APPLYING THE IS SUCCESS MODEL TO MOBILE BANKING APPS

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Bachelor of Management
(Information Management and Information Systems)
Tianjin University of Science and Technology, 2010

A Thesis
Submitted to the School of Graduate Studies
of the University of Lethbridge
in Partial Fulfillment of the
Requirements for the Degree

MASTER OF SCIENCE IN MANAGEMENT

Faculty of Management
University of Lethbridge
LETHBRIDGE, ALBERTA, CANADA

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Date of Defence: December 5, 2013

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Abstract

Mobile banking applications (apps) are the latest technology to be offered by the retail banking sector. However, little research has been done to understand the adoption of this technology. Building on the DeLone and McLean IS Success Model, this study investigates the impacts of banking app quality (i.e., information quality, system quality, and service quality) on satisfaction, perceived innovativeness, and intention to continue using. System quality and information quality were found to be multidimensional structures with the user interface, response time, and security contributing significantly to system quality while understandability and completeness contributed significantly to information quality. The findings suggest that system quality significantly impacts perceived innovativeness while information quality significantly influences satisfaction. Both perceived innovativeness and user satisfaction significantly affect intention to continue using banking apps. Perceived innovativeness also has an indirect impact, through satisfaction, on intention to continue using.

Acknowledgements

First of all, I would like to express my deepest appreciation to my co-supervisors, Dr. Brian Dobing and Dr. Helen Kelley, for their guidance, patience, and commitment. Their expertise, enthusiasm, and curiosity have encouraged me to explore the IS field and have inspired me to conduct this research.

I would also like to thank to my committee member Roberto Bello for sharing his expertise in marketing and Dr. Dave Salisbury for being the external examiner. Both of them have provided valuable insights and comments on my thesis.

I am thankful to Ms. Tammy Rogness for her kindness and assistance. Moreover, special thanks to all my cohort members for being supportive and encouraging.

Last but not least, I would like to thank my parents and friends for being always by my side. I appreciate their unconditional love and unfailing support, which have kept me positive throughout the whole time.

Table of Contents

List of Tables

Table of Figures

Chapter 1: Introduction

Information technology has been long considered an important force that can impact a firm's success (DeLone & McLean, 1992). The retail banking sector is one of the leaders in adopting and utilizing various information technologies (Reid & Levy, 2008). Automatic teller machines (ATMs), Internet banking, and mobile banking are recent technological innovations which have moved banking services from largely face-to-face to more technology-based interactions (Wessels & Drennan, 2010).

Both banks and their customers can benefit from technology-based interactions. Banks can benefit from these electronic channels in terms of standardizing service delivery, reducing labor costs, expanding delivery options, etc. (Curran & Meuter, 2005). Banks may also establish a reputation of being technologically innovative by providing new technology to customers, or as laggards if they do not. For customers, technology makes it convenient to conduct bank transactions quickly, anytime and anywhere (Nasri, 2011).

Among multiple electronic banking channels, mobile banking is the latest technology to be adopted in the retail banking sector (Laukkanen, 2007a, 2007b; Wessels & Drennan, 2010). A Retail Banking Satisfaction Study conducted by J.D. Power (2012) showed that only a small proportion of bank customers have already adopted mobile banking. However, the mobile banking adoption rate increased from 10% in 2011 to 16% in 2012 and has the potential to continue growing (J.D. Power, 2012).

Mobile banking allows users to access banking services via mobile devices (H.-F. Lin, 2011). Mobile banking has multiple channels. Scotiabank (n.d.), one of the major banks in Canada, reports that there are three ways to perform mobile banking: text

banking, Wireless Application Protocol (WAP) banking, and app banking. Recently, due to the popularity of smart phones and the development of mobile communication technologies, banking via mobile apps has become the fastest-growing method used for bank transactions even though its adoption rate still low at 2% in 2012 (J.D. Power, 2011, 2012).

The multi-channel nature of mobile banking has not yet drawn much attention by IS researchers. Without distinguishing among different mobile banking channels, only a few studies have investigated mobile banking adoption (Püschel, José Afonso, & Hernandez, 2010; Wessels & Drennan, 2010; Zhou, 2012), user satisfaction and loyalty (Sanayei, Ranjbarian, Shaemi, & Ansari, 2011), and the intention to continue using mobile banking (Kang, Lee, & Lee, 2012; Püschel et al., 2010). The present study attempts to contribute to the existing literature by specifically investigating mobile banking apps.

Given the tremendous potential for continued growth in banking app usage, identifying the characteristics of banking apps that are crucial to users can help banks further improve their apps, which in turn will encourage larger scale adoption. We propose to do this by studying experienced users' perceptions and intentions to continue using banking apps, allowing researchers and banks identify those crucial features and possible improvements for mobile banking apps. The present study attempts to investigate the following research questions:

Are experienced users satisfied with their mobile banking apps? And why?

Do experienced users intend to continue using their mobile banking apps? And why?

Does user experience with mobile banking apps impact perceived innovativeness of banks? And how?

Researchers have studied intention to continue using mobile banking from both social psychology (e.g., Technology Acceptance Model) and innovation diffusion (e.g., Diffusion of Innovation Theory) perspectives, but little research has been done to investigate if quality could impact intention to continue using mobile banking apps. DeLone and McLean (2003) proposed a comprehensive framework, the Updated IS Success Model, to assess success of information systems by addressing the technical (e.g., system quality), semantic (e.g., information quality), service (e.g., service quality), and effective aspects (e.g., use and satisfaction). We believe that building on the DeLone and McLean (2003) Updated IS Success Model will allow us to investigate multiple dimensions that may influence intention to continue using mobile banking.

Contributions of this study to the existing body of knowledge will be five-fold. First, the present research will specifically investigate mobile banking apps. Second, this study will be one of the few studies empirically testing the DeLone and McLean Updated IS Success Model in a mobile environment and will be the first to apply this model to assess the success of mobile banking apps. Third, this study will extend the Updated DeLone and McLean IS Success dimensions by incorporating perceived innovativeness and intention to continue using. Fourth, we will develop measurements for each construct in our theoretical model based on the existing literature and an exploratory study. Finally, the theoretical model and the measurements will be empirically tested using data collected from banking app users in Canada.

This research begins with the results of an exploratory study on banking app services in Canada by identifying issues raised by current users. Next, the literature on technology adoption, service quality, and satisfaction, with an emphasis on online and mobile banking, is reviewed. Literature on IS success, and corporate reputation is also reviewed. Next, we will identify gaps in the existing literature as well as potential contributions of this study. Then, based on findings from the exploratory study and the extant literature, we will propose a theoretical model and related hypotheses. Following the model and hypotheses development section, the methodology and results for this study will be presented. Finally, we will interpret the findings of this study and then discuss theoretical and practical implications, limitations of this study, and opportunities for future studies.

Chapter 2: Exploratory Study: A Content Analysis

Mobile banking applications (apps) are the latest electronic banking channel. Our understanding of the issues surrounding adoption of this technology is limited. Therefore, an exploratory study using content analysis was conducted in order to understand the role of mobile banking apps in the Canadian banking environment.

Overview of Mobile Banking Applications in Western Canada

Ten banks were identified that provide personal banking services in Western Canada. Five out of 10 are major banks across Canada, which are also known as the "Big 5" (i.e., RBC Royal Bank, TD Canada Trust, Scotiabank, Bank of Montreal, and CIBC). Two are international banks (i.e., ING Direct Canada and HSBC), and three are medium-sized banks (i.e., First Calgary Financial, National Bank of Canada, and 1st Choice Savings). A review of their websites revealed that only 1st Choice Savings does not provide a mobile banking service.

This review also showed that mobile banking apps can be carried on three different platforms: *iOS* (e.g., iPhone and iPod touch), Android, and Blackberry. Mobile banking apps can be downloaded to mobile devices from online app stores. The URL addresses for the online app stores are:

iTunes: http://itunes.apple.com/ca/genre/ios-finance/id6015?mt=8

Android Market: https://play.google.com/store/apps

Blackberry App World: http://appworld.blackberry.com/webstore/?lang=en

After reviewing bank websites and online app stores, we found that some banks provide banking apps for all three platforms, while other banks only provide apps for one or two. The availability of banking apps on different platforms is summarized in Table 1.

Table 1 shows that the banking apps offered by the major Canadian banks (i.e., Big 5) have far more online ratings than other Canadian banks, reflecting their larger customer base. For instance, RBC Royal Bank's app had 1,873 ratings on iTunes, while only 602 and 149 users rated ING Direct Canada's and National Bank of Canada's apps on iTunes, respectively. In addition, banking apps that are carried on *iOS* devices and Android devices received more ratings than those on Blackberry devices. CIBC banking apps, for example, received 4,684 and 440 ratings on iTunes and Android Market respectively, but only 149 ratings from Blackberry App World.

Data Source Selection and Data Overview

Given the availability and popularity of banking apps from various banks on different platforms, user reviews of the Big 5's banking apps on iTunes and Android Market were considered to be better data sources for our content analysis. However, reviews on both the iTunes preview page and iTunes cannot be easily retrieved into a usable format. Therefore, the Android Market was identified as the best data source for our content analysis.

Around 1,200 user comments about the Big 5 banking apps on the Android Market were reviewed online on January 31, 2012 in order to obtain a general understanding of users' concerns. Table 2 presents the number of comments, the number of ratings, average rating, review release period, and topics that were widely discussed by reviewers.

Table 1. Availability of Banking Apps on Different Platforms

Bank	Platform	Availability	# of ratings (avg rating)	Link
RBC	iOS	Yes	1873 (4)	http://www.rbcroyalbank.com
Royal	Android	Yes	837 (4)	/mobile/index.html
Bank	Blackberry	Yes	227 (3)	
TD	iOS	Yes	4750 (3.5)	http://www.tdcanadatrust.com
Canada	Android	Yes	2987 (3.9)	/products-services/banking/ele
Trust	Blackberry	Yes	574 (3)	ctronic-banking/mobile/mobil e-index.jsp
Scotia	iOS	Yes	2702 (2.5)	http://www.scotiabank.com/ca
bank	Android	Yes	917 (4)	/en/0,,320,00.html
	Blackberry	Yes	97 (2.5)	
Bank of	iOS	Yes	1514 (2)	http://www.bmo.com/home/pe
Montreal	Android	Yes	587 (2.6)	rsonal/banking/everyday/mobi
	Blackberry	Yes	478 (2)	le/mobile-banking/details#tab s-1
CIBC	iOS	Yes	4684 (3.5)	https://www.cibc.com/ca/how
	Android	Yes	440 (3.7)	-to-bank/mobile.html
	Blackberry	Yes	149 (3)	
ING	iOS	Yes	602 (3.5)	http://www.ingdirect.ca/mobil
Direct	Android	Yes	295 (4)	e/index.html
Canada	Blackberry	Yes	44 (2.5)	
HSBC	iOS	Yes	34 (3)	http://www.hsbc.ca/1/2/en/per
	Android	No	---	sonal/personal-home
	Blackberry	No	---	
First	iOS	Yes	6 (4)	https://www.firstcalgary.com/
Calgary	Android	Yes	8 (3.5)	BankingAccess/MobileBanki
Financial	Blackberry	Yes	1 (2)	ng/
National	iOS	Yes	149 (4)	http://www.mymobileguide.ca
Bank of	Android	No	---	
Canada	Blackberry	No	---	

Note. Data retrieved on April 26, 2012

Table 2. Summary of Reviews on Big 5 Banking Apps

Bank	No. of reviews	No. of ratings	Average rating	Review release period	Topics
RBC Royal Bank	249	576	4.1	Oct 2, 2011 – Jan 31, 2012	Simple, clear, and quick Information/details missing Only supports English language Errors/running problems Email transfer required
TD Canada Trust	480	2,403	3.9	Apr 16, 2011 – Jan 30, 2012	Slow/Long loading time Doesn't work after updating Lacks useful features Doesn't resize to fit large screens Limited password length Running problems Poor customer service Missing landscape support Auto-logout
Scotiabank	225	713	4.0	Dec 14, 2010 – Jan 31, 2012	Great for email transfers and bill payment Simple and easy to use Incompatible with some phones Running problems (errors, connection problems)
Bank of Montreal	214	420	2.6	Jun 26, 2011 – Jan 31, 2012	Easy to use Good layout Slow Browser launches of a mobile web site Doesn't accept card number to access banking info Missing banking functions (e.g., bill payment, e-transfer) Missing account info Failed to use the saved card number

(Table 2 continues)

(Table 2 continued)

Bank	No. of reviews	No. of ratings	Average rating	Review release period	Topics
CIBC	128	273	3.5	Jun 15, 2011 – Jan 30, 2012	Portal to a mobile website Slow Running problem (white screen) No sign out button Doesn't save card number Can't view statements No bill payment Incompatible with some phones Great for transfers, checking balance Password limited to10 digits Cannot resize to fit the screen size

Note. Data retrieved on January 31, 2012

Coding Scheme I: Initial Data Analysis

The content analysis followed the process suggested by Creswell (2008) for qualitative data analysis. First, data were retrieved from the Android Market (https://play.google.com/store/apps). CIBC was randomly selected from the five major Canadian banks, and 117 comments posted between June 15, 2011and January 20, 2012 were retrieved into an Excel document. Second, data were coded by identifying meaningful text segments. For example, a reviewer made the following comment: "Not compatible with ICS. I upgraded my firmware and now i can't use the app.... not cool.[1]" "Not compatible with ICS" was considered to be a meaningful segment. Next, a code name was assigned to the segment. For the segment "not compatible with ICS," the code named "compatibility" was assigned. Then, related codes were grouped into themes.

[1] All quotations are shown as they appeared on the website, with the original grammar, spelling, etc.

At the end of this analysis, all codes were grouped into seven themes with 13 sub-themes. The themes and sub-themes are presented in Table 3. Themes include performance, functionality, convenience, security, cross platform compatibility, and others. This coding scheme (Coding Scheme I) showed redundancies. For example, two sub-themes, "error" and "stability," were considered redundant because both of them addressed whether a banking app is reliable and error-free.

After reviewing coding Scheme I and example comments, it appeared that some themes might have been overlooked, such as attitude and overall performance.

Table 3. Coding Scheme I

Theme	Sub-themes	Text Segments
Comparison		Compared with mobile site
		Compared with online banking
		Compared with other banks' apps (e.g., TD)
		Compared with same bank's app on another platform (e.g., ICBC on iPhone)
		Compared with advertisement or descriptions
Convenience		Can't remember card number
		Can't remember password
Cross platform compatibility		Can't use
		Can't download
		Not compatible with certain phone/operating systems (e.g., ICS)
Functionality	General Functions	Can't review epost bill
		Can't view statements/no transaction details
		Can't pay bills
		Good for transfers
		Good for balance
	App-only Features	No ABM/branch locator based on map/GPS
		No cache cleaning shortcut

(Table 3 continues)

(Table 3 continued)

Theme	Sub-themes	Text Segments
Performance	Interface	Can't fit the screen
		No back button
		No menu button
	Speed	Slow
		Fast
	Errors	Can't logoff
		Doesn't accept password longer than 10 digits
	Stability	Doesn’t run every time
		Stuck on white screen
		Can't display webpage, needs to refresh
Security		No customized image/phrase
		Can view account information after logoff
Other	Memory Consumption	Can't move to SD card
		Takes too much memory
		Takes little memory
	Shortcut to mobile site	Not a real app
	Support	No technology support

Note. Data source: CIBC reviews on Android Market, posted from June 15, 2011 to January 20, 2012 and retrieved on January 20, 2012.

Coding Scheme II: Refinement Based on CIBC data

In order to eliminate redundancies, and to capture overlooked themes, a list of constructs was prepared based on existing theories and the extant literature. Perceived usefulness, perceived ease of use, and attitude were adopted from the Technology Acceptance Model (Davis, 1989); subjective norms and perceived behavioural control were adopted from the Theory of Planned Behaviour (Ajzen, 1985); relative advantage, compatibility, complexity, trialability, and observability were adopted from the Theory of Innovation Diffusion (Rogers, 1962); and performance expectancy, effort expectancy and facilitating conditions were adopted from the Unified Theory of Acceptance and Use of

Technology (Venkatesh, Morris, Davis, & Davis, 2003). In addition, other constructs that have been empirically investigated in previous research were included: self-efficacy (K.-W. Lee, Tsai, & Lanting, 2011), anxiety (Yuen, Yeow, Lim, & Saylani, 2010), perceived risk (Nasri, 2011), trust (H. Chong, Cates, & Rauniar, 2010), perceived credibility (Sanayei, Shaemi, & Salajegheh, 2011), awareness (Al-Majali & Mat, 2011), convenience (Nasri, 2011), security (Nasri, 2011), price (Sanayei, Shaemi, & Salajegheh, 2011), perceived enjoyment (Amin, 2009), and perceived benefit (M.-C. Lee, 2009).

This construct list has two limitations. First, it was created based on the general IS and the online banking literature so some of the constructs might not be relevant to mobile banking apps. In addition, certain factors that could be closely associated with mobile apps might have not been examined in the previous literature. Thus, the content data analysis was guided by the construct list but was not limited to it.

The CIBC data were coded again by referencing the construct list. This resulted in a refined coding scheme (Coding Scheme II) with 18 themes (see Table 4). Some constructs that were in the construct list, but not mentioned in the online reviews, were not included in Coding Scheme II (e.g., subjective norms), while some new themes, such as availability, comparison, and fulfillment, were incorporated.

Table 4. Coding Scheme II

Themes	Description
Attitude	Reviewer comments on his or her feelings about using the mobile banking app.
Availability	Reviewer comments on the availability of this bank's mobile app.
Comparison	Reviewer makes a comment by comparing this app with another bank's app (e.g., TD mobile banking app), or with this bank's apps for other platforms (e.g., iPhone), with online banking or a mobile banking site, with its advertisement or its description, or with the reviewer's direct experience using the same or a similar app.
Cross platform compatibility	Reviewer comments on whether the app is compatible with his/her smart phone or operating systems.
Convenience	Reviewer comments on whether using mobile banking app makes banking easier and more efficient.
Customer Service	Reviewer comments on the quality or helpfulness of customer service received from the bank or app developer.
Ease of use	Reviewer comments on whether using the app or completing banking tasks is easy to use.
Fulfillment	Reviewer comments on the degree to which the app fulfills his or her expectations or requirements.
Functionality related to banking	Reviewer comments on the features related to banking.
Functionality related to operation	Reviewer comments on the general operation of the mobile application.
Functionality related to smart phone	Reviewer comments on certain features that only relate to mobile applications.

(Table 4 continues)

(Table 4 continued)

Themes	Description
Interface design	Reviewer comments on the quality of design including the display of content, the arrangement of control keys, etc.
Overall performance	Reviewer comments on the overall quality of the app.
Security	Reviewer comments on whether he or she feels safe when banking via mobile banking applications or whether he or she thinks the transactions and the account information are protected.
Speed	Reviewer comments on the response time when loading the app/page or completing transactions.
Stability/Error	Reviewer comments on whether the app has stable performance and can complete tasks successfully every time or whether errors are reported when running the app.
Type of app	Reviewer comments on whether the app is a bookmark of the bank's mobile site.
Usefulness	Reviewer comments on whether the app is useful or helpful in completing banking tasks.

Note. Data source: CIBC reviews on Android Market, posted during June 15, 2011 to January 20, 2012 and retrieved on January 20, 2012

Functionality of Banking Apps

To create a saturated functionality list, TD Canada Trust's banking app reviews on Android Market were selected as an additional data source. The banking app from TD Canada Trust was selected because it had the most reviews, which should provide a wide range of perspectives. Data were retrieved into a Word document on March 1, 2012. In total, 454 user reviews posted during from June 5, 2011 to March 1, 2012 were included.

After analyzing the user comments on CIBC's and TD Canada Trust's banking apps, a list of functionalities were documented (see Table 5).

Table 5. Banking App Functionality

Banking App Functionality	
Banking features:	Transfer funds
	View ePost bills
	Check account balance
	View statement/activities
	View credit card balance/statement
	Bill payment
	e-transfer
Cross Platform Compatibility:	Works across different devices with the same OS
	Works across different OS
	Similar to PC/Web interface
Initial Access/Login: (operational features)	Ease of access
	Sign out properly
	Remember card number
	Remember password
Performance:	Fast
	Prompt response
Reliability:	Does not crash
Security:	App closes properly
	Initial display is custom designed for user (prevent phishing)
Tech Support:	Availability
	Helpfulness
User Interface:	Provides sufficient detail for items
	Good menu access
	Attractive interface

Note. Data source 1: CIBC reviews on Android Market, posted during June 15, 2011 to January 20, 2012 and retrieved on January 20, 2012. Data source 2: TD reviews on Android Market, posted from June 5, 2011 to March 1, 2012 and retrieved on March 1, 2012.

Coding Scheme III: Analysis Based on CIBC Data and TD Data

Coding Scheme II was generated from online reviews of the CIBC banking app. This coding scheme was further developed by incorporating and analyzing reviews of the TD Canada Trust banking app. In addition, the updated functionality list can serve as a guideline to further refine the coding scheme. Thus, reviews of CIBC and TD Canada Trust banking apps on the Android Market were coded by referencing Coding Scheme II and the updated functionality list.

Two themes, comparison and convenience, from Coding Scheme II, were combined into one theme labelled "relative advantage," because users of banking apps might perceive relative advantages when comparing its convenience with other banking channels. "Fulfillment," referring to the degree to which an app fulfills its user's expectations or requirements, was removed since it overlapped with the evaluation of "overall performance." In addition, "availability," which represents the comments on the availability of a banking app, was removed since this category was not that relevant to the purposes of the content analysis. The new coding scheme (Coding Scheme III) with 14 themes and 54 sub-themes is outlined in Table 6.

Table 6. Coding Scheme III

Themes	Sub-themes
Attitude	
Banking features	Transfer funds
	Check account balance
	View statements/activities
	View credit card balance/statement
	Pay bills
	Send e-transfer
	Add bills/payees/e-transfer recipients
	View bills
	Access accounts
	Buy/sell investments (e.g., stocks)
	Check paid bills history
	Pay more than one bill at one time
	Capture cheque deposited
Cross platform compatibility	Works across different devices with the same OS
	Works across different OS
	Tablet support
Ease of use	
Initial operation features	Sign in properly (ease of access)
	Sign out properly
	Remember card number
	Remember password
	Remove “remember card number” option
	Have password length limitation
	Load page and content properly
	Logout automatically
	Fail to connect the Internet
	Contain missing links
Overall performance	
Performance	Prompt response (fast)

(Table 6 continues)

(Table 6 continued)

Themes	Sub-themes
Relevant advantages	
Reliability	Does not crash
	Improved performance after update
Security	Close properly
	Display customized phrases and pictures
	Display secure questions
Specific mobile app related features	Move to SD card
	ABM locator based on map/GPS
	Memory consumption
	Wrapped mobile site or not
	Landscape mode
	Bandwidth use
	Multitask performance
	Native app
	Input feedback
Tech support	Availability
	Helpfulness
Usefulness	
User interface	Good menu access
	Attractive interface
	Adjust screen size
	Navigation
	Color coded +/- balance

Note. Data source 1: CIBC reviews on Android Market, posed during June 15, 2011 to January 20, 2012 and retrieved on January 20, 2012. Data source 2: TD reviews on Android Market, posed during June 5, 2011 to March 1, 2012 and retrieved on March 1, 2012.

Coding Scheme IV: Further Refinement by Using NVivo

In order to ensure intra-rater reliability, the content analysis was conducted again based on CIBC's and TD Canada Trust's online reviews using QSR NVivo 9. NVivo is a powerful tool to analyze large volumes of qualitative data, allowing users to review data

by subject and rating the importance of issues according to the frequency of themes by subjects (Zapata-Sepúlveda, López-Sánchez, & Sánchez-Gómez, 2012).

At the end of this analysis, Coding Scheme IV was obtained containing 19 themes with 66 sub-themes. The frequency of each theme is shown in Table 7. A few changes were made in Coding Scheme IV. For example, "mobility" was separated from "convenience" to capture the mobile nature of app banking services.

Table 7. Coding Scheme IV

Themes	Sub-themes	Frequency
Attitude		38
Banking functionality		56
	Access accounts	
	Add bills or payees	
	Pay bills	
	Check account balance	
	Check deposit capture	
	Check paid bills history	
	Send e-transfer	
	Multiple account management	
	Pay multiple bills at one time	
	Buy/sell investments (e.g., stocks)	
	Transfer funds	
	View bills	
	View credit card balance or statement	
	View statements (activities)	
Comparison		27
Compatibility		20
Convenience		12
Cross platform compatibility		34
	Tablets support	
	Work across different OS	
	Work across devices with same OS	

(Table 7 continues)

(Table 7 continued)

Themes	Sub-themes	Frequency
Ease of use		14
Initial operation		32
	Logout automatically	
	Fail to connect the Internet	
	Load page and content properly	
	Contain missing links	
	Have password length limitation	
	Remember card number	
	Remember password	
	Remove 'remember card number' option	
	Sign in properly	
	Sign out properly	
Mobility		5
Others		5
	Bank's image	
	Buy a new phone	
	Switch banks	
Overall performance		182
Relative advantages		7
Reliability		77
	Improved performance after update	
	Did not crash	
Security		5
	Close properly	
	Display customized phrases and pictures	
	Display security questions	

(Table 7 continues)

(Table 7 continued)

Themes	Sub-themes	Frequency
Specific app features		40
	Bandwidth use	
	Input feedback	
	Landscape mode	
	Map or GPS	
	Memory consumption	
	Move to SD card	
	Multitask	
	Native app	
	Wrapped mobile site	
Speed		62
Tech (Customer) support		4
	Availability	
	Helpfulness	
Usefulness		21
User interface		68
	Attractive interface	
	Color coded +,- balance	
	Menu access	
	Navigation	
	Screen size adjustment	

Note. Data source 1: CIBC reviews on Android Market, posted during June 15, 2011 to January 20, 2012 and retrieved on January 20, 2012. Data source 2: TD reviews on Android Market, posted during June 5, 2011 to March 1, 2012 and retrieved on March 1, 2012.

Coding Scheme V: Refinement of Coding Scheme and Incorporation of the Third Data Source

After reviewing Coding Scheme IV, we found two pairs of categories, comparison and relative advantage, and mobility and convenience, seemed to be redundant. Therefore, we attempted to refine Coding Scheme IV by specifically focusing on these categories.

Comparison involves comparing the banking app with other banking apps or with other banking channels. For instance, a reviewer mentioned “The iPhone version looks,

operates and feels much better than this horrid web app even when it was working," and another one wrote "It's much quicker than turning on computer and logging in to CIBC online." Both of the comments were considered to fit in the comparison themes since the reviewers compared the banking app they were using with some other banking apps or banking channels.

"Relative advantage," according to Rogers, is defined as "the degree to which an innovation is superior to ideas it supersedes" (1962, p. 124). This concept also incorporates comparison, in which an innovation is compared with prior technologies (e.g., online banking). Thus, comparison was treated as a theme with two sub-dimensions. One dimension includes comparisons that are made among different banking apps, and the other dimension, relative advantage, captures the comparisons that are made among different banking channels.

A comment was coded as "mobility" when the reviewer mentioned he or she can bank at anytime and anywhere. For example, one user commented "I love having this app for wherever I am." Mobility was considered to overlap with convenience since mobility seems to be one aspect of convenience.

Reviews of a third banking app from another data source were then analyzed in order to avoid potential biases and limitations due to single-platform data sources. In addition to the Android Market, there are other two data sources: iTunes and Blackberry App World. As discussed earlier, iTunes does not allow operations such as copy and paste so that the data cannot be easily retrieved.

Thus, Blackberry App World became our only source of additional data. Reviews about the RBC Royal Bank app on Blackberry App World were selected as the third data

source for the following two reasons. First, reviews about the RBC Royal Bank on the Android Market had not been analyzed. A third bank might extend what we have learnt from the CIBC and TD reviews. Second, the RBC banking app had a reasonable number of reviews (263 in total). After analyzing the reviews from CIBC and TD, we believed our Coding Scheme IV to be close to saturation. Reviews of the RBC Blackberry banking app were reviewed to determine whether we had reached a saturation level.

Reviews of the RBC Blackberry banking app posted between January 13, 2011 and May 25, 2012 were retrieved into a Word document, and then imported into NVivo. Data from previous sources (i.e., CIBC and TD Canada Trust Android reviews) were analyzed first in order to further refine our coding scheme.

After analyzing reviews of the CIBC and TD apps, the following changes were made to the coding scheme. "Comparison" was coded with two sub-themes: comparison across banking apps and relative advantage. "Mobility" was coded as a sub-theme of "convenience." In addition to "image" that had been included in Coding Scheme IV, other impacts on perception of banks resulting from using the banking app were further explored. "Attitude towards a bank," "competitiveness," "customer care," and "evaluation of a bank" were identified as potential impacts on a bank. "Use," "satisfaction," and "loyalty" were incorporated into the coding scheme. Both "compatibility" and "reliability" were further coded with sub-themes.

After refining the coding scheme, the third data source, reviews about the RBC Blackberry app, was analyzed to examine whether our data analysis had reached saturation. According to Eisenhardt (1989), saturation is achieved when new cases bring minimal contribution. After coding 263 online reviews of the RBC banking app on

Blackberry App World, only one new sub-theme emerged. The sub-theme, labelled "trust in a bank," was incorporated into "perceptions of banks" as one RBC client doubted the trustworthiness of the bank. Table 8 presents Coding Scheme V, which contains 22 themes with 44 sub-themes. In Table 9, our five coding schemes are compared.

Table 8. Coding Scheme V

Themes	Sub-themes	References
Attitude		75
Banking functionality		85
Comparison		
	Comparison across banking apps	28
	Relative advantage	25
Compatibility		
	Compatible with existing values	1
	Compatible with needs	37
	Compatible with past experience	85
Convenience		43
	Mobility	18
Cross platform compatibility		105
Ease of use		28
Initial operation		60
Loyalty		
	New customer	1
	Recommendation	14
	Switch bank	5
Overall performance		350

(Table 8 continues)

(Table 8 continued)

Themes	Sub-themes	References
Perceptions of banks		
	Attitude towards a bank	3
	Competitiveness	9
	Customer care	4
	Evaluation of banks	2
	Image	4
	Trust in banks	1
Reliability		
	System reliability	263
	Transaction reliability	3
Satisfaction		1
Security		10
Similarity as OB		8
Specific app features		
	Bandwidth Usage	1
	Cache Cleaning	1
	Landscape Model Support	9
	ATM locator	9
	Memory Consumption	2
	Multi-task Support	3
	Support to move to SD card	2
	Web broker Support	1
	App or WAP	31
Speed		92
Tech (cst) support		12
Use	Continue to use	9
	Dependency	10
	Frequency of use	6
Usefulness		48
User interface		97

Note. Data source 1: CIBC reviews on Android Market, retrieved from June 15, 2011 to January 20, 2012. Data source 2: TD reviews on Android Market, retrieved from June 5, 2011 to March 1, 2012. Data source 3: RBC reviews on Blackberry App World, retrieved from January 13, 2011 to May 25, 2012

Table 9. Summary of Coding Schemes

Themes	Sub-themes	Coding scheme I	Coding scheme II	Coding scheme III	Coding scheme IV	Coding scheme V
		CIBC	CIBC	CIBC, TD	CIBC, TD	CIBC, TD, RBC
Attitude			✓	✓	✓	✓
Availability			✓			
Banking functionality		✓	✓	✓	✓	✓
Comparison		✓	✓		✓	✓
	Comparison across banking apps					✓
	Relative advantage			✓	✓	✓
Compatibility					✓	✓
	Compatible with existing values					✓
	Compatible with needs		✓			✓
	Compatible with past experience					✓
Convenience		✓	✓		✓	✓
	Mobility				✓	✓
Cross platform compatibility		✓	✓	✓	✓	✓
Ease of use			✓	✓	✓	✓
Perceptions of banks						✓
	Attitude towards a bank					✓
	Competitiveness					✓
	Customer care					✓
	Evaluation of banks					✓
	Image					✓
	Trust in a bank				✓	✓
Initial operation			✓	✓	✓	✓

(Table 9 continues)

(Table 9 continued)

Themes	Sub-themes	Coding scheme I	Coding scheme II	Coding scheme III	Coding scheme IV	Coding scheme V
		CIBC	CIBC	CIBC, TD	CIBC, TD	CIBC, TD, RBC
Loyalty						✓
	New customer					✓
	Recommendation					✓
	Switch banks					✓
Overall performance			✓	✓	✓	✓
Reliability						✓
	System reliability (stability/error)	✓	✓	✓	✓	✓
	Transaction reliability					✓
Satisfaction						✓
Security		✓	✓	✓	✓	✓
Similarity as OB						✓
Specific app features		✓	✓	✓	✓	✓
	Bandwidth Usage			✓	✓	✓
	Cache Cleaning	✓			✓	✓
	Landscape Model Support			✓	✓	✓
	ATM locator	✓		✓	✓	✓
	Input feedback			✓		
	Memory Consumption	✓		✓	✓	✓
	Multi-task Support			✓	✓	✓
	Support to move to SD card	✓		✓	✓	✓
	Web broker Support			✓	✓	✓
	Type of mobile app	✓	✓	✓	✓	✓
Speed		✓	✓	✓	✓	✓
Customer Service (tech) support		✓	✓	✓	✓	✓

(Table 9 continues)

(Table 9 continued)

Themes	Sub-themes	Coding scheme I	Coding scheme II	Coding scheme III	Coding scheme IV	Coding scheme V
		CIBC	CIBC	CIBC, TD	CIBC, TD	CIBC, TD, RBC
Use						✓
	Continue to use					✓
	Dependency					✓
	Frequency of use					✓
Usefulness			✓	✓	✓	✓
User interface		✓	✓	✓	✓	✓

Conclusion

In total, 834 online reviews from three major Canadian banks (i.e., CIBC, TD Trust, and RBC Royal Bank) on two platforms (i.e., Android Market and Blackberry App World) were analyzed. Due to restrictions on downloading from the iTunes site, we were not able to easily retrieve reviews on the *iOS* platform. Consequently, issues specifically related to banking apps on Apple devices were not addressed.

The intra-rater reliability of this content analysis was ensured by having the researcher analyze the online reviews at different times. Another two researchers reviewed the coding schemes and provided suggestions for refinements. All three researchers came to a common agreement on all issues.

As evidenced by the online reviews, the experience of current users of app banking appears to be less than satisfactory. The majority of comments tend to be negative, reporting problems or warning others about their unpleasant experience. The most frequently reported concerns from current app banking users were related to system reliability, cross platform compatibility, user interface, speed (or response time), and banking functionality. System reliability is the most frequent concern expressed by reviewers, with many reporting that banking apps are not stable.

There are three different mobile computing platforms, *iOS* for Apple devices, Android *OS* for Android-powered devices, and Blackberry *OS* for Blackberries. Each platform can carry different versions of these operating systems. This complex mobile computing environment makes it difficult for app developers to design an app that is compatible with different platforms and different versions of mobile operating systems.

Nevertheless, users expect a banking app to always be compatible with their mobile devices.

Users of banking apps also expressed concern about the user interface. The limited screen size and keyboard size of mobile devices require even greater attention to user interface design. For instance, a good menu design can allow users to navigate more efficiently. In addition, the diversity of screen size among mobile devices requires a banking app that can adjust properly to a wide variety of screen sizes.

The response time of a banking app is also important to its users. Many have reported that banking apps are too slow. However, this should be interpreted with caution. The design of an app might cause the slow response time. However, the computing capability of mobile devices and the condition of the mobile network or wireless networks might also contribute to this problem.

Banking apps, as a kind of utilitarian mobile app, are expected to provide various banking services. Some basic banking services, such as balance inquiry and bill payment, can be done on most banking apps. However, some users would like to have more banking functions on their apps, enabling them to monitor loans, buy/sell investments, etc.

Finally, we also found comments that suggested that experience with banking apps could influence users' evaluations of the overall performance of a banking app, their satisfaction, and their attitude towards that app. Furthermore, some users seemed to evaluate banks' technological innovativeness, competitiveness, and trustworthiness based on their experience with a particular banking app. Some users considered switching banks because of the poor performance of its banking app.

Chapter 3: Literature Review

This chapter provides a brief overview of online banking (OB) and mobile banking (MB), along with a review of the existing literature on OB and MB adoption. The service quality literature in the domain of OB is also reviewed. The DeLone and McLean (2003) Updated IS Success Model is a comprehensive framework to assess multiple aspects of the success of information systems. We review this model and some relevant studies. In addition, we review the marketing literature on corporate reputation since the content analysis revealed that users' perceptions of a bank's reputation of being technologically innovative may be impacted by using mobile banking apps. Finally, the gaps in and limitations of the existing literature are identified and ways to address them are presented.

Overview of Electronic Banking

Information technology is prevalent in the service industry (Siu & Mou, 2005). The banking sector can be characterized as service-sensitive, customer-centric, and highly competitive (Ramseook-Munhurrun & Naidoo, 2011; Yang, Jun, & Peterson, 2004; Yu, 2008). Adopting innovative technologies provides banks with opportunities to standardize service delivery, reduce costs, and develop multiple banking channels (Curran & Meuter, 2005).

Multiple electronic banking channels have been tried, namely automated teller machines (ATM), telephone banking, PC banking, TV-based banking, managed network, online banking, and mobile banking (Curran & Meuter, 2005; Laukkanen, 2007b; Nasri, 2011). However, some of them (i.e., telephone banking, PC banking, TV-based banking, and managed network) have not been widely adopted by bank customers (Curran &

Meuter, 2005; Nasri, 2011). The most recent electronic banking channels are online banking and mobile banking (Laukkanen, 2007b). The following sections will discuss each of them.

Online banking. Benefiting from the rapid growth of Internet technology, banks have adopted online banking (or Internet banking) as the main channel of electronic banking (Nasri, 2011). Most banks have deployed online banking to improve customer service and retain competitiveness (Ramseook-Munhurrun & Naidoo, 2011; Xue, Hitt, & Chen, 2011). To be more specific, banks can benefit from online banking in three ways. First, handling and operating fees can be reduced by offering online banking services (M.-C. Lee, 2009; Safeena, Abdullah, & Date, 2010; Xue et al., 2011; Yaghoubi & Bahmani, 2010; Yuen et al., 2010). Second, demands for banking service can be reallocated from branches to online channels. Finally, online banking can improve customer service quality, consequently increasing customer satisfaction, product utilization, and loyalty (Mansumitrchai & Al-Malkawi, 2011; Safeena et al., 2010; Xue et al., 2011).

Banks customers also benefit from online banking. Online banking is convenient, offering bank customers 24/7 service, access to numerous banking activities, and freedom from waiting in line (Nasri, 2011). Previous studies on online banking have noted a long list of banking activities that can be done online, including transaction history reviews, balance inquiries, money transfers, bill payments, cheque orders, payroll deposits, money exchanges, stock or mutual funds trades, and online purchases (Mangin, Bourgault, Guerrero, & Egea, 2011; Mansumitrchai & Al-Malkawi, 2011; Nasri, 2011).

Mobile banking. Mobile banking has been defined as the use of mobile devices (e.g., mobile phones and tablets) to access banking services (H.-F. Lin, 2011; Zhou, Lu, & Wang, 2010). Mobile banking has been seen as an extension of online banking by adopting mobile and wireless technologies, allowing users to complete various banking activities (e.g., balance inquiries, money transfers, and bill payments) on the go (Yao & Zhong, 2011).

Mobile banking began with Short Message Service (SMS) banking and WAP banking (Streeter, 2009). SMS banking (or text banking) can complete a user's banking tasks by responding to text messages that are sent by the user, while WAP banking allows a user to browse a mobile version of web banking (Anonymous, 2010; Streeter, 2009). With the wide adoption of smart phones, such as the iPhone, Blackberry and HTC, a new type of mobile banking has emerged: mobile banking applications (apps) or app banking. After downloading mobile banking apps to their smart phones, users can not only manage their bank accounts but also can obtain additional functions such as locating nearby bank branches and ATMs (Scotiabank expands its suite of mobile banking apps, 2011).

Although mobile banking apps are gaining in popularity, the adoption rate remains low. A recent survey showed that less than two percent of bank customers have tried banking apps (J.D. Power, 2012). Perhaps for this reason, banking apps have not drawn much attention from IS researchers.

Online Banking and Mobile Banking Adoption and Diffusion

The potential benefits to banks, resulting from providing online and mobile banking, can only be obtained when self-service and value-added services are accepted

by its customers. This section reviews the literature on adoption of online banking and mobile banking.

Research based on the Technology Acceptance Model. The Technology Acceptance Model (TAM), which was proposed by Davis (1989), is one of the most cited theoretical frameworks used to explain user acceptance or adoption of information systems (Yaghoubi & Bahmani, 2010). Davis (1989) conceptualized two constructs, perceived ease of use (PEU) and perceived usefulness (PU), as the key determinants of user acceptance. Perceived ease of use is defined as "the degree to which a person believes that using a particular system would be free of effort," and perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320). Both of these constructs affect an individual's attitude towards using an information system. Furthermore, PEU also has an indirect effect on behavioural intention through PU and attitude.

A few studies have examined the relationships proposed in TAM in the context of online banking. Most supported the validity of TAM constructs and the theoretical relationships in this context (M.-C. Lee, 2009; Reid & Levy, 2008; Sanayei, Shaemi, & Salajegheh, 2011; Yaghoubi & Bahmani, 2010). However, research conducted by Mangin, Bourgault, Guerrero, and Egea (2011) in a Canadian online banking environment did not find a significant relationship between PEU and attitude, but the other relationships were supported.

Some researchers have investigated the direct relationships between PU and PEU and behavioural intention. Amin (2009) and Safeena, Abdullah, and Date (2010) found that both PU and PEU had significant positive effects on intention to adopt online

banking. In mobile banking, both Gu et al. (2009) and Rammile and Nel (2012) found significant impacts of PU and PEU on intention to adopt, and they also supported the indirect influence of PEU on adoption intention via PU. However, some other researchers found that PEU was not significantly related to intention to adopt online banking or mobile banking (Chan & Lu, 2004; A. Y.-L. Chong, Ooi, Lin, & Tan, 2010; Koenig-Lewis, Palmer, & Moll, 2010; Wessels & Drennan, 2010). A. Y.-L. Chong et al. (2010) claimed that this might be explained by the fact that the respondents in their online banking adoption study were relatively young (between ages 21 and 30), inferring that young people can learn new technology easily and ease of use was no longer a barrier to their adoption. In mobile banking, Wessels and Drennan (2010) explained this insignificant effect of PEU as the result of proficient utilization of mobile phones, indicating that familiarity with mobile devices and previous experience with other mobile services may create high level of perceived self-efficacy when using mobile banking services.

As Venkatesh and Davis (2000) and Venkatesh and Bala (2008) suggested, understanding the antecedents of PU and PEU would affect the design of interventions, and, consequently, would affect user acceptance of new information systems. In the context of online banking adoption, subjective norms (Chan & Lu, 2004), image (Chan & Lu, 2004), trust (Reid & Levy, 2008), computer self-efficacy (Reid & Levy, 2008), price (Mangin et al., 2011), convenience (Mangin et al., 2011), perceived risk (Chan & Lu, 2004), and performance risk (M.-C. Lee, 2009) were significantly related to PU, whereas trust (Reid & Levy, 2008) and computer self-efficacy (Chan & Lu, 2004; Reid & Levy, 2008) were antecedents of PEU.

In mobile banking, system quality (Gu et al., 2009), including perceived network speed and system stability, social influence (Gu et al., 2009), compatibility (Koenig-Lewis et al., 2010), perceived value (Rammile & Nel, 2012), and habits (Rammile & Nel, 2012) have been identified as antecedents of PU. Self-efficacy (Gu et al., 2009), facilitating conditions (Gu et al., 2009), compatibility (Koenig-Lewis et al., 2010), and awareness of mobile banking and its benefits (Rammile & Nel, 2012) have been found to affect PEU.

Research based on the Theory of Planned Behaviour. The Theory of Planned Behaviour (TPB) hypothesizes that an individual's actual behaviour in performing certain actions is influenced by his or her behavioural intention, which is affected by his or her attitude, subjective norms, and perceived behaviour control (Ajzen, 1985; Ajzen & Madden, 1986). Here, subjective norms is defined as "the person's belief that specific individuals or groups think he should or should not perform this behavior" (Ajzen, 1985, p.14), and perceived behaviour control is defined as "the person's belief as to how easy or difficult performance of the behavior is likely to be" (Ajzen & Madden, 1986, p. 457).

Empirical studies provide consistent support for the positive relationship between subjective norms and behavioural intention to adopt online banking (Amin, 2009; M.-C. Lee, 2009; Yaghoubi & Bahmani, 2010). Similarly, perceived behaviour control was found to be significantly related to behavioural intention (M.-C. Lee, 2009; Yaghoubi & Bahmani, 2010).

Research based on the Diffusion of Innovations Theory. Some other competing theories have been applied by researchers to understand the intention to adopt online banking. The Diffusion of Innovations Theory (DOI) identifies five factors that affect

adoption of technological innovations. Relative advantage is defined as "the degree to which an innovation is superior to ideas it supersedes" (Rogers, 1962, p. 124). Compatibility refers to "the degree to which an innovation is consistent with existing values and past experiences of the adopters" (Rogers, 1962, p. 126). Complexity is "the degree to which an innovation is relatively difficult to understand and use" (Rogers, 1962, p. 130). Divisibility, which is called trialability by other researchers, is defined as "the degree to which an innovation may be tried on a limited basis" (Rogers, 1962, p. 131). Communicability, which is also known as observability, refers to "the degree to which the results of an innovation may be diffused to others" (Rogers, 1962, p. 132).

Al-Majaliand and Mat (2011) found that these five innovative factors could successfully explain online banking adoption. W.-H. Wang (2010) examined the relationships between innovative attributes and attitude, finding that only relative advantage, compatibility, and trialability were significantly associated with attitude towards adopting online banking. In mobile banking, compatibility to lifestyle was also found to significantly influence intention to use (Wessels & Drennan, 2010).

Research based on the Unified Theory of Acceptance and Use of Technology. The Unified Theory of Acceptance and Use of Technology (UTAUT) was proposed by Venkatesh, Morris, Davis, and Davis (2003) in order to unify multiple models and theories. UTAUT hypothesizes that performance expectancy, effort expectancy, social influence, and facilitating conditions, which are moderated by gender, age, voluntariness, and experience, are direct determinants of user acceptance (Venkatesh et al., 2003).

Existing studies on online banking adoption do not provide consistent support for the relationships proposed in UTAUT. Foonand and Fah (2011) tested the four

determinants of user acceptance, finding that all of them were significantly related to intention to adopt online banking. However, Yuen, Yeow, Lim, and Saylani (2010) found only attitude and performance expectancy significantly impacted behavioural intention even though they tested all factors included in UTAUT.

Other determinants of online banking and mobile banking adoption. M.-C. Lee (2009) found that perceived benefits of using online banking, such as faster transaction speed and lower transaction handling fees, positively influenced the intention to adopt online banking. Research conducted by Safeena et al. (2010) revealed that awareness of the existence of an online banking service and its potential advantages would lead to greater intention to adopt online banking.

Trust and perceived credibility, which refer to the extent to which an individual perceives that security and privacy are protected, have been found to significantly affect intention to use online banking (Al-Majali & Mat, 2011; Amin, 2009; A. Y.-L. Chong et al., 2010; Sanayei, Shaemi, & Salajegheh, 2011). M.-C. Lee (2009) and Safeena et al. (2010) found that perceived risk was an obstacle to online banking adoption. Through investigating different dimensions of perceived risk, M.-C. Lee (2009) further found that financial risk and security risk affected the intention to adopt online banking, and performance risk and time risk negatively influenced attitude.

Researchers have also explored other possible determinants of intention to use mobile banking. Perceived risk, trust, and perceived cost have been found to be direct indicators of behavioural intention to adopt mobile banking (Gu et al., 2009; Koenig-Lewis et al., 2010; Wessels & Drennan, 2010). Gu et al. (2009) found that trust

was driven by situation normality, structural assurance (e.g., legal guarantees and regulations), and calculative-based trust (rational assessments of costs and benefits).

Integrated models for mobile banking adoption. In order to obtain a deeper understanding of the intention to use/reuse mobile banking, researchers have tried to come up with more comprehensive frameworks by integrating different theories and models.

H.-F. Lin (2011) proposed a theoretical model based on diffusion of innovation theory and the knowledge-based trust literature. H.-F. Lin (2011) hypothesized that three dimensions of knowledge-based trust (i.e., perceived competence, perceived benevolence and perceived integrity) and three innovation attributes (i.e., perceived relative advantages, perceived ease of use and perceived compatibility) affect attitude towards adoption, which further determines behavioural intention to adopt. All the hypotheses were supported except for the relationship between perceived benevolence and attitude.

Zhou, Lu, and Wang (2010) integrated TTF (task-technology fit) and UTAUT to explain mobile banking adoption by arguing that user adoption was determined not only by users' perceptions and attitude but also by a good task and technology fit. Their research revealed that both task characteristics and technology characteristics impacted task-technology fit, which in turn determined user adoption. Furthermore, performance expectancy, being affected by task-technology fit, social influence, and facilitating conditions, was significantly associated with user adoption, but effort expectancy had no effect on adoption intention.

Püschel et al. (2010) proposed an integrated framework based on social psychology, innovation diffusion, and technology adoption theories. Their theoretical

framework is displayed in Figure 1. The model was tested twice by two sets of data that were collected from mobile banking adopters and non-adopters. For non-adopters, six out of 13 paths were found to have large or medium effects. For adopters, however, only three paths showed medium or large effects and their model only explained 22% of the variance. Tables 10 and 11 summarize all the relationships that have been investigated in the previous literature on online banking and mobile banking adoption.

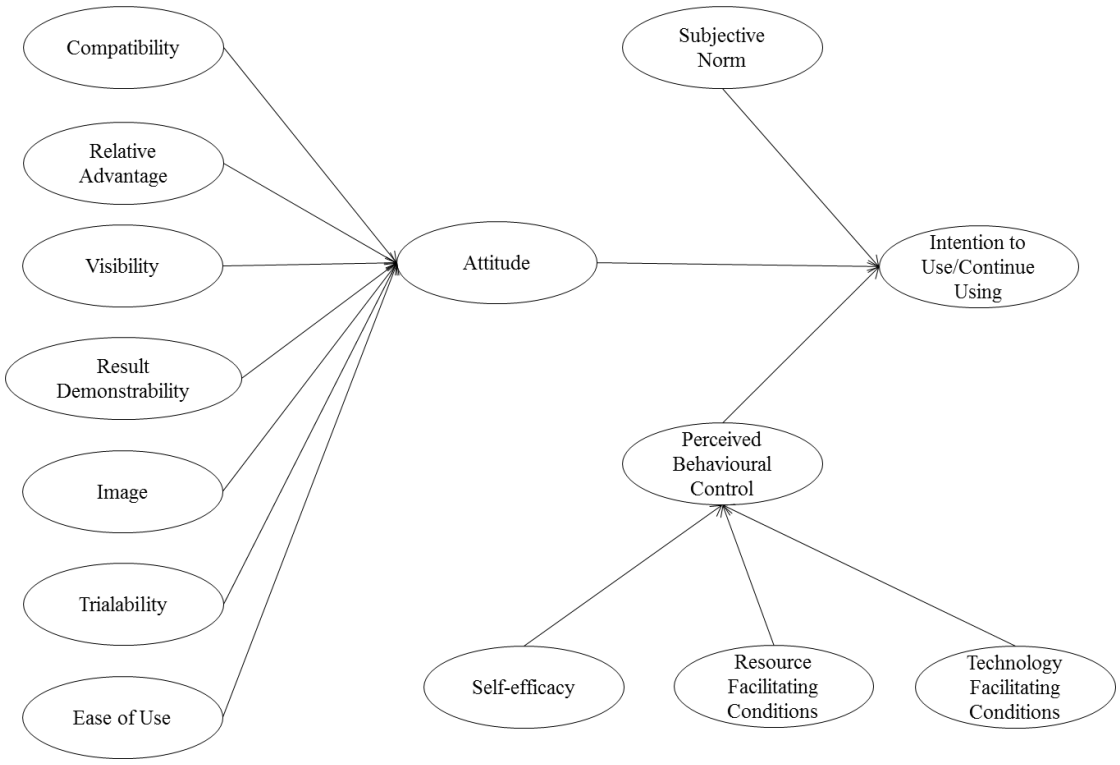


Figure 1. Integrated framework by Püschel et al. (2010, p. 393)

Table 10. Empirical Studies on Online Banking Adoption

Studies	Context	Participants	Findings
Al-Majali and Mat (2011)	Online banking	532 university employees	PU, PEU, compatibility, trialability, trust, and awareness had significant impacts on intention to use.
Amin (2009)	Online banking	206 bank customers	PU, PEU, perceived credibility, and social norms had positive impacts on intention to use, but perceived enjoyment was not found to significantly affect intention to use.
Chan and Lu (2004)	Online banking	499 students	Intention to use was influenced by PU and subjective norms, but PEU was found to be insignificant in affecting intention to use. Personal image and result demonstrability affected PU, while computer self-efficacy affected PEU.
A.Y.-L.Chong et al. (2010)	Online baking	103 bank customers	PU, trust, and government support had impacts on intention to use. However, PEU did not significantly affect intention to use.
Foon and Fah (2011)	Online banking	200 participants	Performance expectancy, effort expectancy, social influence, facilitating condition, and trust positively impacted intention to continue using.
M.-C. Lee (2009)	Online banking	368 bank customers	Intention to use was significantly affected by perceived PEU, PE, attitude, benefit, social norms, perceived behaviour control, financial risk, and security risk. PEU also impacted intention to use through PU. Performance risk, time risk, financial risk, and security risk had indirect impacts on intention to use through attitude.
Mangin et al. (2011)	Online banking	226 students	PU and PEU had significant impacts on attitude, which in turn affected intention to use. PU also had direct impacts on intention to use. Price and convenience were found to be antecedents of PU.
Reid and Levy (2008)	Online banking	374 bank customers	PU and PEU affected attitude which further influenced intention to use, and PEU also indirectly impacted attitude through PU. In addition, PU directly impacted intention to use. Trust was found to be an antecedent of PU and PEU, and computer self-efficacy was found to be an antecedent of PU only.

(Table 10 continues)

(Table 10 continued)

Studies	Context	Participants	Findings
Safeena et al. (2010)	Online banking	53 students	PEU, PU, awareness, and perceived risk significantly influenced intention to use.
Sanayei, Shaemi, and Salajegheh, (2011)	Online banking	247 bank customers	PU, attitude, and trust had direct impacts on intention to use. Trust, PU, and PEU indirectly impacted intention to use through attitude. PEU had positive impacts on PU which further impacted trust. In addition, intention to use was found to have significant impacts on actual use.
W.-H. Wang (2010)	Online banking	1050 forum users	Intention to use was directly impacted by attitude and experience. Relative advantage, compatibility, trialability, and security had indirect impact on intention to use through attitude, but not complexity and observability.
Yaghoubi and Bahmani (2010)	Online banking	349 bank customers	Perceived behavioural control, subjective norms, attitude, and PU significantly influenced intention to use. PEU had indirect impacts on intention to use through attitude and perceived usefulness.
Yuen et al. (2010)	Online banking	1050 Internet users in the US, Australia, and Malaysia	Attitude and performance expectancy significantly affected intention to use. Perceived credibility only played a significant role in affecting intention to use in developed countries. Effort expectancy, anxiety, social influence, facilitating conditions, and self-efficacy did not affect intention to use in either developed or developing countries.

Table 11. Empirical Studies on Mobile Banking Adoption

Studies	Context	Participants	Findings
Gu et al. (2009)	Mobile banking	910 users	PU, PEU, and trust significantly affected behavioural intention. PEU and trust also indirectly influenced behavioural intention through PU. Social influence and system quality were antecedents of PU; self-efficacy, facilitation conditions, and situational normality were antecedents of PEU; and situational normality, structural assurances, and calculative-based trust were antecedents of trust.
Kang et al. (2009)	Mobile banking	185 users	Continue using was affected by perceived usability, perceived value, and channel preference. Perceived usability was impacted by menu design, while perceived value was impacted by perceived usability, fees, and functional coverage.
Koenig-Lewis et al. (2010)	Mobile banking	155 participants (including users and non-users)	PU, compatibility, and risk had significant impacts on behavioural intention. However, perceived cost, PEU, credibility, and trust did not significantly affect behavioural intention, but trust indirectly affected behavioural intention through risk. Compatibility was found to have significant impacts on PU, PEU, and credibility.
H.-F. Lin (2011)	Mobile banking	368 participants (including users and non-users)	PEU, perceived relative advantage, perceived compatibility, and two dimensions of knowledge-based trust (perceived competence and perceived integrity) had significant impacts on attitude, which further affected behavioural intention.

(Table 11 continues)

(Table 11 continued)

Studies	Context	Participants	Findings
Puschel et al. (2010)	Mobile bankings	333 users and 333 non-users	The research model included 13 paths. For non-users, four paths out of 13 had large or medium effects (i.e., attitude → intention, technology facilitation condition → perceived behavioural control, self-efficacy → perceived behavioural control, and relative advantage → attitude). For users, three paths had large or medium effects (i.e., self-efficacy → perceived behavioural control, technology facilitating condition → perceived behavioural control, and PEU → attitude).
Rammile and Nel (2012)	Mobile banking	288 non-users	PU and PEU had significant impacts on behavioural intention, and PEU indirectly affected behavioural intention through PU. Value barrier and tradition barrier were found to be antecedents of PU, while usage barrier and information barrier were found to be antecedents of PEU.
Wessels and Drennan (2010)	Mobile banking	314 participants	Intention to use was affected by PU, attitude, cost, and compatibility. Except for PEU and need for interaction, PU, perceived risk, cost, and compatibility indirectly impacted intention to use through attitude.
Zhou (2013)	Mobile banking	200 users	Intention to use was affected by trust and flow, and intention to use further affected actual usage. Trust was influenced by structural assurance, ubiquity, and PEU. Flow was affected by ubiquity, PEU, personal innovativeness, and trust.
Zhou et al. (2010)	Mobile banking	250 WAP banking users	Performance expectancy, effort expectancy, social influence, facilitating conditions, and task technology fit had significant impacts on user adoption. Task characteristics and technology characteristics affected task technology fit. Technology characteristics had impacts on effort expectancy and task technology fit had impacts on performance expectancy.

Post-adoption of mobile banking. In addition to the adoption research that has been discussed above, some studies were conducted to explore post-adoption states. Chan and Lu (2004) studied factors that influenced intention to continue using online banking. Gu et al. (2009), Püschel et al. (2010), and Kang et al. (2012) also examined users' intentions to continue using mobile banking services. By measuring self-reported frequency of use, Zhou (2012) found a significant relationship between intention to continue using and actual use of mobile banking. Similarly, Sanayei, Shaemi, and Salajegheh (2011) found a significant relationship between willingness to use and actual use in online banking.

Sanayei, Ranjbarian, Shaemi, and Ansari (2011) investigated customer loyalty as an outcome of mobile banking adoption. They found that satisfaction mediated the effects of security, customization, ease of use, responsiveness and perceived risk on loyalty. Customization and perceived risk also had direct impacts on customer loyalty, but usefulness did not show a significant influence on either satisfaction or loyalty.

Sanayei, Shaemi and Jamshidi (2011) investigated the relationships among system quality, information quality, interface design quality, trust, and satisfaction in mobile banking. Their study revealed that system quality and information quality were significantly related to both trust and satisfaction, and trust would further affect satisfaction. However, interface design was not a significant indicator of customer satisfaction, suggesting that the utilitarian nature of mobile banking might minimize the effect of design quality on satisfaction and loyalty.

Service Quality of Online Banking

Given the rigorous competitive pressures within the financial service industry, service quality differentiation is one of the primary strategies that can keep a bank competitive (Yang et al., 2004; Yuen et al., 2010). Offering excellent service quality is believed to be an effective approach to retain existing bank customers and attract new ones (Siu & Mou, 2005; Yang et al., 2004; Yu, 2008). The importance of online banking service quality has led researchers to investigate the components of online banking service quality and its outcomes.

SERVQUAL instrument. SERVQUAL is the most cited measure for evaluating service quality and has been used in numerous service contexts (Ramseook-Munhurrun & Naidoo, 2011; Siu & Mou, 2005; Yang et al., 2004). The SERVQUAL instrument has 22 items within five dimensions (Parasuraman, Zeithaml, & Berry, 1988):

Tangibles: Physical facilities, equipment, and appearance of personnel,

Reliability: Ability to perform the promised service dependably and accurately,

Responsiveness: Willingness to help customers and provide prompt service,

Assurance: Knowledge and courtesy of employees and their ability to inspire trust and confidence, and

Empathy: Caring, individualized attention the firm provides its customers

Dimensions of online banking service quality. The SERVQUAL instrument has been adopted by IS researchers to evaluate the quality of services that are provided by IT departments or IT personnel (Pitt, Watson, & Kavan, 1995). However, SERVQUAL might not be suitable to measure online banking service quality because (1) services provided by IT departments or personnel focus on the interpersonal interactions between

customers and service providers while online services focus on network-based impersonal interactions (Michel, Ashill, Shao, & Carruthers, 2009); and (2) service quality dimensions tend to be context-sensitive and service-type dependent (Yang et al., 2004). Therefore, researchers have attempted to investigate other dimensions of service quality for online banking.

Ease of use. Ease of use has been found to be an influential attribute of online banking service quality (Yu, 2008). Although Shamdasani, Mukherjee, and Malhotra (2008) did not find that ease of use significantly impacted consumer evaluation of online banking service quality, other researchers found it was a strong predictor of the overall service quality (Al-Hawari, 2011; Kassim & Abdullah, 2010; Khurana, 2009; Raman, Stephenaus, Alam, & Kuppusamy, 2008; Ramseook-Munhurrun & Naidoo, 2011; Yang et al., 2004; Yu, 2008).One reason for these conflicting results is that researchers have interpreted and measured ease of use from different perspectives. For example, some researchers claimed that ease of use was related to ease of navigation (Foon & Fah, 2011; Kassim & Abdullah, 2010; Khurana, 2009; Raman et al., 2008; Ramseook-Munhurrun & Naidoo, 2011). Others included understandable content (Raman et al., 2008; Ramseook-Munhurrun & Naidoo, 2011; Yang et al., 2004; Yu, 2008) or the ease of completing banking transactions (Ajzen, 1985; Yang et al., 2004; Yu, 2008) as measures of ease of use.

Reliability. Reliability has been found to be another important element of online banking service quality (Jayawardhena, 2004; Khurana, 2009; Raman et al., 2008; Ramseook-Munhurrun & Naidoo, 2011; Shamdasani et al., 2008; Siu & Mou, 2005; Yang et al., 2004; Yu, 2008). Online banking reliability has generally been defined as

delivering banking services and information accurately via websites (Foon & Fah, 2011; Khurana, 2009; Raman et al., 2008; Shamdasani et al., 2008; Yang et al., 2004), and whether the online banking websites load properly (Shamdasani et al., 2008).

User interface. User interface has been found to have significant impact on service quality in the context of online banking (Al-Hawari, 2011; Jayawardhena, 2004; Kassim & Abdullah, 2010; Raman et al., 2008). This dimension has been given different names. For example, Al-Hawari (2011) called it "e-escape," while Raman et al. (2008) called it "appearance." User interface involves the content, organization, and structure of online banking sites (Kassim & Abdullah, 2010).

Security. Security is believed to be an important element in e-commerce settings (Kassim & Abdullah, 2010). Security is associated with the perceived risks that relate to online transactions, such as threats to privacy (Yang et al., 2004). Security has been included as a dimension of online banking service quality in many studies (Al-Hawari, 2011; Kassim & Abdullah, 2010; Khurana, 2009; Ramseook-Munhurrun & Naidoo, 2011; Siu & Mou, 2005; Yang et al., 2004; Yu, 2008). Siu and Mou (2005) and Yu (2008) found that security was the most influential factor in determining service quality. The research conducted by Khurana (2009) revealed that privacy of personal information was one of the core service quality dimensions of online banking.

In contrast, Yang et al. (2004) found that security was insignificant in determining overall service quality in online banking. Their exploratory content analysis revealed that most of the respondents were accustomed to online transactions, and not overly concerned about security issues.

Responsiveness. Responsiveness refers to the prompt response to customers' requirements (Parasuraman et al., 1988). Although banking services are delivered via banking websites, customers still expect quick responses from customer service to deal with problems related to online banking (Yang et al., 2004). Al-Hawari (2011), Kassim and Abdullah (2010), Khurana (2009), Siu and Mou (2005), Yang et al. (2004), and Yu (2008) included responsiveness as one of their online banking service quality dimensions. However, the study conducted by Yu (2008) showed that responsiveness had less impact on system service quality than security and reliability.

Efficiency. Another determinant of online banking service quality is efficiency. Efficiency refers to the loading speed of the websites and how long it takes to find desired information or services (Siu & Mou, 2005). Several studies have adopted it to evaluate online banking service quality (Khurana, 2009; Shamdasani et al., 2008; Siu & Mou, 2005).

Range of service. Studies have shown that the range of online services is important in overall online banking service quality (Jayawardhena, 2004; Michel et al., 2009; Yang et al., 2004; Yu, 2008). Yang et al. (2004) found that online customers prefer firms that provide diverse services, and the fulfillment of diverse needs could lead to customer satisfaction and loyalty. For this reason, a wide range of financial services and diverse features are crucial in attaining high online banking service quality (Michel et al., 2009).

Other dimensions of online banking service quality. Some other service quality dimensions have been examined by previous studies. Customization has been included as one dimension of online banking service quality (Al-Hawari, 2011). Jayawardhena (2004)

measured the effect of prompt and informative service on trust. Yang et al. (2004) and Yu (2008) measured employees' ability to answer customers' questions and to solve their problems as a part of competence. Shamdasani et al. (2008) found that perceived enjoyment and perceived control were significantly related to service quality of online banking. In addition, Raman et al. (2008) included incentives (e.g., encouragement) from a bank as one measurement of service quality.

Categorizing dimensions of online banking service quality. As can be seen from the above discussion, there is a lack of consensus on measuring online banking service quality in the existing literature. Some researchers have attempted to group related attributes of service quality.

A content analysis conducted by Yang et al. (2004) identified 17 dimensions of online banking service quality, and they were sorted into three groups: ten dimensions within customer service quality (i.e., responsiveness, reliability, competence, access, personalization, courtesy, continuous improvement, communication, convenience, and control), six dimensions within online system quality (i.e., ease of use, accuracy, security, content, timeliness, and aesthetics); and one dimension of product portfolio.

Yu (2008) conceptualized two constructs of online banking service quality: banking service quality and system service quality. Banking service quality included ease of use, competence, and service variety, while system service quality included security, reliability, and responsiveness.

Michel et al. (2009) adopted three broad conceptual categories related to online banking service quality: online consumer service quality, online information system quality, and banking service product quality. Online customer service quality was

measured by reliability, responsiveness, tangibility, and empathy; online information system quality was measured by aesthetics, timeliness, contents, ease of use, security, and accuracy; and banking service product quality was measured by the range of services, features, functions, menu, and cost of online service.

Outcomes of service quality. Along with investigating antecedents or dimensions of online banking service quality, researchers have also examined the outcomes of service quality. After examining five aspects of service quality, Kassim and Abdullah (2010) found that ease of use, web design, and assurance led to satisfaction. They further found that satisfaction had a positive impact on customer loyalty and customer trust towards a bank.

Shamdasani et al. (2008) found that four dimensions of service quality (i.e., speed, reliability, enjoyment, and control) can enhance customer satisfaction, perceived value of online banking, and intention to continue using online banking.

When examining the effects of four service quality dimensions (i.e., reliability-responsiveness, security, ease of use, and accessibility), Ramseook-Munhurrun and Naidoo (2011) found that reliability-responsiveness, security, and ease of use were significantly related to intention to continue using and intention to recommend online banking services. In addition, they found reliability-responsiveness and accessibility were related to satisfaction, which in turn affected intention to continue using and recommending the service to others.

Research conducted by Siu and Mou (2005) revealed that efficiency and security significantly influenced future consumption behaviour (e.g., purchase other financial products or services). Raman et al. (2008) claimed that the service quality measured by

ease of use, appearance, reliability, customization, and incentives affected the adoption of online banking.

Al-Hawari (2011) found that e-escape (or user interface), e-responsiveness and security were related to a bank's brand image, and e-escape and security were related to brand awareness. Brand image and awareness also affect brand loyalty.

Information Systems Success

DeLone and McLean IS Success Model. As noted by DeLone and McLean (1992), a rich body of research has been conducted to identify different aspects of IS success, but the diverse approaches used make result comparison and knowledge accumulation difficult. Building on Shannon and Weaver's (1949) study on communication, Mason's (1978) work on information influence, and other literature, DeLone and McLean (1992) proposed a comprehensive and multidimensional IS Success Model. Their taxonomy of IS success consists of six dimensions: system quality, information quality, use, satisfaction, individual impact, and organizational impact. The six dimensions reflect three levels of IS success: technical (i.e., system quality), semantic (i.e., information quality), and effectiveness (i.e., use, satisfaction, individual impact, and organizational impact).

System quality focuses on the desired characteristics of information systems, and information quality measures the quality of information output that systems produce. The interactions among the information system, its output, and its users are measured by use and user satisfaction, which, in turn, influence individual and organizational performance. DeLone and McLean (1992) noted that even though the six dimensions reflect different

aspects of IS success, they are interrelated and interdependent. Figure 3 presents the DeLone and McLean IS Success Model.

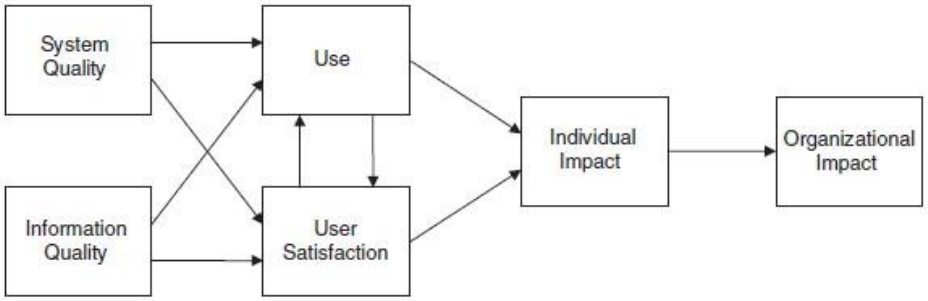


Figure 2. DeLone and McLean IS Success Model (1992, p. 87)

Updated DeLone and McLean IS Success Model. Ten years after DeLone and McLean proposed the original IS Success Model, they refined it based on a review of literature that had validated, modified, and critiqued their original IS Success Model. Pitt et al. (1995) noted that DeLone and McLean's measures of IS success that emphasized the IS function had largely ignored the importance of the IS department or IS personnel in assisting users with various tasks (e.g., installation, problem resolution, and software education). To respond to this criticism, DeLone and McLean incorporated service quality, which is measured by a subset of the SERVQUAL instrument, into their updated model (DeLone & McLean, 2003).

Another update deals with the criticism that the impacts of IS could affect other entities in addition to individuals and organizations (DeLone & McLean, 2003; Petter, Delone, & McLean, 2008). In the updated model, individual impact and organizational impact are replaced by a single construct named net benefits. Net benefits captures the impacts of IS on different entities (i.e., customers, suppliers, employees, organizations, markets, industries, and even societies) (DeLone & McLean, 2003). DeLone and McLean

specifically mentioned that "the challenge for the researcher is to define clearly and carefully the stakeholders and context in which 'net benefits' are to be measured" (2003, p. 23). Thus, researchers should consider "what qualifies as a benefit? for whom? and what level of analysis?" (DeLone & McLean, 2003, p. 22).

The last update was to propose intention to use as an alternative to use. Since "use" could have multiple aspects, intention to use could be more appropriate in some contexts (e.g., mandatory usage) (DeLone & McLean, 2003). They further claimed that the updated IS Success Model is also suitable to assess success of e-commerce. Figure 4 shows the Updated DeLone and McLean IS Success Model.

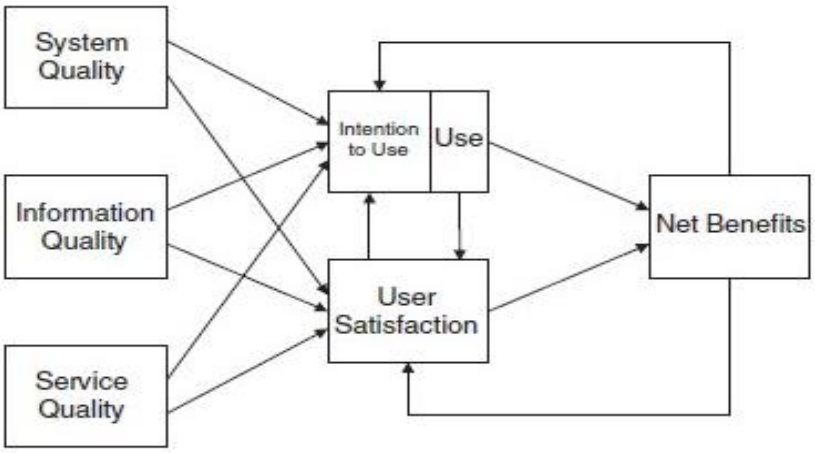


Figure 3. Updated DeLone and McLean IS Success Model (2003, p. 24)

Empirical studies using DeLone and McLean IS Success Model. Even though DeLone and McLean (1992, 2003) repeatedly emphasized that IS success is a multidimensional construct and called for validation of the theoretical framework, little research has been done to empirically test the entire model and only a few studies tested or modified a portion of this framework.

Chong, Cates, and Rauniar (2010) tested the entire updated DeLone and McLean Model in the Business to Customer (B2C) student loan industry. Their study included all

the relationships proposed in the updated model except for the feedback loops from net benefits to use and satisfaction. By running the Structural Equation Model twice, they supported the strong and significant bidirectional relationship between use and satisfaction. They also found that satisfaction had a stronger impact on net benefit than use. However, system quality did not have significant influence on either use or satisfaction.

A few studies have investigated some success dimensions adopted from DeLone and McLean's framework and suggested modifications within certain research contexts. Some of those studies focus on the extensions of technical or semantic level success so that characteristics relevant to a certain context can be represented and investigated. In a study of e-commerce (Wu, 2007), relationship quality was included along with three other quality constructs and satisfaction. Halawi et al. (2007) replaced information quality and net benefits with knowledge quality and success when assessing the success of knowledge management systems. In the context of mobile workers in healthcare, Chatterjee et al. (2009) replaced information quality with content quality (or nature of work), arguing that the characteristics of healthcare work, such as time pressure and task complexity, also play an important role.

Other modifications involved investigating net benefits. Studying the success of virtual communities, H.-F. Lin (2008) suggested member loyalty as a net benefit, claiming that loyalty was a more appropriate indicator of virtual community effectiveness. In this study, information quality and system quality were found to affect satisfaction, which in turn determined loyalty. In another study conducted by Y.-S. Wang (2008), perceived value and intention to continue using were treated as net benefits. Floropoulos,

Spathis, Halvatzis, and Tsipouridou examined perceived usefulness as a benefit of using information systems, claiming that "if a system is used, it must be useful, and therefore successful" (2010, p. 50).

Corporate Reputation

Definition of corporate reputation. There are different definitions for corporate reputation, including reputation as awareness, assessment, and asset (Barnett, Jermier, & Lafferty, 2006). Brown, Dacin, Pratt, and Whetten (2006) suggest a unifying terminology (see Table 10) that distinguishes among corporate associations (i.e., identity, image, and reputation). In their terminology, corporate reputation is defined as "a perception of the organization actually held by an external stakeholder" (Brown et al., 2006, p. 104).

Table 12. Unifying Terminology (Brown et al., 2006)

Construct	Description	Viewpoint
Identity	Mental associations about the organization held by organizational members	"Who are we as an organization?"
Intended image	Mental associations about the organization that organization leaders want important audiences to hold	"What does the organization want others to think about the organization?"
Construed image	Mental associations that organization members believe others outside the organization hold about the organization	"What does the organization believe others think of the organization?"
Reputation	Mental associations about the organization actually held by others outside the organization	"What do stakeholders actually think of the organization?"

Realizing that different stakeholder groups might hold different values and perceive a firm's reputation differently, Walsh and Beatty (2007) studied corporate reputation from the customer's perspective. They defined customer-based reputation as the "customer's overall evaluation of a firm based on his or her reactions to the firm's

goods, services, communication activities, interactions with the firm and/or its representatives or constituencies (such as employees, management, or other customers) and/or known corporate activities" (Walsh & Beatty, 2007, p. 129).

Dimensions of corporate reputation. Walsh and Beatty (2007) found five dimensions of customer perceived corporation reputation for service firms (e.g., banks): customer orientation, good employer, reliable and financially strong company, product and service quality and social and environmental responsibility. For banking services, Sabate and Puente (2003) proposed that bank customers perceive a bank's reputation from four perspectives: quality of financial services, technological innovation, innovation in the product catalogue, and financial transparency.

Not only academia but business magazines have employed different criteria to assess corporate reputation. When creating the World's Most Admired Companies' List, *Fortune*, an American magazine, evaluates nine attributes of corporate reputation: financial soundness; long-term investment value; use of corporate assets; innovativeness; quality of the company's management; quality of its products and services; ability to attract, develop, and keep talented people; acknowledgement of social responsibility; and global competitiveness (The world's most admired companies, 2013).

Antecedents of corporate reputation. Customer satisfaction has been viewed as an antecedent of corporate reputation. Walsh, Mitchell, Jackson, and Beatty (2009) found customer satisfaction can impact the reputation of an energy supply company. This relationship has also been supported in agricultural and industrial companies (Carmeli & Tishler, 2005).

Some research has examined the influence of corporate reputation on customer satisfaction. In a Business-to-Business (B2B) context, corporate reputation affects customer satisfaction (Miremadi, Babakhani, Yousefian, & Fotoohi, 2011). In other service firms (e.g., banks), this relationship has also been found valid (Walsh & Beatty, 2007).

In addition to customer satisfaction, perceived product or service quality has been examined as an antecedent of corporate reputation in a B2B context (Miremadi et al., 2011). When investigating bank reputation, Y. Wang, Hing, and Hui (2003) found that both product quality and service quality impact a bank's reputation. Research conducted by Caruana and Ewing (2010) also indicated that the reputation of online venders is impacted by customer service quality.

Outcomes of corporate reputation. Corporate reputation has been found to impact customer loyalty and customer's positive word of mouth for service firms (Walsh et al., 2009). This relationship is also supported in the B2B market (Miremadi et al., 2011). In retail banking industry, Clemes, Gan, and Zhang (2010) found that a strong bank reputation can reduce customer switching behaviours. In electronic marketing places, reputation of websites or online vendors was found to influence customer online loyalty (Caruana & Ewing, 2010; Casaló, Flavián, & Guinalíu, 2008).

Limitations in Previous Literature

Several limitations and gaps can be identified based on the above literature review. First, mobile banking, as a newer electronic banking channel, has not yet received as much attention as its online counterpart. While online banking and mobile banking share some common characteristics, there are key differences that merit research focusing on the mobile environment.

Second, when conducting research on mobile banking, most researchers have ignored the fact that mobile banking has multiple channels. For example, Scotiabank, one of the major banks in Canada, claims that its mobile banking services can be approached via three ways: text banking, browser banking, and app banking (Scotiabank, n.d.). Previous studies in mobile banking, however, did not indicate which type of mobile banking was under investigation. This is problematic, especially given the finding from Curran and Meuter (2005) that different banking channels (i.e., ATMs, telephone banking, and online banking) have significantly different adoption patterns.

Third, as noted in our literature review, only a few studies have investigated intention to continue using mobile banking by integrating constructs from different theories (e.g., TPB and DOI). However, constructs adopted from TPB and DOI did not have a large effect on intention to continue using (Püschel et al., 2010). Therefore, it is useful to test another theory, such as the IS Success Model, to investigate whether it could better explain intention to continue using. Knowing which characteristics of app banking are important and contribute to user satisfaction may help banks identify potential improvements.

Fourth, although DeLone and McLean (2003) have claimed that their updated model is suitable to assess the success of e-commerce, whether this model can be successfully applied in the mobile environment is yet to be studied. Thus, it is useful to examine this framework in the mobile context.

Fifth, in the decade since DeLone and McLean (2003) published their updated model, operationalization of each success dimension, especially for the three quality constructs, remains inconsistent. Appendix B summarizes the diverse measures of service quality, information quality, and service quality in the recent literature. Furthermore, how to operationalize IS success dimensions in the domain of mobile information systems is still not clear. Thus, the appropriate dimensions to assess success of mobile information systems (i.e., mobile banking applications) need to be determined.

Last, as DeLone and McLean suggested, "'net benefits' measures must be determined by context and objectives for each e-commerce investment" (2003, p. 25). Therefore, what the benefits are and for whom are questions worth investigating in the context of app banking.

Contributions

Based on the previous discussion, the present research will specifically study mobile banking apps. By empirically examining the success of mobile banking apps using the updated DeLone and McLean (2003) IS Success Model, the present study will be one of the few to test this model in a mobile environment. Building on the DeLone and McLean Updated IS Success Model, we will capture various characteristics of app banking at the technical, semantic, and service levels. Consequently, key factors will be identified to improve app banking.

In addition, this study will contribute to how to properly operationalize system quality, information quality, and service quality of banking apps. Based on our content analysis and literature review, operationalization of the above constructs will reflect this specific research context. We will also investigate “benefits” of app banking based on the findings from our content analysis. Last, we will empirically test the research model and the measurements using banking app users in Canada.

Chapter 4: Theoretical Model and Hypotheses Development

In the previous section, we discussed the limitations found in the IS literature on mobile banking adoption and how these limitations could be addressed. In this section, we will propose a theoretical model and hypotheses that aim to extend IS research in this area.

The present study is mainly driven by a content analysis and the IS Success literature. This study proposes a multidimensional theoretical model to evaluate success of mobile banking apps based on the DeLone and McLean (2003) Updated IS Success Model.

As identified by our content analysis, perceived innovativeness should be incorporated into the theoretical model as one of the dimensions of mobile banking app success. Perceived innovativeness and user satisfaction that result from qualities of banking apps will impact users' intentions to continue using banking apps. The proposed theoretical model, to be developed in this chapter, is displayed in Figure 4. In addition, operationalization of exogenous variables (e.g., system quality) also reflects key technical characteristics that were revealed in the content analysis.

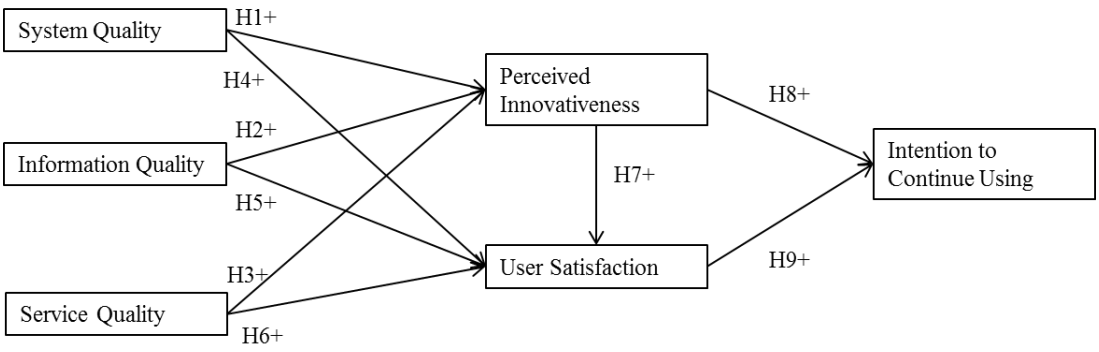


Figure 4. Theoretical Model

Exogenous Construct: System Quality

DeLone and McLean (2003) note that system quality reflects the desired technical characteristics of information systems and suggest that system quality has sub-dimensions such as usability, availability, reliability, adaptability, and response time. Researchers have selected different sub-dimensions to assess system quality in different research contexts. For example, system quality of open-source enterprise information systems has been operationalized by response time, ease of use, and usefulness (S. M. Lee & Lee, 2012). In e-commerce, system quality was assessed by ease of use (Y.-S. Wang, 2008).

In this study, we propose that system quality of mobile banking apps can be operationalized by reliability, ease of use, interface, response time, security, and functionality. Reliability, interface, response time, and functionality were identified as key system characteristics in the content analysis. Ease of use and security are also included because these dimensions are believed to be what bank customers want for their banking apps (Camhi, 2012).

Some other system characteristics that have been investigated in previous studies have been excluded from the present study. For example, availability was suggested as a sub-dimension of system quality by DeLone and McLean (2003), but availability is not an issue with banking apps as they can be downloaded free from online app stores and are easily found using links on bank web sites.

Adaptability is not included either because adaptability is a complicated issue in the mobile computing environment. Our content analysis found that adaptability is related to both different mobile devices and different mobile operating systems for each device.

Usefulness has been examined as a sub-dimension of system quality in a few studies (H. Chong et al., 2010; S. M. Lee & Lee, 2012), but it has been treated as the outcome of system quality in other research (Floropoulos et al., 2010; Seddon, 1997). In addition to the above inconsistency, usefulness might not result in variances in this study. Mobile banking apps are utilitarian applications so being useful is the basic assumption made by users. Therefore, we decide to exclude usefulness from the theoretical model.

Reliability. Reliability refers to "the probability that the system remains successful (does not fail) in achieving its intended objectives within a given period of time and under a given set of conditions" (Zahedi, 1987, p. 188). DeLone and McLean (2003, 2004) suggest that reliability is a sub-dimension of system quality. Other empirical studies in IS Success have also included reliability as a sub-dimension of system quality (H. Chong et al., 2010; Floropoulos et al., 2010; H.-F. Lin, 2008).

Reliability was found to be significantly related to overall service quality of online banking (Khurana, 2009; Shamdasani et al., 2008; Yang et al., 2004). Shamdasani et al. (2008) also found that reliability indirectly influenced satisfaction and intention to continue using online banking through service quality.

For banking apps, the content analysis revealed that reliability is the major concern of reviewers. Many reliability issues have been reported, including blank screens, frozen pages, system crashes, and login/logout problems.

Ease of use. Ease of use is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320) and is one aspect of system quality (DeLone & McLean, 2004; Seddon, 1997). Other studies on IS Success have also included ease of use to measure system quality (H. Chong et al., 2010; S. M.

Lee & Lee, 2012; Rai, Lang, & Welker, 2002; Y.-S. Wang, 2008). Ease of use has also been found to be significantly related to intention to use online banking (Amin, 2009; Reid & Levy, 2008; Safeena et al., 2010) and user satisfaction with mobile banking systems (Sanayei, Ranjbarian, et al., 2011).

Some researchers have argued that ease of use is no longer important due to users' high self-efficiency in learning and using new technologies (A. Y.-L. Chong et al., 2010; Wessels & Drennan, 2010). The content analysis, however, shows that 28 reviewers made comments on ease of use when evaluating mobile banking apps. Therefore, making banking apps easy to use might be important to enhance user satisfaction and intention to continue using banking apps.

User interface. Interface is defined as "a connection between systems, equipment, or people" (Yonck, 2010, p. 15). The user interface of information systems determines how information is organized and displayed (Bharati & Chaudhury, 2004; Sanayei, Shaemi, & Jamshidi, 2011). DeLone and McLean (2004) do not include user interface per se, but they included ease of navigation as one of the "new e-commerce success measures" of system quality (p. 36). Seddon (1997) noted that system quality includes the user interface along with other technical characteristics (e.g., ease of use).

Because of limitations inherent to mobile devices (e.g., screen resolutions, color depth and contrast), displaying rich content and facilitating navigation are challenges (Hassanein & Head, 2003). Therefore, how to display information and structure navigation are crucial questions when designing a banking app interface. In addition, our content analysis has revealed other aspects of the user interface, including aesthetics, menu design, and the ability to adjust to different resolutions of mobile devices. In the

context of app banking, we believe a well-designed user interface can help users understand the features offered, which may result in greater user satisfaction and intention to continue using.

Response time. Response time is defined as "the number of seconds it takes from the moment users initiate an activity until the computer begins to present results on the display or printer" (Shneiderman, 1998, p. 351). DeLone and McLean (2003, 2004) suggest response time is a sub-dimension of system quality. S. M. Lee and Lee (2012) included response time as one aspect of system quality of enterprise information systems. Experimental research on browser-based applications has shown that user satisfaction drops as response time increases and dissatisfaction results in discontinued use (Hoxmeier & DiCesare, 2000).

Given the limited computing capability of mobile devices, response time will probably exceed that of online banking. Reliance on wireless networks could also slow down response time. Our content analysis has revealed that 92 reviewers made comments on response time and the majority of those comments are negative. For example, one reviewer complained that "This app is like a slow death. It takes forever to get into anything." Literature in online banking and web-based information systems suggests that response time includes time to load information, login and logout, and process transactions (Cheung & Lee, 2008; Khurana, 2009; Shamdasani et al., 2008). These aspects of response time should apply to banking apps as well.

Security. Security concerns are believed to be the major reason discouraging people from using mobile banking apps (Matthews, 2012). Mobile banking security has been defined as "protecting the details of transactions and customers from internal and

external fraud/criminal usage" (Sanayei, Ranjbarian, et al., 2011, p. 25). DeLone and McLean (2004) included security as one of the measures of e-commerce system quality because "e-commerce is typically conducted over the Internet rather than a private, proproetary network " (p. 36). Similar to e-commerce, mobile services (e.g., mobile app banking) are also conducted via open networks such as WiFi. Previous studies have found that security concerns or perceived risk is one of the obstacles that affects satisfaction and intention to adopt mobile banking (Koenig-Lewis et al., 2010; Sanayei, Ranjbarian, et al., 2011; Wessels & Drennan, 2010).

Some researchers have claimed that security involves both financial (e.g., account losses) and personal concerns (e.g., privacy) (Ramseook-Munhurrun & Naidoo, 2011). An experimental study, however, found that online customers provide rich personal information to websites even though they claim to be greatly concerned about privacy (Berendt, Gunther, & Spiekermann, 2005). For the same reason, we believe privacy might be not an important issue for banking app users, and security of banking apps is primarily associated with potential financial losses.

For banking apps, security is important because it is associated with users' monetary safety. Secure mobile banking apps must prevent unauthorized transactions fom being conducted through banking apps. Interacting with secure banking apps is less likely to result in account losses. Users who perceive a banking app to be insecure will be less satisfied and may stop interacting with the banking app.

Functionality. Functionality in the present study refers to the banking functions that are available on mobile banking apps. When studying online banking service quality,

Michel et al. (2009), Yu (2008), and Yang et al. (2004) found that offering a wide range of banking services affects user perceptions of overall service quality and satisfaction.

Given that the development of mobile banking apps is still in its early stage, functionality of banking apps is sometimes limited. Our content analysis has found that reviewers expected more banking functions from banking apps such as sending/receiving e-mail transfers, access to trading/investment accounts, checking bill payment history, etc. One possible explanation is that bank customers are used to banking on the Internet. When mobile banking apps are provided as an alternative way to do online banking, bank customers might expect the same functionality. This may result in high user expectations, with anything less causing dissatisfaction and reducing the intention to continue using it.

Exogenous Construct: Information Quality

Information quality captures content issues such as personalization, completeness, ease of understanding, and relevance (DeLone & McLean, 2003, 2004). Mobile banking apps are specifically designed to satisfy personal banking needs. Once bank customers log into their accounts, all the information displayed is highly personalized showing their names, account balances, transaction history, etc. Since information on mobile banking apps is both highly personalized and relevant, measuring its quality might not result in much variance. For this reason, personalization and relevance are not included in the present study.

For mobile banking apps, information quality appears to be a combination of ease of understanding (also known as understandability), completeness, and timeliness. The following sections will discuss these sub-dimensions of information quality in more detail.

Understandability. Understandability refers to "the extent to which data are clear without ambiguity and easily comprehended" (R. W. Wang & Strong, 1996, p. 32). DeLone and McLean (2003, 2004) noted that content on e-commerce sites should be easy to understand to encourage users to continue visiting the sites. McKinney, Yoon, and Zahedi (2002) have found that understandability is one of the most important dimensions of web information quality, which in turn impacts user satisfaction.

In the context of mobile banking apps, understandability might be important for users. Mobile banking apps present personal financial information to users. Users, however, might not have sufficient knowledge to understand complicated financial information output. Therefore, making the information on banking apps easy to understand might contribute to user satisfaction and intention to continue using banking apps.

Completeness. Completeness refers to "the extent to which data are of sufficient breadth, depth, and scope for the task at hand" (R. W. Wang & Strong, 1996, p. 32). DeLone and McLean (2003, 2004) suggest completeness as a sub-dimension of information quality. Completeness has been utilized to assess information quality for different types of information systems, including a taxation information system (Floropoulos et al., 2010), student information systems (Rai et al., 2002), and virtual communities (H.-F. Lin, 2008). Treating completeness as a lower-order construct, Wixom and Todd (2005) found that completeness is significantly related to information quality, which further affects information satisfaction and behavioural intention.

Providing sufficient information on mobile banking apps is crucial to support various banking functions, as suggested by the following comment from the content

analysis “You can pay bills but you can't view them, so you need to know what you owe ahead of time.” When information on banking apps is complete and sufficient to meet users’ bank needs, users might be more satisfied with the banking apps and more likely to continue using them.

Timeliness. Timeliness is defined as “the extent to which the age of the data is appropriate for the task at hand” (R. W. Wang & Strong, 1996, p. 32). While DeLone and McLean (2003) do not include timeliness as a sub-dimension of information quality, other empirical studies in the IS Success literature have (H. Chong et al., 2010; Floropoulos et al., 2010; S. M. Lee & Lee, 2012; H.-F. Lin, 2008).

For mobile banking apps, timeliness refers to the currency of account information. Users of banking apps might want to check transactions when they are executed and see the new account balances. This is a key feature that online banking cannot offer customers until they return home. A lack of information timeliness might make banking apps less satisfactory and make users less likely to continue using banking apps.

Exogenous Construct: Service Quality

DeLone and McLean (2003) incorporate service quality to measure the overall support delivered by service providers (e.g., IS department) in e-commerce. They suggest that service quality can be operationalized by assurance, empathy, and responsiveness and hypothesize that service quality is positively related to user satisfaction. Subsequent studies have supported this relationship (H. Chong et al., 2010; Y.-S. Wang, 2008).

Support from customer service may be important for some app banking users. Supportive customer service can assist users to solve problems related to banking apps. However, our content analysis revealed that some customer service representatives are

not seen as responsive, helpful, or knowledgeable, as suggested by the following comments "I emailed technical support regarding the Atrix and have yet to receive a response," "Talked to someone at TD Canada and they said too bad, use the computer," and "Complained to RBC and they have NO CLUE."

Endogenous Construct: Perceived Innovativeness

Corporate reputation is defined as "a perception of the organization actually held by an external stakeholder" and represents "the "reality" of the organization for that individual" (Brown et al., 2006, pp. 104-105). Noticing that different stakeholder groups have different value systems or perceptions of a firm, Walsh and Beatty (2007) differentiated customers from other stakeholders and defined customer-based reputation as a customer's evaluation of a firm that results from the customer's experience with the firm and from information that he or she has heard about that firm.

Some researchers have addressed different dimensions of corporate reputation. For example, Walsh and Beatty (2007) found five dimensions of customer perceived corporate reputation: customer orientation, good employer, reliable and financially strong company, product and service quality, and social and environmental responsibility. Being innovative was also seen as one of the attributes of corporate reputation (Chun, 2006). Sabate and Puente (2003) included technological innovation when assessing corporate reputation of banks. *Fortune*, an American magazine, also includes innovativeness as an indicator of the reputation of a company when generating the World's Most Admired Companies' List (The world's most admired companies, 2013).

Some researchers have noted that reputation is a collective phenomenon (Walsh et al., 2009) where an aggregation of perceptions towards a firm is shared by observers or

stakeholders (Barnett et al., 2006). In the present study, we attempt to investigate how an individual customer perceives a bank's technological innovativeness. To avoid confusion with the collective nature of reputation, we propose perceived innovativeness as a construct.

Perceived innovativeness is a bank customer's perception of a bank's technological innovativeness. Perceived innovativeness is a belief held by each individual and may change overtime based on the interactions with a mobile banking app. Mobile banking apps as the latest technological innovation in banking sector may directly impact how customers perceive a bank's technological innovativeness. When a mobile banking app provides good system quality and information quality, bank customers may perceive the bank to be more innovative. Therefore, we hypothesize that:

> *H1: App system quality will have a positive impact on user perception of bank technological innovativeness.*
>
> *H2: App information quality will have a positive impact on user perception of bank technological innovativeness.*

Research found that product and service quality can positively influence corporate reputation in the B2B market (Miremadi et al., 2011), banking industry (Y. Wang et al., 2003), and e-commerce (Caruana & Ewing, 2010). Mobile banking apps are relatively new and less mature than other technologies (e.g., online banking). There might be some technical obstacles (e.g., slow response time) that have not yet been overcome. Bank customers might also have difficulties when using mobile banking apps due to unfamiliarity with this new technology. If bank customer service has the knowledge or willingness to help customers solve or report problems, the bank customer's perception of the bank's technological innovativeness may be enhanced. Therefore, we propose:

H3: Service quality will have a positive impact on user perception of bank technological innovativeness.

Endogenous Construct: User Satisfaction

User satisfaction is believed to be a "surrogate for Information Systems success" (H.-H. Lin & Wang, 2006, p. 273). Oliver (1981, p. 27) defined satisfaction as "the summary psychological state resulting when the emotion surrounding disconfirmed expectations is coupled with the customer's prior feeling about the consumption experience."

DeLone and McLean (1992, 2003) propose that system quality positively affects satisfaction. Petter et al. (2008) found a strong support for this relationship in their literature review. This relationship has also been supported by previous empirical studies in multiple research contexts, including enterprise information systems (S. M. Lee & Lee, 2012), virtual communities (H.-F. Lin, 2008), e-commerce (Y.-S. Wang, 2008), and student information systems (Rai et al., 2002). Whether this relationship holds in mobile banking apps has not been studied. We propose that:

H4: App system quality will have a positive impact on user satisfaction with their current banking app.

DeLone and McLean (1992, 2003) hypothesize that information quality positively influences user satisfaction. The literature review conducted by Petter et al. (2008) found strong support for this relationship. A few more recent empirical studies in the IS Success literature have also supported this relationship (H. Chong et al., 2010; H.-F. Lin, 2008; Rai et al., 2002; Y.-S. Wang, 2008). While this relationship has not yet been tested in any mobile environment, we propose that:

H5: App information quality will have a positive impact on user satisfaction with their current banking app.

DeLone and McLean (2003) integrate service quality into their Updated IS Success Model in order to capture the importance of service in e-commerce. This relationship has been supported by Y.-S. Wang (2008) in an e-commerce context and by H. Chong et al. (2010) in the student loan industry. In mobile app banking, when customer service representatives are willing to help users solve problems and are interested in receiving feedback related to banking apps, users might be more satisfied with their banking apps. Therefore, we hypothesize that:

H6: Service quality will have a positive impact on user satisfaction with their current banking app.

A few studies have examined the relationship between corporate reputation and satisfaction. Some authors have proposed that corporate reputation influences satisfaction (Miremadi et al., 2011; Walsh & Beatty, 2007).

In the present study, we propose that a bank customer's perception of the bank's technological innovativeness will impact user satisfaction. In other words, user satisfaction may be enhanced if users believe that their banks are technologically innovative and have the capability to optimize banking apps. Therefore, we hypothesize that:

H7: User perception of bank technological innovativeness will have a positive impact on user satisfaction with their current banking app.

Endogenous Construct: Intention to Continue Using

A few studies in marketing have supported that corporate reputation affects customers' behavioural intentions (e.g., intention to re-purchase) (Nguyen & Leblanc,

2001; Walsh et al., 2009; Yoon, Guffey, & Kijewski, 1993). Clemes, Gan, and Zhang (2010) found that a bank's strong reputation can significantly reduce customer switching behaviour. In an e-Business context, Casalo, Flavian, and Guinaliu (2008) found a positive influence for website reputation on customer loyalty. In app banking, users might be more likely to continue to use banking apps if they perceive the bank to be technologically innovative. Therefore, the following hypothesis is proposed:

> *H8: User perception of bank technological innovativeness will have positive impact on users' intentions to continue using their current banking apps.*

In the original IS Success model (DeLone & McLean, 1992), system usage was treated as one aspect of IS success. The most common ways to measure system usage are system-recorded measures and self-reported measures (Straub, Limayem, & Karahanna-Evaristo, 1995). However, both these measurements of usage have limitations. For instance, actual usage cannot always be recorded by hardware monitors and self-reported measures of system use have been criticized as weaker and less accurate (Trice & Treacy, 1988).

DeLone and McLean (1992, 2003) noted that measuring usage only makes sense when use is voluntary. In their updated model, DeLone and McLean (2003) suggested intention to use as an alternative measure of use, noting that intention to use might be a more suitable measurement than use when system usage is mandatory. Studies on technology adoption often employ intention to use as a proxy to predict potential users' initial system use. However, intention to use is not appropriate to study post-adoption of banking apps. For example, our content analysis was conducted based on the reviews posted by experienced users. They have already made a decision to at least try banking apps. Therefore, studying experienced users' intention to continue using is more

appropriate than studying their initial adoption intention. Kang et al. (2012) used sustained use as the dependent variable when studying post-adoption of mobile banking services and Y.-S. Wang (2008) included intention to reuse when accessing e-commerce systems success.

DeLone and McLean (2003) proposed a bi-directional relationship between use/intention to use and satisfaction. When reviewing literature related to IS Success, Petter et al. (2008) found that the relationship from satisfaction to use was more commonly examined than the reverse path. Y.-S. Wang (2008) also supported that satisfaction enhanced users' intention to continue using e-commerce applications. In addition, when examining online banking service quality, Shamdasani et al. (2008) found user satisfaction is significantly related to continued interaction. In the context of mobile banking apps, users should be more likely to continue to use mobile banking apps if they are satisfied with the apps. Therefore, we hypothesize that:

> *H9: User satisfaction will have a positive impact on users' intentions to continue using their current banking apps.*

Chapter 5: Methodology

A quantitative method using an online cross-sectional survey was employed in the second phase of this study. The targeted population was users of mobile banking apps in Canada.

In the following sections, we discuss the lower-order and the higher-order models, the reflective and formative constructs, measurement development, and the analysis procedures for testing the proposed research model.

Higher-Order Models

Higher-order models involve testing higher-order constructs (Hair, Hult, Ringle, & Sarstedt, 2013), which summarize lower-order constructs into a single dimensional higher-order construct. Higher-order models allow more theoretical parsimony and reduce model complexity (Hair et al., 2013).

DeLone and McLean (1992, 2003) acknowledged the multidimensional structures of system quality and information quality, and summarized their possible dimensions (see Appendix A). Previous studies, however, have not emphasized the multidimensional structures of system quality and information quality when operationalizing these constructs. For example, Rai et al. (2002) and Y.-S. Wang (2008) only used ease of use to represent system quality. H. Chong et al. (2010) acknowledged the multidimensional structure of system quality by including the dimensions of ease of use, reliability, accessibility, usefulness, flexibility, and ease of navigation. However, they only used one item to measure each sub-dimension, which might cause the sub-dimensions to be underidentified. Operationalizing system quality and information quality as higher-order

constructs addresses these concerns and allows their multidimensional structures to be explored with each sub-dimension measured by multiple items.

In the present study, the higher-order constructs, system quality and information quality, are formative; and they are formed by their respective low-order constructs (see the next section for a more detailed discussion). The lower-order constructs that form system quality are reliability, ease of use, user interface, response time, security, and functionality. Information quality is determined by three lower-order constructs: understandability, completeness, and timeliness. The reason we treated system quality and information quality as formative constructs was that their underlying low-order constructs are not necessarily highly correlated. Figures 5 and 6 display the higher-order models for system quality and information quality respectively.

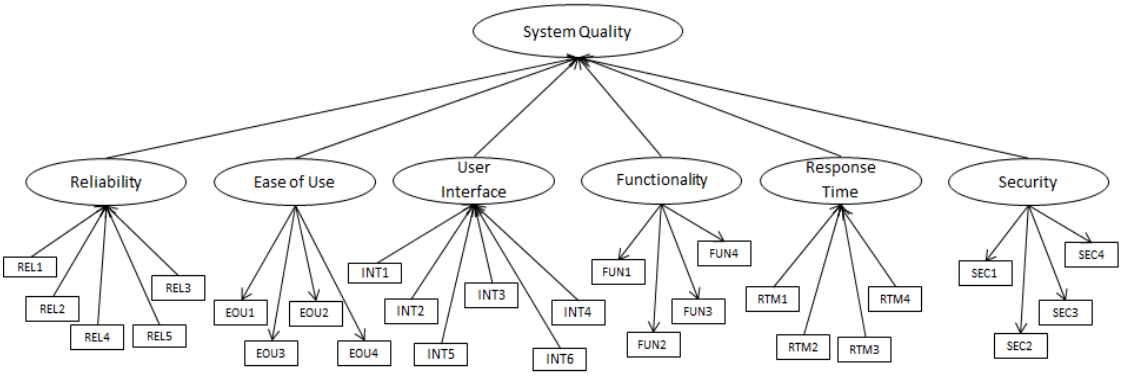


Figure 5. Higher-Order Model for System Quality

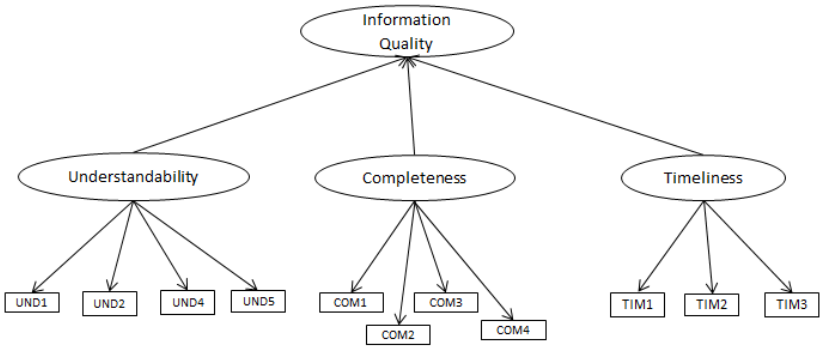


Figure 6. Higher-Order Model for Information Quality

Reflective versus Formative Constructs

Constructs, also known as latent variables, describe unobservable phenomena (e.g., attitude). Measures of constructs, also called indicators or scale items, are observed scores that are commonly gathered with survey instruments (Freeze & Raschke, 2007). Measurement models describe the causal directions of the relationships between a construct and its measures. Reflective and formative models, as displayed in Figure 7, are two types of measurement models where Y1 to Y3 represent survey items.

Figure 7. Reflective and Formative Models (Freeze & Raschke, 2007, p. 1483)

In a reflective model, "changes in the underlying latent construct are reflected by changes in the indicators" (Freeze & Raschke, 2007, p. 1483). For example, if user satisfaction with an information system is treated as a reflective construct, it can be measured by items such as "I am satisfied with the information system" and "The

information system is satisfactory." A user's level of satisfaction determines how he/she rates both of the items. Changes in user satisfaction should cause both items to change in the same direction. Therefore, items of a reflective construct are expected to be highly correlated.

In contrast, indicators determine the construct in a formative model. System quality, for example, could be determined by perceived ease of use and security. A respondent's evaluations of perceived ease of use and security determine the score of system quality. However, ease of use and security are not necessarily correlated. In fact, indicators may change in different directions. For instance, as security controls are enhanced, perceived ease of use may decrease.

We included both reflective and formative constructs in our research model. As mentioned in the last section, system quality and information quality were measured as formative higher-order constructs. Reliability, user interface, and response time were measured as formative lower-order constructs. Service quality was also operationalized as a formative construct. This allowed us to explore and understand the contextual domain of mobile banking apps. For example, by treating reliability as a formative construct, we are able to investigate different reliability issues that might be crucial for users of mobile banking apps.

Measures

Some of the measurements used in this study were adapted from previous research and refined based on the content analysis and reworded in order to reflect the research context. The content analysis also assisted in developing formative measurement items that were closely related to our contextual domain of mobile banking apps.

Items were measured using five-point Likert scale ratings from 1 (strongly disagree) to 5 (strongly agree). The full questionnaire is presented in Appendix D.

System quality. System quality is measured as a formative construct using six sub-dimensions: reliability, ease of use, interface, response time, security, and functionality. These sub-dimensions are not expected to be highly correlated, and some inverse correlations are plausible.

Reliability. Reliability is treated as a formative construct in order to capture different aspects of reliability of mobile banking apps. The content analysis revealed five system reliability issues: blank screens, frozen pages, system crashes, and login/logout problems. Each of these five reliability issues is measured by one item. Two items, related to frozen pages and system crashes, were adapted from Sahadev and Purani (2008). The wording of both items was changed slightly to represent the specific research context. The remaining three items, measuring reliability issues of blank screens and login/logout, were developed from the content analysis. Comments from the content analysis included: "Nothing but a blank white screen," "Won't let me log in," and "it logs out in the middle of the process."

Ease of use. Ease of use is a reflective construct, measured by four items. The items were adapted from previous mobile banking studies conducted by Gu et al. (2009), Rammile and Nel (2012), and Sripalawat, Thongmak, and Ngramyarn (2011). Wording and time tense were changed in order to reflect experienced users' perceptions of the ease

of using banking apps. An example item from this measurement scale is "My ___[2] app is easy to use."

User interface. User interface is a formative construct in this study. The six formative indicators included in the construct were: information display, aesthetics, menu design, layout, navigation, and the ability to adjust screen resolutions. One item that measured information display was adapted from Kassim and Abdullah's (2010) study. The other items were developed based on the comments from the content analysis including: "such an ugly looking app," "We already have a menu button on all our android phone, we don't need one like an iPhone," "navigation is screwed up," and "The app launches in a quarter of the screen."

Response time. Response time is a formative construct based on the time it takes to load content, log in and log out, and process transactions. Four items were used to measure this construct, and three of them were adapted from previous studies (Cheung & Lee, 2008; Khurana, 2009). The adapted items were originally used to measure response time of online banking or other web-based IS. Wording of these items was modified to fit the contextual domain. From the content analysis, one item was developed to capture the speed of processing banking transactions based on comments such as "Email $ transfers in seconds."

Security. Security is a reflective construct. It was measured by four items. Three out of four items were adapted from the literature (Kang et al., 2012; Siu & Mou, 2005; Sripalawat et al., 2011). These items were selected because they had been used to measure security of mobile banking or online banking and they were reworded, as

[2] The blank will be replaced by the bank name selected by the respondent.

necessary, to fit this research context. One example is "I am confident about the security of banking via my ___ app." In addition, considering the possibility of losing mobile devices, we developed another item to ask "If I lost my ___[3], I would not be concerned that someone could access my account via my ___ app."

Functionality. Functionality is a reflective construct. Three items were adapted from Yang et al. (2004) to measure functionality of mobile banking apps. Wording of the items was modified to fit the research context.

Information quality. Information quality is a formative construct. As noted by DeLone and McLean (1992), information quality can be operationalized by multiple dimensions. In the present study, information quality was operationalized by understandability, completeness, and timeliness. Similar to system quality, information quality was treated as a formative construct because understandability, completeness, and timeliness are conceptually independent from each other.

Understandability. Understandability is a reflective construct, which is measured by four items adapted from Cheung and Lee (2008), and Wu and Wang (2006). The original items, used to measure understandability of web-based IS services and knowledge management systems, were reworded to fit the context of mobile banking apps.

Completeness. Completeness is a reflective construct that measures whether a banking app provides sufficient information and whether the information meets users' needs. Three items were adapted from Bailey and Pearson (1983), and Y.-S. Wang (2008). One example is, "The information displayed on my ___ app meets my needs."

[3] The blank will be replaced by the type of mobile device and its manufacturer selected by the respondent.

Timeliness. Timeliness is a reflective construct, which is measured by three items adapted from existing studies (S. M. Lee & Lee, 2012; Y.-S. Wang, 2008; Wixom & Todd, 2005). After rewording these items, we had items such as "My ___ app provides up-to-date account information."

Service quality. DeLone and McLean (2003) suggested that service quality could be measured using three dimensions of SERVQUAL (Parasuraman et al., 1988), namely, assurance, empathy, and responsiveness. The dimensionality of SERVQUAL has been criticized as unstable, that is, the SERVQUAL items do not always load on the desired dimensions (Babakus & Boller, 1992; Coulthard, 2004; Cronin & Taylor, 1992).

In this study, we adopted the dimensions suggested by DeLone and McLean (2003), but chose different measures to avoid potential stability issues relating to the SERVQUAL instruments. Service quality is treated as a formative construct. One item was adapted from each of Yang et al. (2004), Pitt et al. (1995), and Al-Hawari (2011).

Satisfaction. Three items were adapted from Casaló et al. (2008). The original scale was developed to measure user satisfaction with online banking services. We reworded the items, so, for instance, "the website" was changed to "my ___ app." An example item is "The experience that I have had with my ___ app has been satisfactory."

Perceived innovativeness. Although previous studies consider innovativeness as one of the attributes of corporate reputation (Chun, 2006; Sabate & Puente, 2003), there is no existing scale to measure innovative reputation or perceived innovativeness. Therefore, we developed measurement items to assess how banking app users perceive their bank's technological innovativeness. Previous studies and measurement scales on corporate reputation were reviewed. Three items were developed to measure perceived

innovativeness: "___ is innovative in adopting new technology," "The overall impression I have of ___ is that they are technologically innovative," and "___ is a leader in technology."

Intention to continue using. Four items were adapted from Nasri (2011) and Shamdasani et al. (2008) to measure intention to continue using the same banking app. The items originally measured the intention to continue using online banking so the wording was slightly modified. For example, "Assuming mobile technology is available to me, I will use my ___ app on a regular basis in the future."

Procedures

Pretest. The first step of this study was to pretest the measurement scales, which included modified items from previous studies and new items developed based on content analysis. Thus, we needed to (1) ensure the wording was clear and (2) assess the face validity of the survey instrument.

Since the pretest as well as the main study involved human subjects, an application, which included consent letters (see Appendix C) and the survey protocol, was submitted to the Human Subject Research Committee for ethical review. The study procedures and survey protocol were approved by the Faculty of Management Research and Ethics Committee.

Participants in the pre-test needed to have experience with at least one Canadian mobile banking app. Posters were used to recruit pretest participants at the University of Lethbridge. In addition, a snowball sampling technique aided in the recruitment of participants' friends, colleagues, or family members to this study.

In the pretest, each participant completed two tasks: (1) provide feedback regarding the survey structure and wording and (2) respond to the online survey questions. The researcher met each participant individually and took notes of their comments, concerns, and suggestions. After each pretest, the survey instrument was modified before the next participant responded and provided feedback.

Main study. After making adjustments to the survey, the revised survey questions were imported into the Qualtrics online survey design software. The survey was distributed within Qualtrics online panels. The population of interest for the main study comprised current or previous users of mobile banking apps in Canada.

Previous research had found that the adoption rate of mobile banking apps is low (2%) (J.D. Power, 2012). Approaching individuals in this specific population was difficult for us. Online panels have a large respondent pool, allowing researchers to approach the targeted population in a time efficient manner. Therefore, we decided to use Qualtrics online panels to approach the targeted population.

Chapter 6: Results

Results of this study are presented in this chapter. First, results of the pretest are presented, along with the modifications made to the survey. This is followed by the data collection process and the sample characteristics. Then, the results of analyzing the measurement and structural models using the PLS Graph 3.0 are presented.

Pretest

A pretest was conducted before the main study to determine if the wording was clear and to ensure face validity of the measurement. Six students took part in the pretest, five graduate students and one undergraduate student. One participant was introduced by another participant. All the participants were experienced users of mobile banking apps so they were qualified to evaluate the quality of their banking apps and to articulate their level of satisfaction, their perceptions of the bank's technological innovativeness, and their intention to continue using banking apps.

A few adjustments were made to modify ambiguously and redundantly worded questions, incorporate additional options to some questions, and remove unnecessary questions. The statement for the withdrawal option was reworded in order to clarify the meaning of withdrawal and its consequences clear to participants. The final survey is presented in Appendix D.

Data Collection

A Qualtrics online panel was used to recruit 200 participants for this study. After setting up the online survey, the URL link to the survey was sent to the panel manager. The panel manager then sent an e-mail invitation containing the URL. Panelists who

participated in this study received incentives (e.g., cash rewards and/or points) from the online panel.

Two screening questions were included in the survey to make sure that all the participants were (1) 18 years of age or older and (2) experienced users of a Canadian banking app. Seven hundred and fifty three panelists clicked into the online survey, and 200 of them consented to participate, passed the screening questions, and completed the survey. In addition, three university students showed interest in this study and responded to the survey. In total, 203 completed responses were obtained.

Data Screening

All data cases and patterns were examined prior to testing the measurement and structural models. The data screening procedures included checking for suspicious responses, identifying and replacing missing data, identifying outliers, and examining normality.

Suspicious responses. Suspicious responses included those showing a straight lining pattern (Hair et al., 2013). This straight lining pattern occurs when a participant selects the same response for all the manifest variables. To detect suspicious responses, standard deviation (SD) on all the manifest variables was examined for each case. Any case with a standard deviation of zero is identified as a suspicious response. Seven cases out of 203 did not show any variance (SD = 0). They were removed from the data set, leaving 196 cases for further analysis. Descriptive statistics were then examined (see Table 13).

Table 13. Descriptive Statistics for Manifest Variables

Variable	Valid N	Min	Max	Mean	SD	$Z_{skewness}$	$Z_{kurtosis}$
REL1	191	1	5	4.45	.69	-7.70	7.95
REL2	193	1	5	4.18	.85	-6.16	3.10
REL3	194	1	5	4.26	.87	-8.30	7.14
REL4	192	2	5	4.18	.85	-4.68	-0.06
REL5	192	1	5	4.23	.86	-7.19	4.89
EOU1	194	1	5	4.37	.70	-6.94	7.74
EOU2	195	2	5	4.41	.67	-5.15	1.57
EOU3	193	1	5	4.36	.73	-7.54	7.81
EOU4	194	1	5	4.40	.65	-6.88	9.37
INT1	193	1	5	4.17	.76	-5.77	6.16
INT2	194	2	5	4.22	.72	-3.94	1.16
INT3	193	2	5	4.26	.65	-3.11	1.11
INT4	194	1	5	4.13	.78	-4.82	3.04
INT5	195	2	5	4.36	.67	-5.13	2.72
INT6	193	2	5	4.28	.67	-4.10	2.20
RTM1	193	1	5	4.17	.79	-6.45	6.12
RTM2	193	2	5	4.41	.66	-5.17	2.00
RTM3	193	2	5	4.12	.76	-4.09	1.28
RTM4	190	1	5	4.21	.80	-7.17	7.02
SEC1	184	1	5	3.91	.83	-2.71	0.30
SEC2	192	2	5	4.05	.78	-2.83	-0.46
SEC3	185	2	5	4.14	.70	-2.20	-0.65
SEC4	188	1	5	3.66	1.12	-3.20	-1.52
FUN1	189	1	5	4.13	.76	-4.64	3.45
FUN2	192	2	5	4.09	.75	-2.62	-0.54
FUN3	194	1	5	4.11	.81	-5.90	3.92
UND1	196	2	5	4.40	.66	-4.96	1.70
UND2	194	2	5	4.36	.66	-5.04	2.96
UND3	190	2	5	4.22	.72	-2.95	-0.92
UND4	194	2	5	4.26	.64	-2.41	-0.32

(Table 13 continues)

(Table 13 continued)

Variable	Valid N	Min	Max	Mean	SD	$Z_{skewness}$	$Z_{kurtosis}$
COM1	194	2	5	4.34	.70	-5.37	2.70
COM2	195	1	5	4.29	.70	-5.82	6.49
COM3	192	2	5	4.19	.73	-4.08	1.49
TML1	191	1	5	4.34	.73	-6.78	6.56
TML2	194	2	5	4.19	.80	-5.90	2.90
TML3	193	2	5	4.36	.68	-5.72	3.94
CS1	36	2	5	4.36	.72	-2.96	2.36
CS2	36	1	5	4.42	.81	-5.89	10.68
CS3	36	2	5	4.03	.94	-1.26	-1.09
SAT1	195	2	5	4.28	.69	-4.07	1.48
SAT2	196	1	5	4.35	.67	-6.69	9.30
SAT3	196	2	5	4.30	.60	-2.18	0.48
INN1	193	1	5	4.04	.86	-3.59	0.01
INN2	193	1	5	4.01	.85	-3.08	-0.25
INN3	189	1	5	3.78	.94	-2.96	0.40
CTU1	196	2	5	4.36	.68	-3.98	-0.55
CTU2	196	2	5	3.93	.93	-3.17	-1.56
CTU3	194	1	5	4.27	.74	-5.92	5.13
CTU4	195	2	5	4.02	.88	-3.86	-0.61

Missing data. Missing data were detected at the case level and the variable level. At the case level, 57 cases out of 196 contained missing values. The largest percentage of missing values for a particular case was 32.6%, which is smaller than the 50% cut-off value suggested by Hair et al. (2009). Therefore, none of the cases was dropped due to missing values.

At the variable level, five (i.e., UND1, SAT2, SAT3, CTU1, and CTU2) out of 49 variables did not contain any missing values. The other 41 variables, except for CS1, CS2, and CS3, contained fewer than 10% missing values; the largest percentage of missing values was 6.1% for SEC1.

CS1, CS2, and CS3, however, only received 36 valid responses. Missing data on CS1, CS2, and CS3 are ignorable missing data because this was expected given the

design of the online survey (Hair et al., 2009). CS1, CS2, and CS3 were designed to measure service quality. This set of questions was skipped if respondents indicated that they had not contacted customer service representatives to deal with problems related to their banking app.

Before applying any imputation techniques, Missing Value Analysis (MVA) was employed to determine whether data were missing in a completely random pattern. Little's MCAR test indicated that missing data for the manifest variables (excluding CS1, CS2, and CS3) did not occur in a Missing Completely at Random (MCAR) manner (Chi-Square = 2106.926, DF = 1935, p = .004).

The Expectation Maximization (EM) approach was employed to replace missing values. The EM approach "has been shown to work quite effectively in instances of nonrandom missing data processes" (Hair et al. 2009, p. 50). The EM approach is an iterative procedure with two stages: the expectation (E) stage and the maximization (M) stage. The E stage estimates the missing data and the M stage estimates the parameters by assuming missing data are replaced.

Outliers. An outlier is a case with an extreme score on one variable or with a unique combination of scores on two or more variables (Tabachnick & Fidell, 2006). Statistical methods are available to examine the existence of univariate and multivariate outliers. In this study, however, detection of outliers was driven by theory. All the manifest variables were measured using a five-point Likert scale and the minimum and maximum values for each variable were within the range from 1 to 5 (see Table 18). Therefore, we concluded that outliers did not exist.

Normality. Normality refers to "the shape of the data distribution for an individual metric variable and its correspondence to the normal distribution" (Hair et al., 2009, p. 71). Two measures, skewness and kurtosis, are often used to examine normality. Skewness assesses the balance of distribution and kurtosis measures the peakedness or flatness (Hair et al., 2009). The values (*z*) for skewness and kurtosis are evaluated by $z_{\text{skewness}} = \frac{skewness}{\sqrt{\frac{6}{N}}}$ and $z_{kurtosis} = \frac{kurtosis}{\sqrt{\frac{24}{N}}}$ where N is the sample size (Hair et al., 2009). The distribution is considered to be non-normal if z_{skewness} exceeds the critical value of ± 2.58 and if $z_{kurtosis}$ exceeds the critical values of ± 1.96 (Hair et al., 2009).

Z values for each manifest variable are included in Table 13. Only three variables were normally distributed (i.e., SEC3, UND4, and SAT3) with *z* values of skewness and kurtosis in the acceptable ranges of ± 2.58 and ± 1.96. Negative *z* values of skewness were observed on the other variables, indicating that distributions of these variables shifted to the right.

The non-normal distributions were not surprising. In our sample, approximate 85% of the participants were heavy users of banking apps as they use their banking app at least once a week (see Table 16). In addition, the mean value for each variable exceeds 3.5, indicating that most participants were satisfied with the performance of their banking apps, viewed their banks as technologically innovative, and were inclined to continue using their banking apps.

Non-normal data distributions do not cause serious problems for this study. First, Partial Least Squares (PLS) will be used to test the measurement and structural models. According to Hair et al. (2013), the PLS-SEM approach is a nonparametric method which

does not require normality. Second, the impact of non-normality diminishes as the sample size approaches or exceeds 200 (Hair et al., 2009). In this study, 196 cases were used to analyze the research model. Therefore, transformation techniques were not used.

Sample Characteristics

The demographic characteristics of the respondents are described by age, gender, education, and employment status in Table 14. The age of respondents ranged from 18 to 72 years of age and the average age was 33.2 years. Around 60% of the respondents were between 18 and 34 years old. The number of male and female respondents was similar (49.5% and 50.5%, respectively). Over 70% of the respondents had completed college education or above. Sixty-four percent of the participants were employed, either full-time or part-time, and approximately 14% of respondents were students.

Table 14. Demographics of Respondents

Demographic Item	Frequency	Percentage
Age		
18-24	51	26.0
25-34	68	34.7
35-44	35	17.9
45-54	25	12.8
55-64	10	5.1
65 or above	1	0.5
Missing data	6	
Gender		
Male	96	49.5
Female	98	50.5
Missing data	2	
Education		
Less than high school	4	2.0
High school	44	22.4
College	57	29.1
University	71	36.2
Postgraduate (e.g., Master, PhD)	20	10.2
Missing data	0	
Employment		
Employed	102	52.0
Employed part-time	23	11.7
Not currently employed	17	8.7
Student	28	14.3
Retired	5	2.6
Self-employed	13	6.6
Other [a]	6	3.1
Missing data	2	

[a] *Note*: Other employment statuses include: maternity leave, homemaker, and disability.

In addition to the demographic questions, respondents were asked about the bank which provides their primary banking app (see Table 15). The majority (i.e., 86.8%) of the respondents indicated that their primary banking app (i.e., the one they used most of

the time) was provided by one of the major banks in Canada (i.e., Bank of Montreal, CIBC, RBC Royal Bank, Scotiabank, and TD Canada Trust). Approximately 36% of the respondents had been a customer of the bank, which provided their primary banking app, for more than 10 years.

Table 15. Characteristics of Primary Banking App Providers

Characteristics of Provider	Frequency	Percentage
Which Canadian bank provides your primary banking app?		
TD Canada Trust	66	33.7
RBC Royal Bank	35	17.9
CIBC	28	14.3
Bank of Montreal	24	12.2
Scotiabank	17	8.7
ING Direct Canada	5	2.6
National Bank of Canada	3	1.5
HSBC Canada	1	0.5
Other [a]	17	8.7
How long have you been a customer of the bank who provides your primary banking app?		
Less than 1 month	1	0.5
1-6 months	17	8.7
7-12 months	7	3.6
1-5 years	55	28.1
5-10 years	45	23.0
More than 10 years	70	35.7
Missing data	1	0.5

[a] *Note*: Other Canadian banks include: Vancity, Presidents Choice, PC Financial, Meridian Credit Union, Desjardins, Coast Capital Savings, Canadian Western Bank, Alberta Treasury Branch.

Respondents' banking app usage patterns were addressed by a set of questions (see Table 16). Most of the respondents were active users of banking apps. Over 50% of respondents indicated that the last time they used a mobile banking app was one to seven days ago. Another one third of the respondents used a banking app the same day they responded to the survey.

In terms of how long individuals had been using their primary banking app, approximately 55% of the respondents indicated less than six months while around 27% had used their primary banking app over one year.

Respondents were also asked to indicate how often they had used their primary banking app. Over 80% of the respondents used their mobile banking app at least once a week.

Table 16. Characteristics of Use Behaviours

Characteristics of Use	Frequency	Percentage
When is the last time you used a banking app?		
Today	64	32.7
1-7 days ago	108	55.1
1-2 weeks ago	18	9.2
1-2 months ago	3	1.5
3-4 months ago	3	1.5
How long have (or did) you use the ___ app?		
Less than 1 month	15	7.7
1-3 months	46	23.5
4-6 months	47	24.0
7-12 months	36	18.4
More than 12 months	52	26.5
How often have you used the ___ app in the past 3 months?		
Less than once a week	29	14.8
About once each week	71	36.2
Several times each week	69	35.2
About once each day	18	9.2
Several times a day	9	4.6

The app bank activities of respondents are summarized in Table 17. The most commonly used function on banking apps was viewing one's account balance (95.9%), followed by viewing account activity (81.1%) and paying bills (63.3%). In addition,

transferring funds between accounts and reviewing credit card balances were used by more than half of the respondents.

Table 17. Activities on Banking Apps

Activity	Frequency	Percentage
View account balance	188	95.9
View account activity	159	81.1
Pay a bill (e.g., utility bill)	124	63.3
Transfer funds between your accounts	118	60.2
View credit card balance	112	57.1
View credit card activity	96	49.0
Pay credit card bill	91	46.4
Review payment history	83	42.3
View pending bill payment	57	29.1
Find a nearby branch or ATM	49	25.0
Send INTERAC e-Transfer	42	21.4
Transfer money to another person's account	38	19.4
Check transaction right after a purchase	34	17.3
View balances on loan, mortgage, investment, or trade account	30	15.3
Set up a new payee	27	13.8
Receive INTERAC e-Transfer	26	13.3
Check loan or interest rates	18	9.2
Place trades or buy/sell investment	17	8.7
Retrieve stock quotes	15	7.7
Cancel pending bill payment	13	6.6
Set up Paypal	1	0.5

Approximately 90% of respondents accessed their banking app through smart phones, with 44% and 30% using iPhones and Samsung smart phones. This is consistent with the iPhone and Samsung market shares in Canada (32% versus 23%) (Tencer, 2013). Only 16 respondents (8%) used tablets to access their banking app (see Table 18).

Table 18. Mobile Devices Used to Access Banking Apps

		Type of mobile devices			
		Smart Phone	Tablet	iPod Touch	Total
Manufacturer	Apple	78	12	4	94
	Samsung	52	2	0	54
	RIM/Blackberry	24	2	0	26
	HTC	10	0	0	10
	LG	4	0	0	4
	Nokia	3	0	0	3
	Motorola	1	0	0	1
	Sony Ericsson	1	0	0	1
	Other [a]	3	0	0	3
Total		176	16	4	196

[a] *Note*: Other manufacturers include Huawei and ZTE.

Measurement Models

The research model contains higher-order constructs. The measurement models for lower-order constructs were analyzed first, followed by the measurement models for higher-order constructs using latent variable scores.

Lower-order measurement models. The lower-order measurement models contained formative constructs and reflective constructs. We assessed both formative and reflective measurement models and the results are presented in the following sections.

Lower-order formative measurement models. Three lower-order constructs, namely, reliability, user interface, and response time, were formative. Hair, Sarstedt, Ringle, and Mena (2012) suggested two criteria to evaluate formative constructs. First, collinearity was examined. Second, the relevance and significance of the formative indicators were assessed.

Formative indicators represent the construct's independent causes so that high correlations are not expected between formative indicators (Hair et al., 2013). High correlation coefficients, or collinearity, between two formative indicators are problematic and imply that two (or more) indicators contribute the same information to the construct or one indicator is a linear combination of the others (Hair et al., 2013, p. 123).

The variance inflation factor (VIF) is a measure of collinearity. A VIF value of 5 or higher indicates a potential collinearity problem (Hair et al., 2013). The VIF values for the formative indicators are displayed in Table 19; all are well below the threshold value of 5. Therefore, we concluded that collinearity was not an issue for the lower-order formative constructs.

Table 19. Collinearity for Lower-Order Formative Indicators

Lower-Order Construct	Indicator	VIF
Reliability	REL1	1.768
	REL2	1.900
	REL3	1.653
	REL4	2.036
	REL5	1.741
Interface	INT1	2.706
	INT2	2.467
	INT3	2.280
	INT4	2.146
	INT5	1.762
	INT6	1.896
Response Time	RTM1	2.239
	RTM2	1.526
	RTM3	1.876
	RTM4	2.302

In the next step, we analyzed the relevance and significance of each formative indicator. The outer weights determine the relative contribution of a formative indicator

and the *t* value created in the bootstrapping procedure indicates its significance (Hair et al., 2013). According to Hair et al. "the values of the formative indicator weights are influenced by other relationships in the model" (Hair et al., p. 127). Hence, we examined the relevance and significance of formative indicators in their nomological framework (see Figure 8).

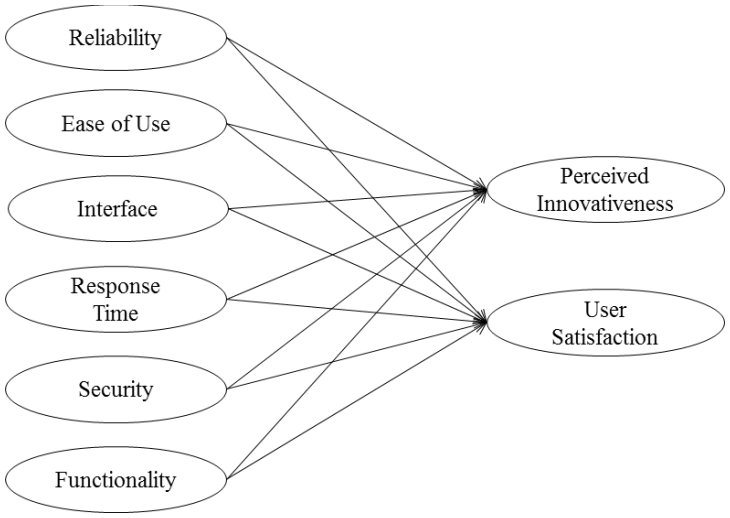


Figure 8. Nomological Framework for System Quality

The outer weights, *t* statistics, and *p* values for the formative indicators are presented in Table 20. Seven formative indicators (i.e., REL1, INT2, INT6, RTM1, RTM2, RTM3, and RTM4) had significant outer weights, indicating that these indicators truly contributed to their underlying constructs. For the indicators with non-significant weights, we also examined their outer loadings. According to Hair et al. (2013), when a formative indicator has non-significant outer weight but its outer loading is above 0.5, the indicator should be interpreted as absolutely important but not as relatively important. Loadings for the non-significant indicators were all above 0.5 (See Table 20). Therefore, we concluded that these formative indicators were also important in forming their respective formative constructs.

Table 20. Relevance and Significance for Lower-Order Formative Indicators

Construct	Indicator	Weight	Loading	*t* stat	*p* value
Reliability	REL1	0.419	0.812	2.171	0.03
	REL2	0.348	0.813	1.800	0.07
	REL3	0.155	0.667	0.918	0.36
	REL4	0.387	0.819	1.572	0.12
	REL5	-0.078	0.554	0.413	0.68
Interface	INT1	0.017	0.690	0.141	0.89
	INT2	0.524	0.912	4.843	<0.001
	INT3	0.212	0.762	1.855	0.07
	INT4	0.031	0.691	0.292	0.77
	INT5	0.138	0.631	1.829	0.07
	INT6	0.313	0.770	3.366	<0.001
Response	RTM1	0.289	0.838	2.849	<0.001
Time	RTM2	0.266	0.633	2.758	0.01
	RTM3	0.377	0.807	3.483	<0.001
	RTM4	0.349	0.819	3.049	<0.001

Lower-order reflective measurement models. The lower-order models also contain reflective constructs such as ease of use, security, functionality, understandability, completeness, and timeliness. The lower-order reflective measurement models were assessed by indicator reliability, composite reliability, convergent validity, and discriminant validity.

Indicator reliability indicates "which part of an indicator's variance can be explained by the underlying latent variable" (Gotz, Liehr-Gobbers, & Krafft, 2010, p 694). One rule of thumb is that over 50% of the variance in the manifest variable should be explained by the latent variable, which requires a factor loading greater than 0.707 (Barclay, Higgins, & Thompson, 1995).

Factor loadings for the lower-order reflective indicators were examined (see Table 21). Two indicators, EOU2 and SEC4, had factor loadings less than 0.707. They were dropped due to lack of indicator reliability and for theoretical reasons.

EOU2 (i.e., Interaction with __ app does not require a lot mental effort) had the lowest factor loading of 0.5704. The mean score of EOU2 was 4.41, indicating that using a banking app did not require much mental effort. Mobile banking app users have opportunities to access different types of mobile apps through their mobile devices. Familiarity with mobile apps in general should allow someone to interact easily with a banking app. Therefore, using banking apps might no longer require much mental effort.

SEC4 (i.e., If I lost my mobile device, I would not be concerned that someone could access my account via my ___ app) also had low loading of 0.615. The security construct measures if the banking app is secure. SEC4, however, did not directly measure the security of banking apps. In addition, losing a mobile device might not threaten the security of the banking apps. A screen lock can be set up on mobile devices to prevent any unauthorized access. Furthermore, bank customers might be less worried about unauthorized access as most banks guarantee to reimburse account losses resulting from unauthorized transactions through mobile banking apps. The above reasons might explain the low loading of SEC4.

Table 21. Factor Loadings for Lower-Order Reflective Indicators

	Reflective Indicator	Loading
EOU1	My ___ app is easy to use.	0.805
EOU2	Interaction with my ___ app does not require a lot of mental effort.	0.570
EOU3	It is easy to use my ___ app to accomplish my banking tasks.	0.839
EOU4	Using my ___ app is simple.	0.808
SEC1	There is little risk involved in using my ___ app.	0.743
SEC2	I am confident about the security of banking via my ___ app.	0.879
SEC3	My ___ app is secure.	0.834
SEC4	If I lost my manufacturer device, I would not be concerned that someone could access my account via my ___ app.	0.615
FUN1	Most online banking functions are included in my ___ app.	0.816
FUN2	My ___ app provides a wide range of online banking functions.	0.857
FUN3	My ___ app provides all the online banking functions that I want.	0.831
UND1	I understand what the information displayed on my ___ app means.	0.781
UND2	The information displayed on my ___ app is understandable.	0.734
UND3	The information displayed on my ___ app is not ambiguous.	0.775
UND4	The information displayed on my ___ app is meaningful.	0.809
COM1	The information displayed on my ___ app meets my needs.	0.852
COM2	The information displayed on my ___ app is sufficient for my needs.	0.793
COM3	The information available through my ___ app is complete.	0.787
TML1	My ___ app provides up-to-date account information.	0.854
TML2	Account information from my ___ app is timely.	0.835
TML3	My ___ app provides current account information.	0.895

Construct reliability is assessed by composite reliability (CR). Composite reliability measures how well a construct is measured by its underlying indicators (Gotz et al., 2010). CR values of 0.6 are acceptable in exploratory studies, with CR values greater than 0.7 preferable (Hair et al., 2013). The CR value for each lower-order reflective construct was created using a bootstrap procedure. Composite reliability values were all above the threshold of 0.7 (see Tables 22 and 23).

Convergent validity is “the extent to which a measure correlates positively with alternative measures of the same construct” (Hair et al., 2013, p. 102). Average variance extracted (AVE) is a common measure for assessing convergent validity; an AVE value of 0.5 or above is acceptable (Hair et al., 2013). The AVE value of each first-order construct

was obtained from the PLS bootstrap procedure. All the AVE values exceeded 0.5, which provided evidence of convergent validity (see Tables 22 and 23).

Discriminant validity is the extent to which a construct can be distinguished from other constructs (Hair et al., 2013). The Fornell-Larcker (Fornell & Larcker, 1981) criterion was used to examine discriminant validity by comparing the square root of AVE with latent variable correlation estimate. Our results showed that the square root of AVE for each construct was greater than its correlation estimates among constructs (see Tables 22 and 23). Discriminant validity was also assessed by examining the cross-loadings. Cross-loadings were created by correlating standardized manifest variables with their respective latent variables. All indicators were highly loaded on their targeted factors (see Table 24). Therefore, the lower-order reflective measurement models demonstrated discriminant validity.

Table 22. Reliability and Validity for Lower-Order Constructs of System Quality

	CR	AVE	REL	EOU	INT	RTM	SEC	FUN
REL (F)	-	-	-					
EOU (R)	0.873	0.697	0.663	0.835				
INT (F)	-	-	0.601	0.700	-			
RTM (F)	-	-	0.612	0.630	0.697	-		
SEC (R)	0.872	0.695	0.415	0.540	0.615	0.575	0.834	
FUN (R)	0.873	0.697	0.445	0.482	0.601	0.498	0.536	0.835

Note. F = formative construct and R = reflective constructs. Psychometric properties for formative constructs were not reported. Square roots of AVE are on diagonal.

Table 23. Reliability and Validity for Lower-Order Constructs of Information Quality

	CR	AVE	UND	COM	TML
UND	0.857	0.601	0.775		
COM	0.853	0.659	0.716	0.812	
TML	0.896	0.742	0.715	0.773	0.861

Note. Square roots of AVE are on diagonal.

Table 24. Cross-Loadings for Lower-Order Constructs

	EOU	SEC	FUN	UND	COM	TML
EOU1	**.843**	.476	.484	.484	.493	.411
EOU3	**.839**	.469	.452	.536	.521	.501
EOU4	**.822**	.401	.244	.394	.352	.349
SEC1	.410	**.768**	.428	.418	.352	.342
SEC2	.518	**.893**	.505	.408	.461	.485
SEC3	.417	**.836**	.406	.334	.442	.396
FUN1	.419	.433	**.816**	.377	.466	.313
FUN2	.395	.471	**.857**	.453	.458	.410
FUN3	.396	.438	**.831**	.409	.501	.397
UND1	.501	.311	.321	**.781**	.598	.657
UND2	.387	.327	.311	**.734**	.576	.545
UND3	.410	.369	.401	**.775**	.500	.527
UND4	.471	.414	.489	**.809**	.552	.501
COM1	.507	.393	.448	.656	**.852**	.639
COM2	.503	.436	.491	.573	**.793**	.591
COM3	.345	.408	.454	.512	**.787**	.648
TML1	.416	.413	.413	.701	.716	**.854**
TML2	.480	.452	.342	.500	.579	**.835**
TML3	.418	.409	.408	.653	.704	**.895**

Higher-order measurement models. The higher-order measurement models were assessed using the approach suggested by Chin and Gopal (1995). First, the latent variable scores of low-order constructs were obtained in the lower-order models. Then, the latent variable scores of lower-order constructs were used as indicators in the higher-order model.

System quality and information quality are higher-order constructs in the research model. The latent variable scores for their underlying lower-order constructs were

obtained in their respective nomological frameworks (see Figures 8 and 9). The formative model and the reflective model were assessed separately.

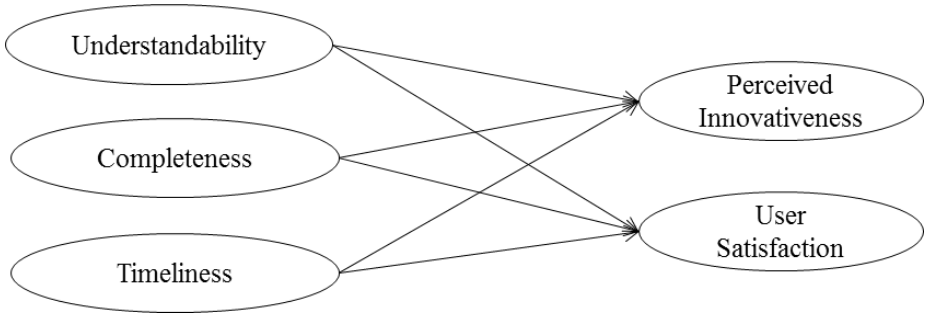


Figure 9. Nomological Framework for Information Quality

Higher-order formative measurement models. Similar to evaluating lower-order formative constructs, collinearity and the significance and relevance of the formative indicators for system quality and information quality were examined. VIF values of the indicators of system quality and information quality are presented in Table 25. Values of VIF were all less than the threshold value of 5, suggesting that collinearity was not an issue for the formative constructs.

Table 25. Collinearity for Higher-Order Formative Indicators

Higher-Order Construct	Indicator	VIF
System Quality	Reliability	2.154
	Ease of Use	2.528
	Interface	3.130
	Response Time	2.774
	Security	1.897
	Functionality	1.829
Information Quality	Understandability	2.693
	Completeness	3.355
	Timeliness	3.253

The relevance and significance of formative indicators were examined by outer weights and their corresponding *t* statistics and *p* values (see Table 26). According to Hair et al. (2013), a formative indicator can make a relative contribution (i.e., a significant *p*

value) or an absolute contribution (i.e., an insignificant *p* value but its loading is greater than 0.5) to its construct. For system quality, three indicators, namely interface, response time, and security, contributed significantly to form this construct. Reliability, ease of use, and functionality had insignificant weights, but their outer loadings were above 0.5, indicating that these indicators made absolute contributions to system quality. Understandability and completeness contributed significantly to information quality. Timeliness was also an important indicator of information quality with its high loading (i.e., above 0.5) even though its weight was insignificant.

Table 26. Relevance and Significance for Higher-Order Formative Indicators

Higher-Order Construct	Lower-Order Construct	Weight	Loading	*t* stat	*p* value
System Quality	Reliability	-0.085	0.580	0.989	0.32
	Ease of Use	0.036	0.718	0.311	0.76
	Interface	0.458	0.914	4.880	<0.001
	Response Time	0.234	0.809	2.360	0.02
	Security	0.323	0.830	4.143	<0.001
	Functionality	0.199	0.743	1.866	0.06
Information Quality	Understandability	0.477	0.921	4.209	<0.001
	Completeness	0.436	0.920	3.199	<0.001
	Timeliness	0.185	0.863	1.287	0.20

Higher-order reflective measurement models. The endogenous variables, (i.e., perceived innovativeness, user satisfaction, and intention to continue using) formed the higher-order reflective measurements. These measurement models were assessed using indicator reliability, construct reliability, convergent validity, and discriminant validity.

Factor loadings for perceived innovativeness, user satisfaction, and intention to continue using are presented in Table 27. All the indicators had factor loadings that

exceeded the threshold of 0.707 (Barclay et al., 1995). Therefore, we concluded that the measurement models showed indicator reliability.

Table 27. Factor Loadings for Endogenous Variables

	Manifest Variables	Loading
INN1	___ is innovative in adopting new technology.	0.898
INN2	The overall impression I have of ___ is that they are technologically innovative.	0.878
INN3	___ is a leader in technology.	0.880
SAT1	The experience that I have had with my ___ app has been satisfactory.	0.784
SAT2	Overall, I am satisfied with the way that my ___ app has performed.	0.853
SAT3	In general, I am satisfied with my ___ app.	0.839
CTU1	Assuming mobile technology is available to me, I will use my ___ app on a regular basis in the future.	0.844
CTU2	Assuming what I want to do can be done through my ___ app, I will probably use the app rather than visiting a branch or going online.	0.767
CTU3	For future banking tasks, I will continue to use my ___ app.	0.879
CTU4	Whenever possible, I will use my ___ app to do my banking tasks in the future.	0.862

Construct reliability for the endogenous variables was accessed by examining composite reliability. Values for composite reliability were all greater than the 0.7 cut-off, indicating acceptable construct reliability (see Table 28).

AVE values of the endogenous variables were evaluated to assess convergent validity. All the AVE values were all greater than the 0.5, which provides evidence of acceptable convergent validity (see Table 28).

The Fornell-Larcker criterion (Fornell & Larcker, 1981) was applied to examine discriminant validity. The square roots of AVE values were greater than the latent variable correlations, suggesting discriminant validity of the higher-order measurement models (see Table 28). The cross-loadings of higher-order reflective constructs as displayed in Table 29 also provided evidence for discriminant validity.

Table 28. Reliability and Validity for Higher-order Measurement Model

	CR	AVE	SYSQ	INFOQ	INN	SAT	CTU
SYSQ (F)	-	-	-				
INFOQ (F)	-	-	0.728	-			
INN (R)	0.916	0.784	0.710	0.451	0.885		
SAT (R)	0.865	0.682	0.694	0.700	0.575	0.826	
CTU (R)	0.905	0.704	0.592	0.465	0.636	0.607	0.839

Note: F = formative construct and R = reflective construct. Square roots of AVE are on diagonal. Psychometric properties for formative constructs were not reported.

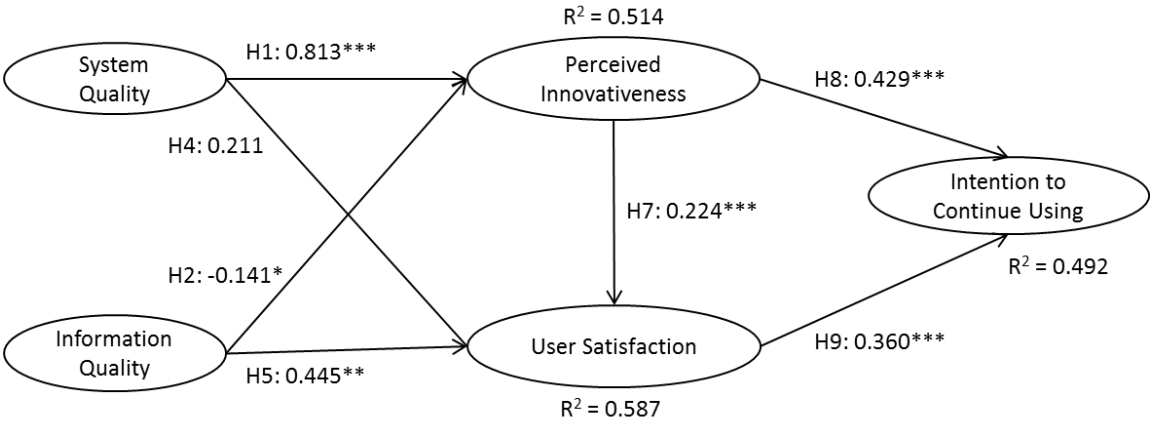
Table 29. Cross-Loadings for Higher-Order Constructs

	INN	SAT	CTU
SAT1	.383	**.784**	.401
SAT2	.499	**.853**	.548
SAT3	.528	**.839**	.539
INN1	**.898**	.554	.566
INN2	**.878**	.506	.589
INN3	**.880**	.461	.533
CTU1	.562	.600	**.844**
CTU2	.421	.373	**.767**
CTU3	.573	.566	**.879**
CTU4	.556	.459	**.862**

Structural Model

The measurement models provided evidence of acceptable psychometric properties. Therefore, we examined the structural model. Hair et al. (2013) recommended four criteria for assessing structural models in PLS-SEM: path coefficients, coefficient of determination (R^2), effect size f^2, and predictive relevance Q^2.

Path coefficients. Path coefficient describes the strength of a hypothesized relationship (Hair et al., 2013). The path coefficients of the research model are presented in Figure 10.



Note. *** $p < .001$; ** $p < .01$; * $p < .05$

Figure 10. Results of the PLS Structural Model

The PLS structural model does not create *p* values for the path coefficients. Alternatively, the significance of path coefficients can be obtained by examining the *t*-statistics and the corresponding *p* values (Hair et al., 2013). The jackknifing procedure was used to calculate the *t*-statistics (Chin, 1998). Then, the corresponding *p* values were computed using the T.DIST.2T function in Microsoft Excel (Gaskin, 2011). The path coefficients, *t*-statistics, and *p* values are displayed in Table 30.

Table 30. Significance of Path Coefficients

Hypothesis	Path Coefficient	*t* stat	*p* value
H1: System quality --> Perceived innovativeness	0.813	11.885	<0.001
H2: Information quality --> Perceived innovativeness	-0.141	2.279	0.02
H4: System quality --> User satisfaction	0.211	1.104	0.27
H5: Information quality --> User satisfaction	0.445	2.546	0.01
H7: Perceived innovativeness --> User satisfaction	0.224	3.771	<0.001
H8: Perceived innovativeness --> Intention to continue using	0.429	4.845	<0.001
H9: User satisfaction --> Intention to continue using	0.360	4.909	<0.001

Note: H3 and H6 were not tested due to insufficient sample size of service quality

Hypothesis 1 stated that system quality would have a positive impact on user perception of bank innovativeness. The path coefficient was found to be significant. This relationship, therefore, was supported ($r = 0.813$; $t = 11.88$; $p < 0.001$).

The second hypothesis proposed that information quality would have a positive impact on users' perceptions of bank innovativeness. However, information quality was negatively associated with perceived innovativeness ($r = -0.141$), which was opposite to the proposed direction of the relationship. Therefore, H2 was not supported.

We hypothesized that system quality would have a positive impact on user satisfaction with their current banking app. This relationship (H4) was not supported since the path coefficient was not significant ($r = 0.211$; $t = 1.10$; $p = 0.27$).

Hypothesis 5 stated that information quality will have a positive impact on user satisfaction with their current banking app. This hypothesis was supported ($r = 0.445$; $t = 2.55$; $p = 0.001$).

Hypothesis 7 predicted that user perception of bank innovativeness would have a positive impact on user satisfaction with their banking app. This path was found to be significant ($r = 0.224$; $t = 3.77$; $p < 0.001$), and, therefore, H7 was supported.

We also hypothesized that user perception of bank innovativeness would have a positive impact on users' intentions to continue using their current banking app (H8). This relationship was significant ($r = 0.429$; $t = 4.85$; $p < 0.001$). Therefore, H8 was supported.

Last, hypothesis 9 proposed that user satisfaction with their banking app would have a positive impact on their intentions to continue using their current banking app. This hypothesis was supported with a significant *t*-statistic of 4.91 ($p < 0.001$).

Coefficient of determination (R^2). Coefficient of determination (R^2) evaluates the predictive accuracy of the structural model (Hair et al., 2013). R^2 represents the amount of explained variance of each endogenous latent variable (Hair et al., 2012). Three endogenous latent variables were included in the research model: perceived innovativeness, user satisfaction, and intention to continue using. The R^2 for each endogenous latent variable is shown in Table 31.

Table 31. R^2 for Endogenous Latent Variable

Endogenous Latent Variable	R^2
Perceived Innovativeness	0.514
User Satisfaction	0.587
Intention to Continue Using	0.492

Approximately 51% of the variance in perceived innovativeness was explained by system quality and information quality, and 59% of the variance in user satisfaction was accounted for by its exogenous variables (i.e., system quality, information quality, and

perceived innovativeness). Finally, approximately 49% of the variance in intention to continue using was explained by perceived innovativeness and user satisfaction.

Effect size (f^2). Effect size (f^2) assesses the impact of a particular exogenous latent variable on an endogenous latent variable (Hair et al., 2012). The f^2 captures the change in the R^2 when an exogenous construct is omitted, and the effect size is calculated as $f^2 = \frac{R^2_{included} - R^2_{excluded}}{R^2_{included}}$. Values for f^2 of 0.02, 0.15, and 0.35 represent small, medium, and large effects (Hair et al., 2013).

The structural model included four exogenous latent variables: system quality, information quality, perceived innovativeness, and user satisfaction. Their respective effect sizes on related endogenous latent variables are outlined in Table 32.

Table 32. f^2 Effect Size for Exogenous Constructs

Exogenous Constructs	Endogenous Constructs	f^2	Effect Size
System Quality	Perceived Innovativeness	0.63	Large
System Quality	User Satisfaction	0.03	Small
Information Quality	Perceived Innovativeness	0.02	Small
Information Quality	User Satisfaction	0.22	Medium
Perceived Innovativeness	User Satisfaction	0.03	Small
Perceived Innovativeness	Intention to Continue Using	0.24	Medium
User Satisfaction	Intention to Continue Using	0.17	Medium

System quality had a large effect on perceived innovativeness (f^2 = 0.63), whereas its effect on user satisfaction was small (f^2= 0.03). The effect size of information quality on user satisfaction was medium (f^2 = 0.22). However, information quality had a small impact on perceived innovativeness (f^2= 0.02).

Perceived innovativeness had a small effect on user satisfaction (f^2 = 0.03). Its effect size on intention to continue using was medium with an f^2 value of 0.24. Last, the effect size of user satisfaction on intention to continue using was medium (f^2 = 0.17).

Predictive Relevance (Q^2). The final assessment of the structural model is predictive relevance (Q^2 or Stone-Geisser's Q^2). A model exhibiting predictive relevance can accurately predict the data points of indicators of an endogenous construct in a reflective model (Hair et al., 2013).

The blindfolding procedure is used by assuming some data points in the indicators of endogenous constructs are missing (Gotz et al., 2010). The Q^2 values estimated by the blindfolding procedure represent how well the path model can predict the original data (Hair et al., 2013).

A positive value for an endogenous construct indicates that the endogenous measurement model has predictive validity (Gotz et al., 2010). The value of Q^2 for each endogenous construct was larger than zero (see Table 33), providing evidence of predictive validity for the structural model.

Table 33. Q^2 for Endogenous Constructs

Endogenous Construct	Q^2
Perceived Innovativeness	0.337
User Satisfaction	0.352
Intention to Continue Using	0.285

Similar to f^2 effect size, the effect size of predictive relevance (q^2) of a certain exogenous construct is assessed by the change in Q^2 when an exogenous construct is excluded. The q^2 effect size is calculated as $q^2 = \frac{Q^2_{included} - Q^2_{excluded}}{1 - Q^2_{included}}$, and values for q^2 of 0.02, 0.15, and 0.35 indicate an exogenous construct has a small, medium, or large

predictive relevance for a particular endogenous construct (Hair et al., 2013). Table 34 presents the q^2 effect size for exogenous constructs.

Table 34. q^2 Effect Size for Exogenous Constructs

Exogenous Constructs	Endogenous Constructs	q^2	Effect Size
System Quality	Perceived Innovativeness	0.58	Large
System Quality	User Satisfaction	0.01	None
Information Quality	Perceived Innovativeness	0.01	None
Information Quality	User Satisfaction	0.13	Small
Perceived Innovativeness	User Satisfaction	0.03	Small
Perceived Innovativeness	Intention to Continue Using	0.17	Medium
User Satisfaction	Intention to Continue Using	0.11	Small

The q^2 value of 0.58 suggested that system quality had large predictive relevance to perceived innovativeness. However, information quality did not exhibit predictive relevance on perceived innovativeness (q^2 = 0.01). Similarly, system quality did not have predictive relevance for user satisfaction (q^2 = 0.01). Both information quality and perceived innovativeness had small predictive relevance on user satisfaction. Last, perceived innovativeness and user satisfaction had medium and small predictive relevance on intention to continue using respectively (q^2 = 0.17; q^2 = 0.11).

Post-Hoc Analysis

Post-hoc analysis of the measurement models. The formative measurements for reliability, interface, and response time were developed based on the content analysis. In the initial measurement model, some formative items did not have significant outer weights. We acknowledge that formative indicators are not supposed to be dropped as eliminating formative items may cause their related construct to be incomplete. However, we decided to revise the measurement model by progressively dropping the insignificant items for the formative lower-order constructs to further explore the importance of the

formative items in this research context. Then, we tested whether the revised measurement models influenced the results of the structural model.

Except for REL1, the other indicators of reliability did not show significant outer weights in the initial measurement model. REL5 had the least contribution to its construct so REL5 was dropped first. For the remaining indicators, REL2 and REL3 had insignificant weights, and the weight of REL2 was slightly greater than that of REL3. Therefore, REL3 was dropped in the next step. Weights and significance for the remaining indicators (i.e., REL1, REL2, and REL4) were examined again. The results showed that only REL2 was an insignificant indicator for reliability. After dropping REL2, REL1 and REL4 significantly contributed to the construct of reliability.

The significant outer weights for REL1 and REL4 indicated that they were the key items for the reliability of banking apps: “My banking app does not log me out in the middle of transactions” and “Pages on my banking app do not freeze.” Some of our respondents have experienced these issues, and both of these issues may make users unsure if their transactions or service requests have been completed or not. Consequently, users may feel less control over their banking apps. REL2, REL3, and REL5 were not significant, which suggested that problems related to these items might have been fixed by banks and that they no longer influenced the reliability of banking apps.

The same procedure was repeated to trim the indicators for interface. INT1, INT4, and INT5 were dropped due to insignificant weights. None of the indicators were dropped for response time since all its indicators exhibited significant contribution in forming the construct. The relevance and significance of the trimmed formative indicators are outlined in Table 35.

INT2, INT3, and INT6 significantly contributed to user interface, which suggested that users may appreciate well designed menus, interfaces, and straightforward navigation. INT1 and INT4, however, had insignificant weights. INT1 and INT4 asked respondents if the information on their banking apps is attractively displayed and if the layout of their banking apps is appealing. It is possible that users expect the interface of banking apps to be concise rather than aesthetic. INT5 asked about a banking app's ability to adjust to different screen sizes on mobile devices. This item was not significant. A possible explanation is that most of our respondents only use their banking app on one mobile device so they were not able to evaluate this item. Last, the four formative items measuring response time were all significant.

Table 35. Relevance and Significance for Lower-Order Formative Constructs (Trimmed)

Lower-Order Construct	Indicator	Weight	*t* stat	*p* value
Reliability	REL1	0.577	2.840	<0.001
	REL4	0.588	3.115	<0.001
Interface	INT2	0.564	5.653	<0.001
	INT3	0.271	2.635	0.01
	INT6	0.353	3.389	<0.001
Response time	RTM1	0.290	2.314	0.02
	RTM2	0.266	2.528	0.01
	RTM3	0.376	3.764	<0.001
	RTM4	0.349	3.014	<0.001

The trimmed formative indicators as well as the reflective indicators for the lower-order constructs were used to create latent variable scores. Then, latent variable scores were used as indicators for the higher-order constructs (i.e., system quality and information quality) in the structural model. The relevance and significance of lower-order constructs to their respective higher-order construct were examined in the structural model (see Table 36). Except for functionality, the significance of the

lower-order constructs did not change compared to the initial measurement model. Functionality became significant in forming system quality in the revised measurement model. It is possible that dropping formative items in the lower-order model affected the latent variable scores of higher-order constructs, which further influenced the relevance and significance of functionality.

Table 36. Relevance and Significance for Higher-Order Formative Constructs (Trimmed)

Higher-Order Construct	Lower-Order Construct	Weight	Loading	*t* stat	*p* value
System Quality	Reliability	-0.053	0.548	0.745	0.46
	Ease of Use	0.042	0.719	0.402	0.69
	Interface	0.433	0.909	5.242	<0.001
	Response Time	0.244	0.809	2.765	0.01
	Security	0.316	0.831	4.576	<0.001
	Functionality	0.194	0.744	2.066	0.04
Information Quality	Understandability	0.477	0.921	3.695	<0.001
	Completeness	0.437	0.920	2.960	<0.001
	Timeliness	0.185	0.863	1.046	0.30

Results of the structural model using the revised measurement model are outlined in Tables 37 and 38. The revised measurement model slightly changed the path coefficients and R^2 for endogenous latent variables. H2 was not supported in the initial model due to its negative path coefficient. When using the revised measurement model, H2 was still not supported as it had an insignificant *p* value and a negative path coefficient.

Table 37. Significance of Path Coefficients for Revised Measurement Model

Path	Path coefficient	*t* stat	*p* value
H1: System quality --> Perceived innovativeness	0.817	12.071	<0.001
H2: Information quality --> Perceived innovativeness	-0.143	1.012	0.31
H4: System quality --> User satisfaction	0.196	1.852	0.07
H5: Information quality --> User satisfaction	0.454	3.522	<0.001
H7: Perceived innovativeness --> User satisfaction	0.231	3.670	<0.001
H8: Perceived innovativeness --> Intention to continue using	0.429	5.123	<0.001
H9: User satisfaction --> Intention to continue using	0.360	4.662	<0.001

Table 38. R^2 for Revised Measurement Model

Endogenous Latent Variable	R^2
Perceived innovativeness	0.517
User satisfaction	0.585
Intention to continue using	0.492

Post-hoc analysis of the structural model. A revised structural model was created by eliminating the non-significant paths (i.e., H2 and H4). The insignificant paths might influence other parts of the model, so dropping them might improve the structural model. Figure 11 depicts the revised structural model. The path coefficients and their *p* values and R^2 were assessed (see Table 39 and Table 40).

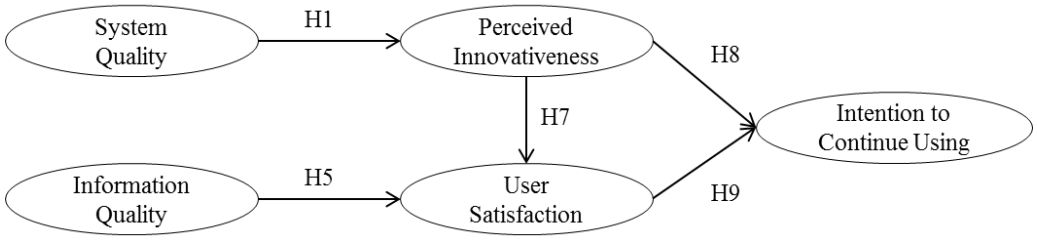


Figure 11. Revised Structural Model

Table 39. Significance of Path Coefficients for Revised Structural Model

Path	Path coefficient	*t* stat	*p* value
H1: System quality --> Perceived innovativeness	0.720	17.671	<0.001
H5: Information quality --> User satisfaction	0.560	6.751	<0.001
H7: Perceived innovativeness --> User satisfaction	0.329	2.924	<0.001
H8: Perceived innovativeness --> Intention to continue using	0.429	5.192	<0.001
H9: User satisfaction --> Intention to continue using	0.360	3.758	<0.001

Table 40. R^2 for Revised Structural Model

Endogenous Latent Variable	R^2
Perceived innovativeness	0.531
User satisfaction	0.583
Intention to continue using	0.492

In comparison to the initial structural model, the path coefficients were slightly improved for H5 and H7. Approximately 53% of the variance in perceived innovativeness was explained by system quality, which was higher when compared to explained variance in the initial model. Path coefficients for H8 and H9 as well as R^2 for user satisfaction and intention to continue using did not change in the revised structural model.

Based on the above post-hoc analyses, the revised measurement models and the revised structural model did not significantly improve the results of data analyses. In the revised measurement models, we dropped the formative items with insignificant outer weights. Insignificant outer weights for formative indicators suggest that these indicators have little contribution or influence in forming the underlying construct. Consequently, including or eliminating the insignificant indicators may have little impact on the structural model. In the revised structural model, two insignificant paths (i.e., H2 and H4) were

excluded. Dropping these paths, however, did not result in significant improvements for the structural model. A plausible explanation is that the strength of either path (i.e., r = -0.141 for H2 and r = 0.211 for H4) is too weak to improve the R^2, path coefficients, or p values. Based on the above discussion, we concluded that the revised models are not preferred over the initial model.

Chapter 7: Discussion

This study adopted and extended the DeLone and McLean IS Success Model (1992, 2003). We acknowledged the multidimensional structures of system quality and information quality and operationalized them as higher-order constructs. Moreover, we empirically tested two relationships (i.e., system quality and satisfaction, and information quality and satisfaction) proposed in the DeLone and McLean IS Success Model (1992, 2003) in the context of mobile banking apps. Last, we extended the IS Success Model by incorporating two endogenous variables (i.e., perceived innovativeness and intention to continue using).

Based on the results of our data analysis, we discuss and interpret the findings of this study. In addition, theoretical and practical implications are presented. Last, we explain potential limitations of our study.

Dimensions of System Quality and Information Quality

In this study, we explored the multidimensional structures of system quality and information quality. Operationalizing them as higher-order formative constructs allowed us to investigate the importance and contribution of the dimensions (or lower-order constructs) to their related higher-order constructs.

We investigated six dimensions of system quality: reliability, ease of use, interface, response time, security and functionality. These aspects of system quality were revealed in our exploratory content analysis. Their relevance (i.e., weights) and significance (i.e., *t* statistics and *p* values) were examined. Interface, response time, and security were found to be significant indicators for system quality.

The importance of the user interface may be explained by the screen sizes of mobile devices. Mobile banking apps run on smart phones or tablets where the screen sizes are limited. This requires banking apps to make effective use of the screen and provide a well-designed menu and straightforward navigation. Response time also significantly contributes to system quality of banking apps. Users expect their banking apps to quickly log them in and out, load content, and process transactions. Fast access to banking services is one of the key advantages of banking apps. If banking apps cannot quickly respond to users' requests, banking apps may lose their competitive advantage relative to online banking. Security is another dimension that significantly contributes to system quality. Security of banking apps is closely related to users' monetary safety. Unauthorized access to banking apps may cause account losses. Therefore, developers need to enhance the security of banking apps and investigate new techniques to prevent fraud and unauthorized access through banking apps.

In contrast, reliability, ease of use, and functionality did not significantly contribute to system quality. Our content analysis revealed a series of issues related to reliability based on the online reviews posted from June 5, 2011 to May 25, 2012. Banks may have updated their apps, addressing some of the reliability issues. Ease of use was not a significant indicator in forming system quality either. Users of mobile devices have many chances to use different types of mobile apps on their devices. Familiarity with mobile apps in general may make using banking apps easier. Last, we found that users mainly conducted basic banking tasks on the apps, such as viewing balances and activities, paying bills, and transferring funds. These basic functions are provided by

most banking apps, which may explain why users did not associate functionality with system quality.

Three dimensions of information quality were examined in this study: understandability, completeness, and timeliness. Understandability and completeness were found to be desired characteristics of the information displayed on the banking apps. For instance, someone wanting to send an email transfer should be able to look up the recipient information on the app. Incomplete information may make mobile banking less convenient. Timeliness did not turn out to be a significant indicator of information quality of banking apps. Users of banking apps may accept that banking apps retrieve information from the same databases as online banking and ATMs. If users cannot check their latest purchases with their banking apps, they understand that the transaction record may not have been submitted to the bank's database. Consequently, they do not blame the delay on the banking apps.

Updated DeLone and McLean IS Success Model

In this study, we empirically examined the relationships between system quality and user satisfaction, and information quality and user satisfaction. DeLone and McLean (1992, 2003) propose that system quality positively influences user satisfaction. However, this relationship was not supported in the context of mobile banking apps. The result, nevertheless, was consistent with previous research where system quality did not significantly impact user satisfaction of student loan systems (H. Chong et al., 2010) and taxation systems (Floropoulos et al., 2010).

System quality had a small and insignificant impact on user satisfaction (f^2 = 0.031, p = 0.057). A possible explanation is that our respondents may not have high

expectations of system quality and their basic requirements of system quality have been met. As experienced users, our respondents may acknowledge and accept some limitations of banking apps, such as slow response time and potential security threats. Bank customers may also tolerate these glitches in order to "bank on-the-go." As a result, their level of satisfaction is not affected by system quality.

We also tested the relationship between information quality and user satisfaction as proposed by DeLone and McLean (1992, 2003). We found that information quality significantly influenced user satisfaction ($p = 0.004$) and it had a medium effect on user satisfaction ($f^2 = 0.183$). This finding is consistent with previous studies (H. Chong et al., 2010; Floropoulos et al., 2010; Rai et al., 2002; Y.-S. Wang, 2008).

Our participants indicated that some of their frequently used functions through banking apps were information oriented, such as viewing account balance and activities, reviewing payment history, checking transactions right after a purchase, etc. (see Table 17). These functions suggest that in addition to conducting transactions, users also rely on banking apps to check for information. Therefore, their information seeking requests can only be satisfied when banking apps provide quality information.

Perceived Innovativeness

DeLone and McLean (2003) included "net benefits" as one success dimension in their Updated IS Success Model. However, they did not identify what net benefits should include and encouraged researchers to determine and measure benefits in different contexts and objectives. In this study, we investigated perceived innovativeness as a benefit. We defined perceived innovativeness as the extent to which bank customers perceive a bank to be technologically innovative. We found that system quality had

significant impacts on perceived innovativeness, which in turn, influenced user satisfaction and intention to continue using.

System quality had a positive and significant impact on perceived innovativeness and its effect size was large ($p < 0.001$, $f^2 = 0.363$). Even though we did not find a significant relationship between system quality and user satisfaction, excellent system quality of banking apps can impress users and make them perceive the bank to be more technologically innovative. This, in turn, may lead them to believe that their banks have the capability to optimize banking apps, which will further increase their satisfaction levels.

We also tested the impact of information quality on perceived innovativeness. This relationship, however, was not supported. In this research context, information displayed on banking apps is not different from the information displayed on online banking or bank statements. The information displayed on banking apps, in fact, is often simplified given the small screen size and the limited computing capacity of mobile devices. Therefore, information quality is unlikely to enhance a bank's innovativeness. In addition, we found a negative relationship between information quality and perceived innovativeness, which was in the opposite direction to that hypothesized. This may imply that users do not expect too much information to be displayed on banking apps. Users may perceive a bank to be technologically innovative when only the essential information is displayed to support the banking functions they use on their apps.

Intention to Continue Using

In this study, we investigated the post-adoption of mobile banking apps by examining the intention to continue using. Perceived innovativeness and user satisfaction were found to have significant impacts on intention to continue using banking apps. In total, 49.2% of the variance in intention to continue using was explained by the research model, which exceeds the amount of variance explained by the framework proposed by Püschel et al. (2010) (see Figure 1).

Püschel et al. (2010) investigated users intention to continue using mobile banking from the perspectives of sociology and social psychology. For example, they examined the impact of subjective norm on intention to continue using. Their model only explained 27.9% of the variance for intention to continue using mobile banking. Unlike other types of information systems, mobile banking apps are private where users deal with their financial information on the apps. Therefore, users of banking apps are less likely to communicate their use experience, which may suggest that sociological and social psychological factors (e.g., subjective norm) have less explanatory power on behavioural intention (e.g., intention to continue using).

Theoretical Implications and Future Studies

The present study empirically tested the impacts of system quality and information quality on user satisfaction in a mobile environment. These relationships are part of the IS Success Model (DeLone & McLean, 1992, 2003). The relationship between system quality and user satisfaction was not supported, which implies that users of mobile banking apps may have different expectations of and requirements for system quality. Future studies could test this relationship as well as the IS Success Model using

other utilitarian mobile information systems. For example, researchers could examine mobile commerce apps, such as the mobile app for eBay, and compare their findings with ours.

Previous studies have not taken a consistent approach to operationalizing system quality and information quality. For example, Rai et al. (2002) used ease of use to represent system quality, while H. Chong et al. (2010) measured system quality using ease of use, reliability, accessibility, usefulness, flexibility, and ease of use. In this study, we acknowledged that system quality and information quality are multidimensional and we operationalized them as higher-order constructs. Therefore, we were able to conceptualize a more comprehensive framework for system quality and information quality. Future research could further explore the advantages of treating them as higher-order constructs. Furthermore, future research could continue exploring other dimensions of system quality and information quality for mobile apps. For example, researchers could use qualitative methods (e.g., interviews) to investigate possible dimensions that may contribute to system quality and information quality.

Innovativeness has been studied in the marketing literature as one aspect of corporate reputation, but little research has been done to investigate whether innovativeness impacts technology adoption and acceptance. In this study, we included perceived innovativeness as one of the endogenous variables and found that it had significant impacts on user satisfaction and intention to continue using. It could be interesting to extend other IS theories by incorporating perceived innovativeness. For example, researchers could study whether perceived innovativeness impacts attitude or social norm.

We intended to examine the role of service quality in determining perceived innovativeness and user satisfaction in the context of mobile banking apps. However, we were not able to test the proposed relationships due to an insufficient sample size. Future studies could explore the importance of technical support and customer service in affecting user satisfaction and perceived innovativeness. Support provided by banks may play an important role to help users overcome technical difficulties, especially when new technologies are introduced to bank customers.

Last, some new formative measurements were developed based on the content analysis so that they better reflect the research context of mobile banking apps. These measurement scales exhibit satisfactory levels of quality in this study, and they may be applicable for evaluating other mobile applications. Future studies could continue validating these measurements in other mobile environments, such as mobile commerce.

Practical Implications

This study provides a framework for banks to assess the success of their banking apps. We investigated the success of mobile banking apps from five dimensions: system quality, information quality, perceived innovativeness, user satisfaction, and intention to continue using. System quality and information quality represent technical and semantic levels of success. They are the foundations for achieving higher levels of success: user satisfaction and perceived innovativeness. Successful banking apps can satisfy users and build the bank's reputation of being technologically innovative. Intention to continue using is the highest level of success for banking apps. Only when bank customers continue to interact with banking apps will long term benefits, such as reduced labor

costs, reallocated service demands, enhanced customer relationships, be achieved by banks.

This study also helps developers of banking apps identify user requirements. Among the system characteristics we examined, user interface, response time, and security are the main attributes of system quality for banking apps. These suggest that banking app developers should focus on optimizing user interfaces, reducing response time, and enhancing security control when designing and updating banking apps. Moreover, understandability and completeness are the key attributes of information quality for users of banking apps. This requires developers to carefully consider users' literacy in interpreting banking information and to retrieve sufficient information from banks' databases to support banking functions that are available on the apps.

Limitations

There were five limitations in this research. First, using the Qualtrics online panel provided an easily approach to access a segment of our targeted population, but we lost the opportunity to approach a larger group of banking app users. Only two-hundred participants were requested from the Qualtircs online panel for budgetary reasons. Our online survey was closed when the quota was met. Consequently, later respondents were not able to participate in this study and their opinions were not available to us.

Second, the sample of this study may not represent the general population of interest and may make generalization difficult. We noticed that the mean scores of most of the manifest variables were above 4. This indicates that most of our respondents seem to be satisfied with their primary banking apps. It is possible that those banking app users

who were not satisfied with their banking apps might not have participated in the study, which resulted in biased responses.

Third, we only included adopters of banking apps in this study. It is possible that non-adopters may have different opinions on banking apps qualities. Banking app qualities may also have different impacts on their level of satisfaction, perceived innovativeness, and intention to use.

Fourth, participants received incentives from the Qualtrics online panel. Incentives encourage participation, but they might bias the responses. The participants might spin their responses to make them look better to the researchers. However, Mizes, Fleece, and Roos (1984) found that monetary incentives increase response rate, but do not appear to bias responses.

Last, we operationalized system quality and information quality as formative higher-order constructs. Six dimensions of system quality were selected based on the content analysis and three dimensions of information quality were selected based on the literature. Our selections of indicators for system quality and information quality might not cover the entire scope of the latent variables, leaving some determinants of system quality and information quality excluded from this study.

Conclusions

This study empirically tested and modified the DeLone and McLean IS Success Model (1992, 2003) in the context of mobile banking apps. Some of our findings were not consistent with the relationships proposed in the DeLone and McLean IS Success Model. For example, system quality did not have significant impacts on user satisfaction.

This suggests that users may have different requirements and expectations of mobile apps.

In addition to system quality, information quality, and user satisfaction, we included perceived innovativeness and intention to continue using as other success dimensions of mobile banking apps. A successful banking app should influence how its users perceive the bank's technological innovativeness. Furthermore, a banking app is successful and beneficial to the bank only when its clients continue to use it.

We used different ways to operationalize system quality and information quality compared to previous studies. System quality and information quality were operationalized as higher-order formative constructs so that we were able to better capture their multidimensional structures.

This research also provides value for the banking industry. First, we provided a framework for banks to evaluate the success of their banking apps. We proposed five success dimensions for banking apps. Banks could adopt these dimensions to assess the success of their banking apps. Banks, however, should note that these dimensions are interrelated and no single dimension is superior to another. Therefore, they should be examined jointly. Second, banks and banking app developers should note that user requirements and expectations of system quality and information quality might be slightly different for banking apps compared to other types of software applications. For example, users may expect faster response time and enhanced security control for banking apps. Therefore, banks and banking app developers should carefully consider user requirements and adjust system design and information display accordingly.

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Appendix A - Summary of MIS Success Measures by Category (DeLone & McLean, 1992, pp 84-85)

System Quality	Information Quality	Information Use	User Satisfaction	Individual Impact	Organization Impact
Data accuracy	Importance	Amount of use/duration of use	Satisfaction with specifics	Information understanding	Application portfolio
Data currency	Relevance	Number of inquiries	Overall satisfaction	Learning	Range and scope
Database contents	Usefulness	Amount of connect time	Single-item measure	Accurate interpretation	Number of critical applications
Ease of use	Informativeness	Number of functions used	Multi-item measure	Information awareness	Operating cost reductions
Ease of learning	Usableness	Number of records accessed	Information satisfaction	Information recall	Staff reduction
Convenience of access	Understandability	Frequency of report requests	Difference between information needed and received	Problem identification	Overall productivity gains
Human factors	Readability	Number of reports generated	Enjoyment	Decision effectiveness	Increased revenues
Realization of use	Clarity	Charges for system use	Software satisfaction	Decision quality	Increased sales
Usefulness of system features and functions	Format	Regularity of use	Decision-making satisfaction	Improved decision analysis	Increased market share
System accuracy	Appearance	Use by whom		Correctness of decision	Increased profits
System flexibility	Content	Direct vs. chauffeured use		Time to make decision	Return on investment

(Appendix A continues)

(Appendix A continued)

System Quality	Information Quality	Information Use	User Satisfaction	Individual Impact	Organization Impact
System reliability	Accuracy	Binary use		Confidence in decision	Return on assets
System sophistication	Precision	Use vs. nonuse		Decision-making participation	Ratio of net income to operating expenses
Integration of systems	Conciseness	Actual vs. reported use		Improved individual productivity	Cost/benefit ratio
System efficiency	Sufficiency	Nature of use		Change in decision	Stock price
Resource utilization	Completeness	Use for intended purpose		Causes management action	Increase work volume
Response time	Reliability	Appropriate use		Task performance	Product quality
Turnaround time	Currency	Type of information used		Quality of plans	Contribution to achieving goals
	Timeliness	Purpose of use		Individual power or influence	Increased work volume
	Uniqueness	Level of use		Personal valuation of IS	Service effectiveness
	Comparability	General vs. specific use		Willingness to pay for information	
	Quantitativeness	Recurring use			
	Freedom from bias	Institutionalization /routinization of use			
		Report acceptance			
		Percentage used vs. opportunity for use			
		Voluntariness of use			
		Motivation to use			

Appendix B - Measures of Quality Constructs in Recent Literature

Study / Quality construct	Floropoulos et al. (2010)	H. Chong et al. (2010)	Chatterjee et al. (2009)	Y.-S. Wang (2008)	H.-F. Lin (2008)	Wu (2007)	DeLone and McLean (2003)
System quality	Reliability Validity Flexibility Understand-ability	Ease of use Reliability Accessibility Usefulness Flexibility Ease of navigation	Extent of data processing Extent of information access Communica-bility Portability	Ease of use	Reliability Convenience of access Response time Flexibility	Accuracy Reliability Response time Ease of use Ease of navigation Usefulness	Adaptability Availability Reliability Response time Usability
Information quality	Completeness Accuracy Reliability Timeliness	Content Availability Accuracy Timeliness Conciseness Convenience		Accuracy Content Reliability Timeliness	Accuracy Completeness Currency Customized Format	Accuracy Impartiality Uniqueness Reliability Up-to-date Timeliness Completeness Precision Conciseness Understand-ability Format Usefulness of info Relevance Sufficient Clarity	Completeness Ease of understand-ing Personalization Relevance Security

(Appendix B continues)

(Appendix B continued)

Quality construct \ Study	Floropoulos et al. (2010)	H. Chong et al. (2010)	Chatterjee et al. (2009)	Y.-S. Wang (2008)	H.-F. Lin (2008)	Wu (2007)	DeLone and McLean (2003)
Service quality	Improved quality Simplified and standardized process Flexible interaction Improved control Improved cooperation Reduced time	Service availability Security Responsiveness Service quality	Reliability System support	Reliability Responsiveness Assurance Empathy		Up-to date technology Visual appealing Structure Professional look Timely service Error free Prompt service Willing to help Always respond Instill confidence Knowledgeable Close attention Users' interests	Assurance Empathy Responsiveness

Appendix C - Letter of Consent

Dear Participant:

You are invited to participate in a research study on mobile banking applications (apps). Banking apps are designed for your smart phone (e.g., iPhone, Blackberry, etc.) or tablet (e.g., iPad, Microsoft Surface, etc.), and let you bank on the go. In this study, we invite you to evaluate the quality of your banking app and to provide your perceptions of your banking app and your bank.

You will be asked to fill out a questionnaire and it will take about 20 minutes of your time. There are no anticipated risks or discomforts related to this research.

Your participation in this research is completely voluntary. You will receive awards for your participation from Qualtrics. **Please note that you are free to withdraw from the research at any time**. If you decide to withdraw, you can click on the "I do not consent to participate in this survey" option at the bottom of this consent letter. You can also choose to withdraw at the end of the survey by click on "Please delete me from this study and destroy all my responses" option. In either case, any information obtained from you will be destroyed.

Your responses will be confidential and anonymous to the researchers. First, no identifying information will be collected. Second, only my supervisors and I will have access to your responses. Last, data collected from the survey will be stored in a secure location, and all information will be destroyed after five years.

The results from this study will be presented as part of a Master's thesis, in journal articles, and/or presented at conferences and meetings. Only aggregate information and/or quotes from open-ended questions will be reported. No identifying information will be collected or released.

If you wish to receive a copy of the results from this study, you may contact the researcher at taoting.li@uleth.ca. If you have any other questions regarding your rights as a participant in this research, you may also contact the Office of Research Services at the University of Lethbridge at 403-329-2747 or research.services@uleth.ca.

Thanks for taking the time to participate in this study.

Taoting Li
Master of Science in Management Candidate
Faculty of Management
University of Lethbridge

I have read the above information regarding this study on mobile banking apps, and

- ❍ I consent to participate in this survey. (1)
- ❍ I do not consent to participate in this survey. (0)

Appendix D - Questionnaire

Mobile banking apps can be downloaded to your mobile devices (i.e., smart phones or tablets) from online app stores (e.g., iTunes) or links on a bank webpage. Mobile banking apps are designed to work on your smart phones or tablets and let you bank almost anywhere at any time.

Filter Questions:

Have you ever used a mobile banking app offered by a Canadian bank?
- ❍ Yes (1)
- ❍ No (0)

Are you 18 years old or above?
- ❍ Yes (1)
- ❍ No (0)

General Questions:

When is the last time you used a mobile banking app?
- ❍ Today (1)
- ❍ 1-7 days ago (2)
- ❍ 1-2 weeks ago (3)
- ❍ 3-4 weeks ago (4)
- ❍ 1-2 months ago (5)
- ❍ 3-4 months ago (6)
- ❍ More than 4 months ago (7)

Which Canadian bank provides your primary mobile banking app (i.e., the one you use most of the time)?
- ❍ Bank of Montreal (1)
- ❍ CIBC (2)
- ❍ HSBC Canada (3)
- ❍ ING Direct Canada (4)
- ❍ National Bank of Canada (5)
- ❍ RBC Royal Bank (6)
- ❍ Scotiabank (7)
- ❍ TD Canada Trust (8)
- ❍ Other (9) _____

How long have you been a customer of ___[4]?

- ❍ Less than 1 month (1)
- ❍ 1-6 months (2)
- ❍ 7-12 months (3)
- ❍ 1-5 years (4)
- ❍ 5-10 years (5)
- ❍ More than 10 years (6)

How long have (or did) you use the ___ app?

- ❍ Less than 1 month (1)
- ❍ 1-3 months (2)
- ❍ 4-6 months (3)
- ❍ 7-12 months (4)
- ❍ More than 12 months (5)

[4] In the online survey, the blank will be filled in by the selected option of Which Canadian bank provides your primary mobile banking app (i.e., the one you use most of the time)? This also applies to other items that contain a blank.

How often have you used the ___ app in the past 3 months?

- ❍ Less than once a week (1)
- ❍ About once each week. (2)
- ❍ Several times each week. (3)
- ❍ About once each day. (4)
- ❍ Several times a day. (5)

Please check all the activities that you have done through the ___ app in the last 3 months.

- ❑ View account balance (1)
- ❑ View account activity (2)
- ❑ Pay a bill (e.g., utility bill) (3)
- ❑ View pending bill payment (4)
- ❑ Cancel pending bill payment (5)
- ❑ Review payment history (6)
- ❑ Set up new payee (7)
- ❑ Transfer funds between your account (8)
- ❑ Transfer money to another person's account (9)
- ❑ Send INTERAC e-Transfer (10)
- ❑ Receive INTERAC e-Transfer (11)
- ❑ View credit card balance (12)
- ❑ View credit card activity (13)
- ❑ Pay credit card bill (14)
- ❑ Find a nearby branch or ATM (15)
- ❑ Check loan or interest rates (16)
- ❑ View balances on loan, mortgage, investment, or trade account (17)
- ❑ Retrieve stock quotes (18)
- ❑ Place trades or buy/sell investment (19)
- ❑ Check transaction right after a purchase (20)
- ❑ Other (21) _____

What type of mobile device do you use most frequently to access the ___ app?

- ❍ Smart Phone (1)
- ❍ Tablet (2)
- ❍ iPod Touch (3)

Who is the manufacturer of the above device?

- ❍ Apple (1)
- ❍ HTC (2)
- ❍ RIM/Blackberry (3)
- ❍ Motorola (4)
- ❍ Samsung (5)
- ❍ LG (6)
- ❍ Nokia (7)
- ❍ Sony Ericsson (8)
- ❍ Other (9) _____

C: Independent Variables

System Quality

Please indicate the degree of your agreement or disagreement with each statement by clicking on the button that applies to you.

		Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Don't Know (0)
Reliability							
REL1	My ___ app does not log me out in the middle of transactions.						
REL2	My ___ app does not crash.						
REL3	My ___ app always lets me log in.						
REL4	Pages on my ___ app do not freeze.						
REL5	My ___ app does not give me blank screens.						
Ease of Use							
EOU1	My ___ app is easy to use.						
EOU2	Interaction with my ___ app does not require a lot of mental effort.						
EOU3	It is easy to use my ___ app to accomplish my banking tasks.						
EOU4	Using my ___ app is simple.						
User Interface							
INT1	The information on my ___ app is attractively displayed.						
INT2	The menu of my ___ app is well designed.						
INT3	The interface of my ___ app looks good.						
INT4	The layout of my ___app is appealing.						
INT5	My ___app adjusts well to the screen size of my manufacturer device[5].						

[5] In the online survey, "manufacturer device" will be filled in by selected options of "What type of mobile device do you use most frequently to access the ___ app?" and "Who is the manufacturer of the above device?" This also applies to SEC4.

INT6	My ___ app provides straightforward navigation to the functions I want to use.						
Response Time							
RTM1	Logging into my ___ app is fast.						
RTM2	Logging out of my ___ app is fast.						
RTM3	My ___ app quickly loads all content.						
RTM4	My ___ app processes my transactions quickly.						
Security							
SEC1	There is little risk involved in using my ___ app.						
SEC2	I am confident about the security of banking via my ___ app.						
SEC3	My ___ app is secure.						
SEC4	If I lost my manufacturer device, I would not be concerned that someone could access my account via my ___ app.						
Functionality							
FUN1	Most online banking functions are included in my ___ app.						
FUN2	My ___ app provides a wide range of online banking functions.						
FUN3	My ___ app provides all the online banking functions that I want.						

Information Quality

Please indicate the degree of your agreement or disagreement with each statement by clicking on the button that applies to you.

		Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Don't Know (0)
Understandability							
UND1	I understand what the information displayed on my ___ app means.						
UND2	The information displayed on my ___ app is understandable.						
UND3	The information displayed on my ___ app is not ambiguous.						
UND4	The information displayedon my ___ app is meaningful.						
Completeness							
COM1	The information displayed on my ___ app meets my needs.						
COM2	The information displayed on my ___ app is sufficient for my needs.						
COM3	The information available through my ___ app is complete.						
Timeliness							
TML1	My ___ app provides up-to-date account information.						
TML2	Account information from my ___ app is timely.						
TML3	My ___ app provides current account information.						

Service Quality

Have you ever attempted to contact customer service to deal with problems relating to the ___app?

❍ Yes (1)

❍ No (0)

		Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Don't Know (0)
CS1	The customer service/tech support representatives have the knowledge to answer my questions related to my ___ app.						
CS2	The customer service/tech support representatives are willing to help me solve problems related to my ___ app.						
CS3	The customer service/tech support representatives are interested in my feedback related to my ___ app.						

D: Dependent Variables

Please indicate the degree of your agreement or disagreement with each statement by clicking on the button that applies to you.

		Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)	Don't Know (0)
Satisfaction							
SAT1	The experience that I have had with my ___ app has been satisfactory.						
SAT2	Overall, I am satisfied with the way that my ___ app has performed.						
SAT3	In general, I am satisfied with my ___ app.						
Perceived Innovativeness							
INN1	___ is innovative in adopting new technology.						
INN2	The overall impression I have of ___ is that they are technologically innovative.						
INN3	___ is a leader in technology.						
Intention to Continue Using							
CTU1	Assuming mobile technology is available to me, I will use my ___ app on a regular basis in the future.						
CTU2	Assuming what I want to do can be done through my ___ app, I will probably use the app rather than visiting a branch or going online.						
CTU3	For future banking tasks, I will continue to use my ___ app.						
CTU4	Whenever possible, I will use my ___ app to do my banking tasks in the future.						

E: Demography of Participants

What is your age? _____
If you prefer not to provide your age, please enter 0.

What is your gender?
- ❍ Male (1)
- ❍ Female (2)
- ❍ Decline to answer (0)

What is highest level of education you have completed?
- ❍ Less than high school (1)
- ❍ High school (2)
- ❍ College (3)
- ❍ University (4)
- ❍ Postgraduate (e.g., Master, PhD)(5)

I tend to be one of first to use new technology.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Neither Agree nor Disagree (3)
- ❍ Agree (4)
- ❍ Strongly Agree (5)

Which one of the following best describes you?
- ❍ Employed, working 30 hours or more per week (1)
- ❍ Employed part-time, working less than 30 hours per week (2)
- ❍ Not currently employed (3)
- ❍ Student (4)
- ❍ Retired (5)
- ❍ Self-employed (6)
- ❍ Other, _____ (7)
- ❍ Decline to answer (0)

Which other Canadian banks have you tried for app banking?

- ❑ None (0)
- ❑ Bank of Montreal (1)
- ❑ CIBC (2)
- ❑ HSBC Canada (3)
- ❑ ING Direct Canada (4)
- ❑ National Bank of Canada (5)
- ❑ RBC Royal Bank (6)
- ❑ Scotiabank (7)
- ❑ TD Canada Trust (8)
- ❑ Other (9) _____

F: Open-ended Questions

Why do you use a mobile banking app(s)?

_____

What other features would you like to have available from your mobile banking app(s)?

_____

What has been your worst experience with mobile banking app(s)?

_____

G: Withdraw

If you want to remove all your responses from this study so that you are no longer a participant, please check the following option. Otherwise, please click the "Next" button.

- ❑ Please delete me from this study and destroy all my responses. I do not wish to be a participant.