Measuring Banks' Automated Service Quality:
A Confirmatory Factor Analysis Approach

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Automated service quality has been recognised as the factor which determines the success or failure of electronic commerce. Those models currently available to measure automated service quality are limited in their focus, encompassing only one electronic channel – the internet – thereby ignoring attributes of the other automated service channels. In relation to the banking sector, research has identified that bank customers tend to use a combination of automated service channels. As such, this research strives to develop a comprehensive model of banking automated service quality taking into consideration the unique attributes of each delivery channel and other dimensions that have a potential influence on quality issues. The proposed model has been empirically tested for unidimensionality, reliability, and validity using confirmatory factor analysis.

Key words: Automated Services, Banks, Quality, ATM, Internet banking, Telephone banking, Confirmatory Factor Analysis

Introduction

Numerous models have been developed to measure customer perceptions of service quality. Most of these models utilised face-to-face interaction between customers and the employees of service providers to conceptualise a service quality measurement models. However, developments in information and communications technology have provided a platform by which companies can design, develop and deliver services that can be perceived by customers as superior (Surjadjaja *et al.* 2003). There are several competitive advantages associated with the adoption of technology in service organisations, some of which include the creation of entry barriers, enhancement of productivity, and increase of revenue generation from new services (Fitzsimmons & Fitzsimmons 1997). Service quality is one of the main factors that determines the success or failure of electronic commerce (Santos 2003). Automated service quality has tended to lag behind because practitioners have focused mainly on issues of usability and measurement of use, with little or no consideration to the issues of service quality (Buckley 2003).

It has been proposed that customer perceptions and preferences of service quality have a significant impact on a bank's success (Mouawad & Kleiner 1996). The main aim of this research is to develop a comprehensive conceptual model to measure customer perception of automated service quality in the banking sector. Automated service quality is defined as the customer's overall evaluation of the excellence of the provision of services through electronic networks such as the internet, Automated Teller Machine (ATM), and telephone banking (Santos 2003). Analysing markets based on customer perceptions, designing a service delivery system that meets customer needs, and enhancing the level of service performance are pertinent objectives for banks to gain and retain a competitive advantage (Brown & Swartz 1989). Service quality has received much attention because of its obvious relationship with costs, financial performance, customer satisfaction, and customer retention.

To provide greater understanding of the main issues relating to service quality in the virtual marketplace, this study has developed and tested a comprehensive model to measure customer perceptions of bank automated services quality. The study is justified as it provides a model incorporating the key dimensions that should be assessed when measuring customer perceptions of automated service. This will allow bank administrators to gain a comprehensive understanding of the quality issues associated with automated services, thereby allowing them a better opportunity to improve customer satisfaction and help gain a competitive advantage. The theoretical arguments that underlie the automated service quality model framework are presented as well as the research design and methodology for empirical testing.

The Impact of Technology on Banks' Philosophy

During the last two decades the financial sector has developed rapidly in terms of size, industry structure and the variety of consumer and business-to-business products and services (Edey 1996). The Australian financial sector has been transformed from a relatively closed system in the 1950s and 1960s based on traditional bank activities to a more open, effective and competitive system which is able to offer a wide range of products and services (Edey & Gray 1996). Technological developments and financial liberalisation (deregulation) are viewed as the main forces influencing the financial sector's development (Edey & Gray 1996, Thompson 1996, Gardener *et al.* 1999).

These changes motivated banks to be aware of future trends in order to survive and compete effectively. Many retail banks face a huge challenge in reducing the number of branches they currently operate as down-sizing efforts bring with them complex post-merger problems such as social and political issues, organisational culture concerns, product modifications and IT integration (Gyptra & Dixon 2002).

Recently, technology has had a remarkable influence on the growth of service delivery options (Dabholkar & Bagozzi 2002) and a profound effect on service marketing (Bitner *et al.* 2000). In order to remain competitive, banks are increasing their technology based service options (Fitzsimmons & Fitzsimmons 1997). More and more banks have adopted technology to deliver their services and this has resulted in: reduced costs, the creation of value added services for customers (Zhu *et al.* 2002), the facilitation of their employees' jobs and ultimately, the provision of self-service options for customers (Dabholkar & Bagozzi 2002).

In today's intensely competitive economy, providing excellent customer service plays a vital role in a company's success and failure (Mouawad & Kleiner 1996). An increasing number of banks are using technology to deliver their regular service to the consumer. Investigations of quality issues of banks' automated services are necessary because of their potential influence on: attractiveness, customer retention, positive word-of-mouth, and maximising competitive advantages (Santos 2003). To embrace this new technology–oriented context, it is necessary for banks to realise how quality issues of automated services distinguish their customer services from others. This research will assist bank administrators to ascertain a better understanding of customer perceptions of automated services now integrated into the banks' product offering.

Defining and Measuring Automated Service

Automated service provides a good opportunity for organisations to provide new models for service design strategies and new service development (Henderson *et al.* 2003). A review of the current conceptualisation of automated service reveals that general automated service definitions include specific reference to the internet but they negate the inclusion of other important automated service dimensions such as telephone service and automated service delivery outlets. For example, Ruyter *et al.* (2001, p186) define automated service as '*interactive, content-centered and internet-based customer service, driven by the customer and integrated with related organisational customer support process and technologies with the goal of strengthening the customer-service provider relationship*'. Moreover, Surjadjaja *et al.* (2003) identify automated service as web-based service delivered through the internet whereby the customer's interaction or contact with the organisation is limited to the information and communication technology (ICT) itself. The most recent study that has been done by Parasuraman *et al.* (2005) is similar to these previous definitions. They refer to automated service as a web sites-based customer service. A more holistic definition adopted for the purposes of this research, is that which is proposed by Buckley (2003) who defines automated service as the electronic provision of a service to customers. This definition is identified as far more holistic as it allows for the inclusion and examination of other service delivery channels beyond services through the internet.

Automated Service Quality

Service quality, within the personal interaction environment, has well established definitions in the literature, but it is only recently that it has been applied to the e-commerce environment (Santos 2003). To date, the automated service quality research has been limited to relationship management rather than metrics of service quality (Buckley 2003). Currently there exists a lack of a comprehensive definition of automated service quality in the literature. For example, Parasuraman *et al.* (2005) only discuss automated service quality within the services that are delivered through web sites. Zeithaml (2002, p135) limits the definition of automated service quality with specific reference to the internet defining it as, '*the extent to which a web site facilitates efficient and effective shopping, purchasing and delivery*'. For the purposes of this research a definition proposed by Santos (2003) has been adopted as it is recognised as not only providing a more general definition of automated service quality but one that extends beyond internet based dimensions. Automated service quality is defined by Santos (2003, p235) as "*the consumers' overall evaluation and judgement of the excellence and quality of e-service offerings in the virtual marketplace*". This definition seems to be the most appropriate fit for this research, as the internet banking channel is not the only automated service delivery channel that can be identified in the banking sector. In addition to internet banking service quality, telephone banking and ATM service quality need to be addressed within this particular service environment.

Research on automated service is still in its infancy stage and there are no generally accepted theoretical conceptualisations of automated services quality (Riel *et al.* 2001, Long & McMellon 2004). Two predominant conceptualisation approaches towards service quality have been identified in the literature. The first is based on disconfirmation while the second is based on Cronin and Taylor's (1994) SERVPERF (performance-only) model. Expectations seem to be of lesser importance as a comparison standard in e-commerce and customers appear to use experience–based norms (Santos 2003). Yang and Jun's (2002) study revealed that the majority of consumers tended not to have a clear conception of what expectations

they held for online services. Consequently, this paper focuses on a performance-only approach to measuring automated service quality.

Measurement Models in the Automated Services Context

Two main approaches to developing measurement models of automated service quality have been identified in the literature (Riel *et al.* 2001, Santos 2003). The first approach utilises the existing service quality theory as a basis for developing a generally accepted model to measure automated service quality. Supporters of this approach argue that past conceptualisations of service quality need not be completely discarded but may instead be used as a base to develop a theoretical description of automated service (Yang & Jun 2002, Zeithaml 2002, Long & McMellon 2004). The second approach focuses on the technological interfaces and the quality of new categories of self-service technology (Santos 2003). This approach has generated new categories and measurement models of automated service (Riel *et al.* 2001). Advocates of this approach argue that the general conceptualisation of service quality, focused mainly on capturing the interpersonal nature of service encounters, may not be enough to capture the specific nature of customer interaction with electronic delivery channels (Joseph *et al.* 1999, Meuter *et al.* 2000, Joseph & Stone 2003).

In the first approach, most of the dimensions and items generated to measure automated service quality are derived from traditional service quality literature. Riel *et al.* (2001) argue that the antecedents of traditional service quality should be modified before they can be useful in an automated service context. Furthermore, advocates of this approach referred to web-sites in order to conceptualise automated service quality (Yang & Jun 2002, Zeithaml 2002, Long & McMellon 2004). The internet is not the only automated banking delivery channel. Other electronic channels are widely used by banks in delivering services to consumers such as personal computers, the telephone, and ATM (Hway-Boon & Yu 2003). This paper has adopted a broader definition of automated service because of the increasing use of various automated channels in banks (Hway-Boon & Yu 2003). Therefore, it is not possible to rely completely on current online–quality models to conceptualise automated service quality.

Mols (2000) argued that customer acceptance of the new automated channels of service delivery in banks may bring a dramatic change in the way that retail banks build and maintain a close relationship with their customers. The introduction of new automated channels of service delivery has made customer participation more widely possible (Dabholkar 1994) and therefore, researchers need to adopt new ways to conceptualise automated service quality, taking into consideration the attributes of all electronic delivery channels (Dabholkar 1996, Meuter *et al*. 2000, Szymaski & Hise 2000). Advocates for the second approach have begun to study different quality aspects of all automated service channels (Joseph *et al.* 1999; Joseph & Stone 2003, Meuter *et al.* 2000) and recommended that a move is made away from looking at only online service quality. This research aims to build upon previous research based on this more encompassing approach to measuring automated service quality.

While the second approach takes into account more service delivery channels than the first approach, it is recognised that the second approach only provides models where all the channels are aggregated and the context is evaluated as a single composite channel (Meuter *et al.* 2000, Szymaski & Hise 2000, Joseph & Stone 2003). Every automated service delivery channel has its own attributes (Dabholkar 1996) and consequently the main shortcoming of this method is its failure to separate the particular attributes of every delivery channel, or

other compounding factors, that may affect customer perception of automated services quality. Nevertheless, these two approaches agree about the role of certain factors in shaping consumer perception of the automated delivery channels quality. The two approaches have the following common factors; reliability, ease of use, personalisation, accessibility, accuracy, security, and efficiency (Joseph *et al.* 1999, Meuter *et al.* 2000, Yang & Jun 2002, Zeithaml 2002, Joseph & Stone 2003, Long & McMellon 2004). As such, some of these factors are incorporated, where appropriate, into the measurement models proposed for each of the automated delivery channels highlighted in this research. This will provide a more consistent picture of customer perceptions of bank automated service quality. The generation of the individual measurement items for each automated channel will be introduced in the methodology section.

Conceptualisation of automated service quality in banks

After reviewing the literature intensively, it is observed that there currently exists no generally accepted model of automated service quality. There have been many studies identifying the key service quality factors in the traditional banking environment, where the interaction between employees and customers is the main communication channel (Jun & Cai 2001). However, there are a few studies that have investigated automated service quality attributes in banking (Szymanski & Hise 2000, Meuter *et al.* 2000, Joseph & Stone 2003). As such there is a need for further empirical investigation into the most pertinent factors to be used when measuring automated service quality in the banking sector. The automated service quality model presented in this paper is designed to include all the possible factors that may shape customer perceptions of automated service quality.

Dabholkar (cited in Joseph & Stone 2003) argued that the categorisation of technology-based service delivery options may be applied across a spectrum of industries that utilise technology in delivering their service to the customer. The first classification in this categorization is based on *who* uses technology to deliver *what* service. Joseph and Stone (2003) provide the following example to illustrate the point that in person-to-person deliveries, employees use technology to service individual accounts. Consumer technology refers to the customer's ability to use existing technology, such as the ATM. The second categorisation is based on the location, *where* the service has to be delivered. For example, at the firm's physical surroundings, homes or office using PC computers. The final categorisation involves the ability to identify the various levels of contact the customer will have during the total period of service delivery either directly (face-to-face) or indirectly (such as in the case of telephone banking). In relation to banking, it can be identified that the service delivery components of ATM, internet banking and telephone banking are representative for the three categories of technology based service discussed. Furthermore, a number of marketing scholars identify these three delivery channels as the principal automated delivery channels for retail banking (Radecki *et al.* 1997, Joseph *et al.* 1999, Joseph & Stone 2003).

Automated channels have many different names in the literature such as innovative distribution channels, online banking or technology intensive delivery system (Wong 1998, Fiotto *et al.* 1997, Daniel 1999). By definition, automated channels refer to methods of delivering service products using electronic media such as the telephone, internet and ATM (Hway-Boon & Yu 2003). Telephone banking provides services such as account balances, instruction to issue bank cheques, account payments. While ATM, the most frequently used electronic distribution channel, allows customers to perform their main banking transactions,

such as deposits and withdrawals, 24 hours a day (Davies *et al.* 1996). Furthermore, internet banking allows consumers to check account balances, conduct credit card payments/transfers, transfer funds and account payments (Jun & Cai 2001). The incredible growth of the internet is changing the way corporations conduct business with customers and it allows banks, as with ATM, to offer financial services without a need for employee-consumer interaction.

In the banking sector, customers tend to use the different service delivery channels in a complementary way. Consequently, developing a relationship with the customer can be achieved from any one of these media and more likely, a combination of them (Ramsay & Smith 1999, Patricio *et al.* 2003, Lang & Colgate 2003). Customer evaluation of automated service options and their intention to use a particular option are directly affected by their perception toward the attributes associated with that option (Dabholkar 1996). That is, every different channel has its own attributes which differ from the others, so it is important to measure the quality of each channel separately and not aggregate the channels to glean a more accurate picture of customer perceptions of automated service quality. The quality of every automated delivery channel will be important to form the customers' overall perception of automated service quality and each delivery channel has been considered as a factor in the proposed automated service quality model.

Additional Determinants of Automated Service Quality

Price is essential factor in determining customer perception of automated service quality (Surjadjaja *et al.* 2003; Iqbal *et al.* 2003). From a customer perspective, price is the most important motivation for engaging in online purchases and the most critical comparison element (Surjadjaja *et al.* 2003). Furthermore, online consumers are more price sensitive than offline consumers (Iqbal *et al.* 2003). Pricing problems associated with perceptions of unfairness and non-competitiveness, for example fee charges, often contribute to consumer decisions to switch banks (Keaveney 1995, Colgate & Hedge 2001). Consequently, price has been incorporated as an additional factor that could influence the customers' overall perception of automated service quality

Identifying an objective conceptualisation of price to determine its role in the complex pricing environment of services is difficult (Chen *et al.* 1994). In the banking sector, a wide variety of products and services are offered and the prices of service products vary from one bank to another. As such, perceived price is used in this research to describe customers' judgment about a service price (Chen *et al.* 1994).

The core service ("what" is being offered) has features that shape customer perception and differentiate one service provider from another (Sureshchandar *et al.* 2002; Brogowicz *et al.* 1990; Rust & Oliver 1994, Schneider & Bowen 1995; Kotler 1984). The core service is considered as an important component of automated service (Riel *et al.* 2001) as the product offerings and product information represent a set of elements that could positively impact on automated service satisfaction levels (Szymanski & Hise 2000). Product innovation and knowledge development factors have a significant effect on the success of automated delivery channels (Hway-Boon & Yu 2003). Therefore, customer perceptions of the variety of products/services offered by a bank will be considered as another predominant factor that could influence overall customer perceptions of automated service quality.

Conceptual Model

In summary, this research posits that customers' perceived automated service quality for banking services is based essentially on five factors (refer to figure 1), namely:

1- ATM service,
2- internet banking service,
3- telephone banking service,
4- core service, and
5- customer perception of price.

Figure 1. The critical factors of customer-perceived banking Automated Service Quality (ASQ)
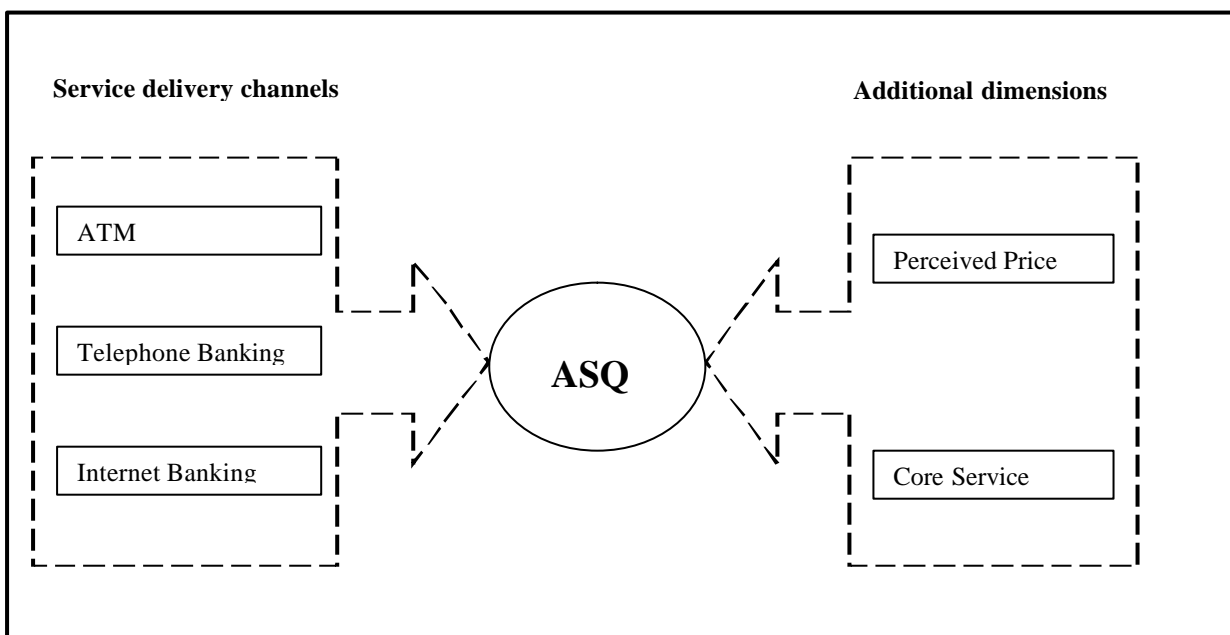
Empirical Testing of Automated Service Quality Factors

Methodology

A quantitative study, involving the administration of a survey was conducted in order to empirically validate the identified factors of bank automated service quality.

The survey instrument consisted of 22 items which were identified through a comprehensive review of the automated service and service quality literature. Prior to empirical testing, the instrument was refined through an expert panel of marketing academics and researchers. The instrument was divided into five main sections. Each section represented a group of items measuring a particular factor.

The Quality Measures of the Automated Service Channels

The items pertaining to telephone banking were generated from a study conducted by Joseph and Stone (2003) which focused upon evaluating the impact of technology on service delivery. As such, six distinct items were identified (refer to table 1).

Items identified in relation to the service quality of ATM were extracted from various studies such as, Joseph and Stone (2003), Buttle and Alldigan (2002), Bahia and Nantel (2000) and Jabnoun and Al-Tamimi (2003). Five predominant items were selected from these studies as presented in table 1.

Many models have been identified which measure customer perceptions of internet banking service quality (Yang & Jun 2002, Zeithaml 2002, Long & McMellon 2004). This factor was represented by seven items (refer to table 1) originally developed by Jun and Cai (2001) and subsequently used by Yang and Jun 2002, Zeithaml 2002 and Long and McMellon 2004.

Table 1. Items for each automated service quality dimension

Critical dimensions	Related items
ATM	- Sufficient number of ATM ** - Secure locations - ATM has a user-friendly system - Conveniently located - ATM functions
Telephone banking	- Pleasant musical background ** - Reasonable number of voice prompts - Short waiting time - Clear instructions - Reliability - Telephone banking options
Internet banking	- Availability of information - Easy to use - Secure - Error free transactions - Attractive web site - Website interface accuracy - Up to date information
Price	- Adequately explaining service charges - Acceptable fees - Competitive fees - Clearly shows the service charges on statements **
Core Product	- Wide range of services (retirement's accounts, loans for cars, foreign exchange, purchases of cars, etc.) - Diverse service features (different interest rates, wide choice of loan periods) - Availability of most service options * - Follow the most advanced technology

* Items deleted in the first stage
** Items deleted in the second stage

The Additional Factors Measures

Perceived price is considered as in important component of the automated service quality, as discussed before. Zeithaml (1988) argues that perceived price should include monetary as well as non-monetary price factors in service industries. As a result, this factor was identified as a multi-faceted item, represented by aspects of price itself in monetary form as well as a wider definition of price which encompasses the non-monetary aspects of price. Four items were generated for this factor which were modified from studies by Bahia and Natali (2000) and Colgate and Hedge (2001), as illustrated in Table 1.

The service component's features shape and distinguish the service quality of one supplier from others. Core service was measured by a multi-item one-dimensional variable adopted from Sureshchandar *et al.* (2002). Table 1 outlines the four items that were identified as fitting the core service definition.

Research Design

This study was conducted in two stages. Stage one involved a pilot study which was conducted to refine the test instrument. Specific issues addressed were question ambiguity; the refinement of the research protocol and the confirmation of scale reliability (Teijlingen & Hundley 2001). Thirty five respondents were interviewed in the pilot testing phase with all surveys being included in the exploratory analysis. The results showed Cronbach alpha coefficient above 0.7 for all but one of the scales which indicated an acceptable level of reliability (Nunnally & Bernstein 1994). The Cronbach alpha coefficient for the core service dimension was 0.6057. Henryson (1971) noted that an item-to-total test correlation should be over 0.3 for inclusion in a survey test. Consequently, "the availability of most service options" item was deleted as it had a value of less than 0.3. This in turn, led to an increase in the reliability of the core service scale to 0.71.

Stage two involved the distribution of 600 surveys to a random sample of people from the general public. Only respondents who used at least one of the bank automated services were accepted in this sample. A mall intercept method was used to administer the survey which was collected via face-to-face interviews. Respondents were asked to give their perception of the quality level of automated banking services on a seven point Likert scale ranging from 1 indicating very poor to 7 indicating very good. A total of 442 useable surveys were collected with 158 rejections, which gave a response rate of 74 per cent. The high response rate was due to the face to face approach utilised in this research. The surveys also encompassed service quality evaluations from ten different banks, credit unions and building societies within Queensland. The interviews were conducted in a number of different cities in different malls.

Justification for Using Confirmatory Factor Analysis

The data was entered into the statistical soft-ware package SPSS and checked for incorrect entries and missing data. The data was then transferred to the statistical soft-ware AMOS 5 to conduct the remainder of the statistical analysis required. Confirmatory Factor Analysis (CFA) was selected to refine and validate the measurement scales. CFA was identified as an appropriate statistical test particularly as the researchers had a reasonably sound knowledge of the number of factors that were required to explain the intercorrelations among the

measurement variables (Sureshchandar *et al.* 2002). Additionally, the researchers had a reasonably sound knowledge about the observed variables that were more likely to be reliable indicators of a particular factor (Sureshchandar *et al.* 2002). Given the fact that the proposed model was based on logic, previous empirical research and theoretical findings, the CFA approach was considered the most appropriate method to statistically confirm the proposed factors of customer perceptions of bank automated service quality.

Scale Refinement and Validation

In undertaking a statistical analysis, unidimensionality should be always assessed first, prior to examining reliability and validity (Hair *et al.* 1995). This is thought to reduce the possibility of misspecifications (Gerbing & Anderson 1988), because the analysis of reliability and validity is based on the assumption of unidimensionality (Nunnally & Bernstein 1994). In order to test for unidimensionality, CFA was conducted on measurement models for each of the five factors. A comparative fit index (CFI) of 0.9 or above for the model implies that there is a strong evidence of unidimensionality for the factors (Sureshchandar *et al.* 2001). In relation to this study, the CFI indices for all five of the factors are above the 0.9 level as shown in table 2 which indicates evidence of unidimensionality.

Table 2. **Unidimensionality analysis outcomes**

Factor	Comparative fit index (CFI)
ATM service quality	0.915
Telephone banking service quality	0.969
Internet Banking service quality	0.971
Customer perception of core service	0.996
Customer perception of price	0.975

Reliability and Validity

Reliability and validity tests are important to standardise the measurement scales, and to demonstrate whether they truly measure what they are supposed to measure. In structural equation modelling (SEM), there are some statistical outputs which can be used to measure the construct reliability. They include squared multiple correlations R^2 for each measurement item, composite reliability, and variance extracted for each factor. As a rule of thumb, measurement variables are reliable when the squared multiple correlation R^2 of each one is greater than 0.5 (Holmes-Smith 2001, Byrne 2001). The first run of the measurement model showed that the R^2 for the majority of measurement items was greater than 0.5, which indicated a good reliability level. Three items however, showed R^2 values of less than 0.5. Consequently, the three items, 'sufficient number of ATM', 'pleasant musical background', and 'show the service charges on statements' were deleted. In the second run of testing the measurement model R^2 values for all measurement items were greater than 0.5.

Cronbach alpha coefficient, composite reliability and variance extracted were calculated to measure the reliability of each factor, as represented in table 3. Composite reliability should be greater than 0.7 and variance extracted >0.5 to indicate reliable factors (Hair *et al.* 1995, Holmes-Smith 200). The composite reliability and variance extracted were calculated using Fornell and Larker's (1981) formula.

The composite reliability, variance extracted, and Cronbach alpha coefficient values for all critical factors, greatly exceeded the minimum acceptable values. This indicated that measures were free from error and therefore yielded very consistent results (Zikmund 2003).

Table 3. Composite reliability and variance extracted for each factor

Variable name	l_i	e_i	Composite reliability	Variance extracted	Cronbach Alpha coefficient
ATM service quality			**0.97**	**0.89**	**0.861**
Secure places	0.735	0.1			
User-friendly system	0.819	0.054			
Conveniently located	0.763	0.09			
ATM functions	0.827	0.06			
Telephone banking service quality			**0.98**	**0.92**	**0.939**
Voice prompts	0.829	0.072			
Short waiting time	0.852	0.078			
Clear instructions	0.912	0.056			
Reliability	0.877	0.064			
Options number	0.867	0.058			
Internet banking service					
Availability	0.883	0.048	**0.99**	**0.93**	**0.947**
Easy to use	0.906	0.042			
Secure	0.890	0.049			
Error free transactions	0.866	0.055			
Attractiveness	0.774	0.088			
Interface accuracy	0.816	0.077			
Information Updating	0.803	0.075			
Core service quality					
Wide range of services	0.790	0.053	**0.96**	**0.91**	**0.829**
Follow advanced technology	0.710	0.074			
Diverse service features	0.865	0.056			
Customer perception of price quality					
Explaining service charges	0.741	0.123	**0.95**	**0.86**	**0.856**
Acceptable fees	0.901	0.117			
Competitive fees	0.822	0.089			

Different validity terms were used to demonstrate various aspects of construct validity. This research utilised convergent, discriminant, and criterion-related validity to indicate the ability of the measurement items to measure accurately the constructs of the study (Hair *et al.* 1995). SEM is an appropriate statistical test to assess the construct validity using convergent and discriminant validity (Anderson & Gerbing 1988). *Convergent validity* is recognised when the relationship between measurement items and the factor is significantly different from zero. Based on this criterion, critical ratios can be used to evaluate the statistical significance. Parameters which have a critical ratio greater than 1.96 can be considered significant based on the level of p=0.05 (Anderson & Gerbing 1988). In relation to the study, all of the measurement items represented their factors significantly, as the critical ratio of every item exceeded the 1.96 value; hence, all of the measurement items satisfied the convergent validity test.

Discriminant validity, on the other hand, measures the extent to which the latent variables are different (Zikmund 2003). Based on Fornell and Larker's (1981) approach for evaluating the discriminant validity, Holmes-Smith (2001) recommended that the average extracted variance

of the two constructs must exceed the square of their correlation to satisfy the test. To test the discriminant validity for the proposed measurement models, the average variance extracted and the square correlation for every possible pair of factors were calculated. The results, presented in table 4, showed that the average variance extracted for each pair of latent variables was greater than the squared correlation for the same pair, indicating that each construct was a distinct construct.

Table 4. Discriminant validity test outcomes

*	ATM	Telephone	Internet	Product	Price
ATM		0.905	0.91	0.9	0.87
Telephone	0.277		0.925	0.915	0.89
Internet	0.277	0.351		0.92	0.895
Product	0.238	0.215	0.327		0.885
Price	0.314	0.218	0.200	0.192	

    * The upper level represents the average extracted variance while the lower level represents the squared correlations for every pair.

Criterion-related validity reflects the success of measures used for an empirical estimating purpose (Emory & Cooper 1991). In this study, criterion-related validity is established by correlating scale scores with customer loyalty. Price and core service dimensions were considered earlier as additional factors to the main service delivery channel dimensions. Accordingly, the squared multiple correlations (R^2) of customer loyalty were also tested both with, and without, these two factors to confirm their importance in the proposed model. The correlations and R^2 are shown in table 5. It should be noted that all of the five scales have significant positive correlations with loyalty. Furthermore, R^2 of customer loyalty with the addition of price and core service were higher. Thus, the criterion–related validity was established and the inclusion of all factors was necessary in this measurement model.

Table 5. Correlations and squared multiple correlations between the factors of automated service quality and the criteria

The factor	Loyalty	Squared multiple correlations (R^2)	
		All factors	The first three factors only
ATM service quality	0.552*		
Telephone banking service quality	0.560*		0.414
Internet banking service quality	0.463*	0.611	
Price	0.712*		
Core service quality	0.540*		

  Note: * All correlations are significant at a level of 0.01

After conducting the validity and reliability tests for all of the critical factors of customer perception of banking automated services, it is also necessary to demonstrate the overall fit of the measurement model. The overall fit of the measurement model was determined by confirmatory factor analysis (CFA). The fit of this model was extremely important in that all possible factors were nested appropriately within it (Ho 2000). Obtaining a poor fit at this stage would require a further refinement of the measurement model (Anderson & Gerbing 1988). To evaluate the measurement model in this study it was necessary to use a variety of "goodness of fit" indices (Byrne 2001). Accordingly, the assessment of the model fit in this paper was based on multiple criteria; the normed x^2 or x^2/df ratio, the root mean square Error

of Approximation (RMSEA), the comparative fit index (CFI), Tucker-Lewis Index (TLI), Normed Fit Index (NFI), Incremental Fit Index (IFI), and the Relative Fit Index (RFI) (Hair *et al.* 1995, Schumacker & Lomax 1996, Baumgartner & Homburg 1996, Byrne 2001 Holmes-Smith 2001). Table 6 shows the acceptable fit criteria and the automated service quality fit indices values. All of the statistical values of the final measurement model indicated that the model fitted well in representing the data.

Table 6. Goodness of fit indices for the automated service quality model

Goodness of fit indices	Fit Criteria	E-service quality Model
x^2		462.856
df		199
x^2/df	=3	2.326
RMSEA	=0.08	0.055
CFI	=0.9	0.95
TLI	=0.9	0.93
NFI	=0.9	0.91
IFI	=0.9	0.95
RFI	=0.9	0.9

Adapted from Hair *et a.l* 1995, Schumacker & Lomax 1996, Baumgartner & Homburg 1996, Byrne 2001, Holmes-Smith 2001

Summary of the Research

The aim of the study was to establish the critical determinants of automated service quality by including those attributes of each main banking delivery channel that were currently assessed by existing service quality instruments and those attributes that were currently overlooked in the automated service quality literature. Subsequently, this paper proposed a conceptual model of automated services quality, as perceived by customers, with specific emphasis on the banking service sector. The proposed comprehensive model was empirically validated by perceptual data collected from customers of banks, building societies, and credit unions in Queensland, Australia.

All of the proposed five factors of customer perceptions of automated banking service quality have exhibited strong unidimensionality, reliability, convergent, discriminant, and criterion-related validity. Moreover, the CFI and the other criteria indices for the overall model have also been found to exceed the obligatory requirements. Consequently, it can be accepted that the automated service quality in banks can be conceptualised as a five-factor structure consisting of: ATM service quality, telephone banking service quality, internet banking service quality, core service quality and price quality.

Practical Applicability and Future Directions

The instrument thus standardised can be used to measure levels of customer perceived automated service quality for banking institutions. Furthermore, an automated service quality index (ASQI), with respect to each dimension, can also be measured. The ASQI for a particular bank with respect to a particular dimension is the average value of the factor score per item (Sureshchandar *et al.* 2002). The ASQI will give an indication of the automated service quality delivered by the bank from the customer's perspective with respect to a particular dimension. The ASQI values for all of the dimensions will provide a comprehensive picture of the level of automated service quality. Bank administrators can

utilise these indices as reference points, in order to highlight those automated service quality aspects which may need further enhancement. These indices will also assist researchers to better understand the different aspects related to customer perceptions of automated service quality in banks. Furthermore, researchers can use these results as a basis for subsequent studies in other service organisations that utilise technology to deliver their services. Such studies are very important in enriching the growing field of automated service quality research. Ultimately, the findings of such future studies would enable researchers and practitioners alike to identify the different attributes, of the key automated channels and other prominent dimensions, to be taken into consideration when adopting a comprehensive measure of automated service quality.

Limitations of the Research

Three limitations related to the sample and the research design were identified in this study. First, although the automated service quality measurement model comprehensively addresses different automated quality aspects in banks, it may be that other aspects needed to be explored and investigated as well.

A second limitation was due to the limited number of financial institutions covered by this research. This shortcoming was unavoidable given the nature of the Australian financial institution sector and the dominance of the Big Four. However, this study included the "Big Four" and national banks in Queensland as well as some credit unions and building societies. Accordingly, this sample of financial institutions is considered comprehensive and representative of Queensland financial institutions, which in turn was equivalent to the scope of coverage of published overseas studies. However, because of the dominance of the major banks in Australia, these findings have national significance and indeed can be extended to any other country that has similar financial regulations and banking culture, such as New Zealand.

Third, the instrument was validated by collecting data from bank customers, in Queensland, Australia. Technology adoption patterns- Internet banking, telephone banking, and ATMs- may differ from country to country (Greenspan 2002). That is, the way in which some organisations develop strategies and the extent to which business utilise technologies in their marketing management, may differ across cultural boundaries (Geiger & Martin 1999). Thus, if conclusions and implications are to be applied to other countries with different cultures and financial regulations, further research should be conducted to confirm the relevance of the findings of this research in differing cultural contexts.

References

Anderson J & Gerbing W (1988). Structural equation modelling in Practice: A review and recommended two stage approach. *Psychological Bulletin, 27* (1), 5-24.

Bahia K & Nantel J (2000). A reliable and valid measurement scale for the perceived service quality of banks. *The International Journal of Bank Marketing, 18* (2), 84-91.

Baumgartner H & Homburg C (1996). Applications of structural equation modelling in marketing and consumer research: A review. *International Journal of Research in Marketing, 1*(13), 139-161.

Bitner M, Brown S & Meuter M. (2000).Technology infusion in service encounter. *Journal of Academy of Marketing Science, 28*(1), 138-149.

Brogowicz A, Delene L & Lyth D (1990). A Synthesised service quality model with managerial implications. *International Journal of Service Industry Management, 1*(1), 27-45.

Brown S & Swartz T (1989).A gap analysis of professional service quality. *Journal of Marketing, 53*, 92-108.

Buckley J (2003). E-service and the public sector. *Managing Service Quality, 13*(6), 453- 462.

Buttle A & Aldaigan A (2002). SYSTRA-SQ: a new measure of banks service quality. *International Journal of Service Industry Management, 13*(4), 362-381.

Byrne B (2001). Structural equation modelling with AMOS. New Jersey. Lawrence Erlbaum Associate.

Chen I., Gupta A. & Rom W (1994). A study of Price and Quality in Service Operation. *International Journal of Service Industry Management, 5*(2), 23-33.

Colgate M & Hedge R (2001).An investigation into switching process in retail banking service. *International Journal of Bank Marketing, 19*(5), 201-212.

Dabholkar P (1994). Technology based service delivery. *Advances in Service Marketing and Management, 3*(1), 241-271.

Dabholkar P (1996).Consumer evaluations of new technology-based self-service options: an investigations of alternative models of service quality. *International Journal of Research in Marketing, 13*(1), 29-51.

Dabholkar P & Bagozzi R (2002). An attitudinal Model of Technology-based Self-Service: Moderating effects of Consumers Traits and Situational Factors. *Journal of Academy of Marketing Science, 30*(3), 184-201.

Daniel E (1999). Provision of electronic banking in the UK and the republic of Ireland. *International Journal of Bank Marketing, 17*(2), 72-82.

Davies F, Moutinho L & Curry B (1996). ATM users Attitudes: a neural network analysis. *Marketing intelligence & Planning, 14*(2), 26-32.

Edey M. (1996). *Introduction to the Future of the Financial System*. Reserve Bank of Australia, Retrieved July, 2004, Available from
http://www.rba.gov.au/PublicationsAndResearch/Conferences/1996/Introduction.pdf

Edey M & Gray B (1996). *The Evolving Structure of the Australian Financial System*. Reserve Bank of Australia, Retrieved July 2004, Available from
http://www.rba.gov.au/PublicationsAndResearch/Conferences/1996/EdeyGray.pdf

Emory C & Cooper D (1991). *Business Research Methods* (fourth ed). United states of America: Irwin

Fiotto U, Tanzi P & Saita F (1997).Consumers needs and front-office technology adoption. *International Journal of Bank Marketing, 15*(1), 13-21.

Fitzsimmons J & Fitzsimmons M (1997). *Service Management: Operations Strategy, and Information Technology*. New York: Irwin and McHraw-Hill.

Fornell C & Larker D (1981). Evaluating structural equation models with unobserved variables and Measurement errors. *Journal of Research Marketing, 27*(3), 445-466.

Gardener E, Howcroft B & Williams J (1999). The new retail banking revolution. *The Service Industries Journal,. 19*(2), 83-100.

Geiger S & Martin S (1999). The internet as a relationship marketing tool-some evidence from Irish companies. *Irish Marketing Review, 12*(2), 25-36.

Gerbing D & Anderson J (1988). An update paradigm for scale development incorporating unidimensionality and its assessment. *Journal of Marketing Research, 25*, 186.

Greenspan R (2002). *China Pulls Ahead of Japan*. Retrieved December, 2003, from www.cyperatlkas.internet.com/big_picture/geographics/article/0,,5911_1013841,00.html#table

Gyptra P & Dixon P (2002). *Future of banking- Expectation*. Global change Retrieved 10 February, 2004. Available from http://www.globalchange.com/futurebank.htm

Hair J, Anderson R, Tatham R & Black W (1995). *Multivariate Data Analysis with Readings*. Englewood Cliffs: Prentice-Hall International.

Henryson S (1971). Gathering, analysis and using data on test items. In R.L .Thorndike (ED) *Educational Measurement* (2nd ed) p 153. Washington,D.C : America council on education

Henderson J, McGoldrick E & McAdam R (2003). A critical review of e-service in Northern Ireland Electricity. *Managing Service Quality, 13*(6), 463-470.

Ho R (2000). *Handbook of Univariate & Multivariate Data Analysis & Interpretation: SPSS Approach*. Rockhampton: Central Queensland University.

Holmes-Smith P (2001). *Introduction to Structural Equation Modelling using LISREAL*. Perth: ACSPRI-Winter training Program.

Hway-Boon O & Yu C (2003). Success factors in e-channels; The Malaysian banking scenario. *International Journal of Bank Marketing, 21*(6), 369-377.

Iqbal Z, Verma R & Baran R (2003).Understanding consumer choices and preferences in transaction-based e-service. *Journal of Service Research, 6*(1), 51-65.

Jabnoun N & Al-Tamimi H (2003). Measuring perceived service quality at UAE commercial banks. *International Journal of Quality & Reliability Management, 20*(4), 458- 472

Joseph M, McClure C & Joseph B (1999). Service quality in the banking sector: the impact of technology on service delivery. *International Journal of Bank Marketing, 17*(4), 182-191.

Joseph M & Stone G. (2003). An empirical evaluation of US bank customer perceptions of the impact of technology in service delivery in the banking sector. *International Journal of Retail & Distribution Management, 31*(4), 190-202.

Jun M & Cai S (2001). The key determinants of internal banking service quality: A content analysis. *International Journal of Bank Marketing, 19*(7), 276-291.

Keaveney S (1995). Customer switching behaviour in service industries: An exploratory study. *Journal of Marketing, 59*(2), 71.

Kotler P (1984). *Marketing Management: Analysis, Planning and Control*. Prentice-Hall, Englewood Cliffs, NJ.

Lang B & Colgate M (2003). relationship quality, on-line banking and the information technology gap. *International Journal of Bank Marketing, 21*(1), 29-37.

Long M & McMellon C (2004). Exploring determinants of retail service quality on the internet. *Journal of Service Marketing, 18*(1), 78-90.

Meuter M, Ostrom A, Roundtree R & Bitner M. (2000). Self-service technology: Understand customer satisfaction with technology-based service encounters. *Journal of Marketing, 64*(3), 50-64.

Mols N (2000). The internet and service marketing-the case of Danish retail banking. *Internet research: Electronic Networking Applications and Policy. 10*(1), 7-18.

Mouawad M & Kleiner B (1996). New developments in customer service training. *Managing Service Quality, 6*(2), 49-56.

Nunnally J & Bernstein I (1994). *Psychometric Theory*. New York: Mcgraw-Hill.

Patricio L, Fisk R & Cunha J (2003). Improving satisfaction with bank service offerings: measuring the contribution of each delivery channel. *Managing Service Quality, 13*(6), 471-482.

Parasuraman A, Zeithaml V & Malhotra A (2005). E-S-QUAL: A Multiple-Item Scale forAssessing Electronic Service quality. *Journal of Service Research, 7*(3), 213-234

Radecki L, Wenninger J & Orlow D (1997). Industry structure: Electronic Delivery's Potential Effects on Retail Banking. *Journal of Retail banking Service, 19*(4), 57-63.

Ramsay J & Smith M (1999). Managing customer channel usage in the Australian banking sector. *Managerial Auditing Journal, 14*(7), 329-338.

Riel A, Liljander V & Jurriens P (2001). Exploring consumer evaluation of e-service: a portal site. *International Journal of Service Industry Management, 12*(4), 359-377.

Rust R & Oliver R (1994). *Service Quality: Insights and Managerial Implications from Frontier.* In R. Rust & R. Oliver (Eds.), Service quality, new directions in theory and practice. London: Sage.

Ruyter K, Wetzels M & Kleijnen M. (2001). Customer adoption of e-service: an experimental study. *International Journal of Service Industry Management, 12*(2), 184-207.

Santos J (2003). E-service quality: a model of virtual service quality dimensions. *Managing Service Quality, 13*(3), 233-246.

Schumacker R & Lomax R (1996). *A Beginner Guide to Structural Equation Modelling.* Mahwah, New Jersey: Lawrence Erlbaum Association.

Schneider B & Bowen D (1995). *Wining the Service Game.* Harvard Business School Press, Boston.

Sureshchandar G, Rajendran C & Anantharaman R (2002). Determinants of customer-perceived service quality: A confirmatory factor analysis approach. *Journal of Service Marketing, 16*(1), 9-34.

Sureshchandar G, Rajendran C & Anantharaman R. (2001).A holistic model for total quality service. *International Journal of Service Industry Management, 12*(2), 378-412.

Surjadjaja H, Ghosh S & Antony J (2003). Determining and assessing the determinants of e-service operations. *Managing Service Quality, 13*(1), 39-53.

Szymanski D & Hise R (2000).e-satisfaction: an initial Examination. *Journal of Retailing, 76*(3), 309-322.

Teijlingen & Hundley (2001). *The Importance of Pilot Studies.* University of Surrey. Retrieved July, 2004, Available from http://www.soc.surrey.ac.uk/sru/SRU35.html

Thompson G (1996). *Retail Banking, Technology and Prudential Supervision.* Reserve Bank of Australia Bulletin. Retrieved July 2004, Available from http://www.rba.gov.au/PublicationsAndResearch/Bulletin/bu_may96/bu_0596_2.pdf

Wong C (1998). Consumers: the driving force in strategies and spending. *Banker's Journal Malaysia,* December/January, 9-13.

Yang Z & Jun M (2002). Consumer perception of e-service quality: from internet purchase and Non-Purchase Perspectives. *Journal of Business Strategies, 19*(1), 19-41.

Zeithaml V (2002). Service-excellence in electronic channels. *Managing Service Quality, 12*(3), 135-138.

Zeithaml V (1988). Consumer perceptions of price, Quality and Value: A Means-End model

and Synthesis of evidence. *Journal of Marketing, 52*(3), 2-22.

Zhu F, Jr W & Chen I (2002). IT-based services and service quality in consumer banking. *International Journal of Service Industry Management, 13*(1), 69-90.

Zikmund W (2003*). Business Research Methods* (Seventh ed.). Australia: South western.

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