examined as an additional variable in our model.

Acknowledgements

The work presented in this paper has been partly funded by the European Commission through the IST Project SMART: Intelligent Integration of Supply Chain Processes and Consumer Services based on Unique Product Identification in a Networked Business Environment (No. ST-5-034957-STP) (www.smart-rfid.eu). The authors thank all the project partners for their contribution.

About the authors

Katerina Pramatari is Assistant Professor at the Department of Management Science and Technology of Athens University of Economics and Business. She holds a B.Sc. in Informatics and M.Sc. in IS from AUEB and a Ph.D. in IS and Supply Chain Management from the same University. She has worked as systems analyst for P&G Europe and marketing assistant for P&G Greece, as well as in the setup of B2B ventures. She has published several papers and articles in academic journals such as the *European Journal of Information Systems*, *Decision Support Systems*, *Journal of Information Technology* etc. and in several peer-reviewed international conferences. Her research interests are in electronic services, e-business, supply chain collaboration, and RFID.

Aristeidis Theotokis is a post-doctoral researcher at the ELTRUN Research Center at the department of Management Science and Technology of the Athens University of Economics and Business. He has a B.Sc. in Industrial Management and Technology and an M.Sc. in Operational Research from University of Edinburgh. His research interests are in the areas of consumer acceptance of technology, consumer behavior in retailing and services marketing. His work has been published in academic journals such as *European Journal of Marketing* and *European Journal of Information Systems* and in several peer-reviewed international conferences.

References

AJZEN I (1985) From intentions to actions: a theory of planned behavior. In *Action-control: From Cognition to Behavior* (KUHL J and BECKMAN J, Eds) Springer, Heidelberg.

BATESON J (1985) Self-service consumer: an exploratory study. *Journal of Retailing* **61(3),** 49–76.

BOBBITT LM and DABHOLKAR PA (2001) Integrating attitudinal theories to understand and predict use of technology-based self-service. *International Journal of Service Industry Management* **12(5),** 423–450.

BURKE R (2002) Technology and the customer interface: what consumers want in the physical and virtual store. *Journal of the Academy of Marketing Science* **30(4),** 411–432.

CURRAN J and MEUTER M (2005) Self-service technology adoption: comparing three technologies. *Journal of Services Marketing* **19(2),** 103–113.

CURRAN J, MEUTER M and SUPRENANT C (2003) Intentions to use self-service technologies: a confluence of multiple attitudes. *Journal of Service Research* **5(3),** 209–224.

DABHOLKAR PA (1996) Consumer evaluations of new technology-based self-service options: an investigation of alternative models of service quality. *International Journal of Research in Marketing* **13,** 29–51.

DABHOLKAR PA and BAGOZZI R (2002) An attitudinal model of technology-based self-service: moderating effects of consumer traits and situational factors. *Journal of the Academy of Marketing Science* **30(3),** 184–201.

DABHOLKAR PA, BOBBIT LM and LEE EJ (2003) Understanding consumer motivation and behavior related to self-scanning in retailing. *International Journal of Service Industry Management* **14(1),** 59–95.

DAVIS FD, BAGOZZI RP and WARSHAW PR (1989) User acceptance of computer technology: a comparison of two theoretical models. *Management Science* **35(8),** 982–1003.

DAVIS FD 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.

EAGLY A and CHAIKEN S (1993) *The Psychology of Attitudes*. Harcourt Brace Jovanovich College, Fort Worth.

ECKFELDT B (2005) What does RFID do for the cosnumers? *Communication of the ACM* **48(9),** 77–79.

FISHBEIN M and AJZEN I (1975) *Belief, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. Addison-Wesley, Reading MA.

FORNELL C and LARCKER DF (1981) Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research* **18(1),** 39–50.

GÜNTHER O and SPIEKERMANN S (2005) RFID and the perception of control: the consumer's view. *Communications of the ACM* **48(9),** 73–76.

GEFEN D and STRAUB D (2005) A practical guide to factorial validity using PLS-graph: tutorial and annotated example. *Communications of the AIS* **16,** 91–109.

IM IL, KIM Y and HAN H-J (2007) The effects of perceived risk and technology type on users' acceptance of technologies. *Information & Management* In Press, Corrected Proof.

LOEBBECKE C and HUYSKENS C (2008) A competitive perspective on standard-making: Kaufhof's RFID project in fashion retailing. *Electronic Markets* **18,** 30–38.

MEUTER M, BITNER M, OSTROM A and BROWN S (2005) Choosing among alternative service delivery modes: an investigation of customer trial of self-service technologies. *Journal of Marketing* **69**, 61–83.

MEUTER M, OSTROM A, BITNER M and ROUNDTREE R (2003) The influence of technology anxiety on consumer use and experiences with self-service technologies. *Journal of Business Research* **56**, 899–906.

MEUTER M, OSTROM A, ROUNDTREE R and BITNER M (2000) Self-service technologies: understanding customer satisfaction with technology-based service encounters. *Journal of Marketing* **64**, 50–64.

OHKUBO M, SUZUKI K and KINOSHITA S (2005) RFID privacy issues and technical chalenges. *Communication of the ACM* **48(9)**, 66–71.

PARASURAMAN A (2000) Technology readiness index (TRI): a multiple-item scale to measure readiness to embrace new technologies. *Journal of Service Research* **2(4)**, 307–320.

REINDERS MJ, DABHOLKAR PA and FRAMBACH RT (2008) Consequences of forcing consumers to use technology-based self-service. *Journal of Service Research* **11(2)**, 107–123.

RESATSCH F, SANDINER U, LEIMEISTER JM and KRCMAR H (2008) Do point of sale RFID-based information services make a difference? Analyzing consumer perceptions for designing smart product information services in retail business. *Electronic Markets* **18**, 216–231.

RINGLE CM, WENDE S and WILL A (2005) *SmartPLS* 3edn, University of Hamburg, Hamburg, Germany.

ROGERS EM (1995) *Diffusion of Innovations*. Free press, New York.

ROTHENSEE M and SPIEKERMANN S (2008) Between extreme rejection and cautious acceptance: consumers' reactions to RFID-based IS in retail. *Social Science Computer Review* **26(1)**, 75–86.

SIMON F and USUNIER J-C (2007) Cognitive, demographic, and situational determinants of service customer preference for personnel-in-contact over self-service technology. *International Journal of Research in Marketing* **24**, 163–173.

SPIEKERMANN S (2007) User control in ubiquitous computing: design alternatives and user acceptance. Habilitation Thesis, Humboldt-Universität, Berlin.

THEOTOKIS A, VLACHOS P and PRAMATARI K (2008) The moderating role of customer-technology contact on attitude towards technology-based services. *European journal of Information Systems* **17(4)**, 343–351.

TSIROS M and HEILMAN C (2005) The effect of expiration dates and perceived risk on purchasing behavior in grocery store perishable categories. *Journal of Marketing* **69(April)**, 114–129.

VENKATESH V, MORRIS MG, DAVIS GB and DAVIS FD (2003) User acceptance of information technology: toward a unified view. *MIS Quarterly* **27(3)**, 425–478.

WEISER M (1991) The computer for the 21st century. *Scientific American* **265(3)**, 94–104.

ZEITHAML V and GILLY M (1987) Characteristics affecting the acceptance of retailing technologies: a comparison of elderly and nonelderly consumers. *Journal of Retailing* **63(1)**, 49–68.

Appendix A

General technology-based service stimuli

Imagine a service in the supermarket store that offers you product information and different price for the products with different expiration dates...

You are standing in front of the shelf with the fresh packaged meat and consider your choices for today's shopping

The meat that approaches its expiration date have different price than the meat that doesn't approach its expiration date

In order to get informed about the price and the expiration date of the product you are interested you use the electronic displays that are located near to the shelf

You pick the product you want and put it in front of the display. Then, the display shows information about this product.

In order to choose what product you will buy you read the display. So, you take information about the price, the expiration date as well as information about the quality of the product (such as the production location or the delivery method) and ideas for cooking.

You choose the product with the price and expiration date you like.

Appendix B

See Table B1.

Table B1 Respondents demographics

	Greece (n = 173) (%)	*Ireland (N = 402) (%)*
Gender		
Male	39.3	28.1
Female	60.1	71.4
Age		
18–24	30.1	7.0
25–35	27.7	18.4
36–44	13.9	18.4
45–55	14.5	32.1
55+	8.1	23.6
Marital Status		
Married	55.5	68.7
Unmarried	41.0	21.6
Unspecified	3.5	9.2