# IMPROVING USABILITY OF E-COMMERCE WEBSITES VIA TAG-BASED CUSTOMISATION: A STUDY ON ONLINE AND MOBILE BANKING

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# Abstract

Customisation is known to enhance the appeal, attractiveness and overall user experience of websites. Customised websites can better fulfil the needs and wants of individual customers. In the Australian banking context, customisation is noted as imperative and a key determinant of usability (satisfaction), particularly among the younger generation. However, banking customisation is not well addressed both in the literature and in practice. Furthermore, to date, little is known about the impact of customisation on usability, particularly in the online and mobile banking contexts.

This study explores the use of tags, a Web 2.0 technology, to facilitate customization of online and mobile banking websites. Tags, also known as people-powered metadata, are keywords assigned to Web resources primarily for information management. Tags are largely personal and contextual, and considered as a potential source of knowledge about user's interests and needs. Presently, in the financial space, tags assist personal financial management (PFM) via tools such as Mint (http://www.mint.com) and ANZ-MoneyManager (http://www.anz.com/anz-moneymanager/), where a user can assign tags to transactional data for purposes such as budgeting, expense tracking, cash flow analysis, etc. These tools, however, only enable tags to be assigned to financial transactions at a high level as categories or descriptions, but not at a lower level for details such as bank accounts, billers, references, etc. By supporting a more detailed level of tagging, online and mobile banking interactions may be customised to individual users.

In order to demonstrate the idea, a software-based prototype with an implementation of a tag-based interface in the online and mobile contexts is developed. For the purpose of evaluating the prototype, a comparative usability study is conducted with a conventional banking interface. The study measured the impact of tag-based customisation on usability (perceived and actual) in both online and mobile contexts. This was done through a set of banking tasks where participants had to perform the tasks using both the conventional and tag-based interfaces. They (participants) then evaluated and provided feedback on the interfaces. The results suggest that the tag-based interface improves perceived usability (satisfaction) of young- (21-30) and middle- aged (31-40) banking users. A more apparent difference is seen in the mobile context especially among inexperienced users. No significant

difference is found however in terms of actual usability (effectiveness and efficiency). Based on the study, a range of challenges and recommendations are presented.

As an outcome of the study, a tag-based customisation model is put forward that aims to provide the knowledge and understanding to facilitate customisation for E-commerce websites especially banking websites. The customisation model is targeted at E-commerce designers/developers and service providers. To generalise the approach, two case studies are presented that illustrate the application of tag-based customisation in two different contexts: retail and travel.

In summary, based on the findings, I propose that tag-based customisation can improve perceived usability (satisfaction) through a simple and easy-to-use website interaction. This is especially important to E-commerce providers especially banks who strive to provide the best possible experience to their users. Additionally, higher levels of satisfaction in the mobile context suggest that the approach may positively influence the adoption and acceptance of mobile banking and other mobile services alike, which are rapidly growing along with the number of mobile users.

# Table of Contents

# List of Figures

# List of Tables

# List of Abbreviations

AU – Actual usability

EDT – Expectation Disconfirmation Theory

H – Hypothesis

PFM – Personal financial management

PU – Perceived usability

RQ – Research question

SUS – System Usability Scale

UI – User interface

# Statement of Original Authorship

The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

Signature: _____

Date:     4th September 2013

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# Publications

1. Ravendran, R. (2011). *Website customisation: Exploring a tag-based approach in the Australian banking context*. In Proc. 13th IFIP TC13 International Conference on Human-computer Interaction (INTERACT - Doctoral Consortium), Lisbon, Portugal. ACM.

2. Ravendran, R., MacColl, I., & Docherty, M. (2011). *Online banking customisation via tag-based interaction*. In Proc. INTERACT Workshop on Data-Centric Interactions on the Web (DCI), Lisbon, Portugal. CEUR-WS.

3. Ravendran, R., MacColl, I., & Docherty, M. (2011). *Mobile banking customisation via user-defined tags*. In Proc. 23rd Annual Conference of the Australian Computer-Human Interaction Special Interest Group (OZCHI), Canberra, Australia. ACM.

4. Ravendran, R., MacColl, I., & Docherty, M. (2012). *TagNBank: Tag-based interaction in mobile banking*. In Proc. 13th Annual Conference of the NZ ACM Special Interest Group on Human-Computer Interaction (CHINZ) - Demo, Dunedin, New Zealand, ACM.

5. Ravendran, R., MacColl, I., & Docherty, M. (2012). *Tag-based interaction in online and mobile banking: A preliminary study of the effect on usability*. In Proc. 10th Asia Pacific Conference on Computer-Human Interaction (APCHI), Matsue, Japan. ACM.

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# Chapter 1. Introduction

This chapter provides an introduction to the thesis. Section 1.1 offers background to the research. Section 1.2 provides the context of the research. Section 1.3 mentions the purposes of the research. Section 1.4 highlights the significance of the research. Section 1.5 lists the theoretical and applied contributions of the research. Section 1.6 provides an outline of the thesis.

## 1.1    BACKGROUND

The advent of the World Wide Web (WWW) has provided a new platform for businesses to market and deliver their products and services online. Industries of many kinds are leveraging the Internet as a retail channel, which has given rise to electronic commerce (E-commerce). Online banking as a part of e-commerce has experienced high growth over recent years as a result of technological advancements and growing acceptance in conducting financial activities online. According to market reports, Australia has the fourth highest online banking adoption rate among developed nations (behind Canada, US and UK) (comScore, 2008) and Australian consumers prefer online banking over ATM, phone and branch (Nielsen, 2007).

A study by Rahim and JieYing (2009) in the Australian banking context highlights that *customisation* is an imperative dimension and determinant of usability (satisfaction), particularly among the younger generation. Customisation is defined "as the ability of a website to be shaped in a way that better fulfils the wants of individual users" (Rahim, et al., 2009). The concept of customisation in online banking in general has not been widely discussed. Conversely, in the retail domain, E-commerce giants like Amazon.com have profited from the notion by tailoring their website user interfaces to suit individual user goals (Kalyanaraman et al., 2006). Additionally, customised services based on analysis of similar preferences are provided. For example, when a user is shopping for a particular book, Amazon.com shows a list of items that other users have purchased alongside with the book that interests the user. The e-commerce literature suggests that customisation can lead to loyalty and long-term relationships between customers and product or service providers (Fung, 2008). Such associations are said to directly translate into on-going profits (Peppers et al., 1996).

Addressing the individual needs of customers in the e-commerce space is practicable, largely due to technological advancements of software and database systems (Yang et al., 2005). Present customisation approaches include static and dynamic techniques. Static methods are primarily concerned with customizing website features according to information gathered from users at a particular time (i.e., during registration) which may quickly become irrelevant or out-dated given the ever-changing needs of consumers. Conversely, dynamic methods namely web usage mining (Pierrakos et al., 2003), information filtering (Hanani et al., 2001) and clustering (Yen et al., 2002) facilitate a more robust form of customisation by anticipating what the users might find interesting and valuable (Fung, 2008). Some of the known problems pertinent to dynamic methods include expensive computational cost, technical issues, ethical concerns and limitations due to dynamic nature of user behaviour (Pierrakos, et al., 2003).

This thesis proposes a tag-based approach to facilitate customisation of banking interaction. The proposed method is user- and system- based with users as active participants of the customisation process and the system providing customisation based on user input (tags). Tags are essentially keywords used to annotate resources (i.e., photos, videos, people, etc). Tags assigned by users are dynamic and inherently personal (Marlow et al., 2006), and are said to be a potential source of information for discovering individual interests, preferences and goals, among other attributes of user models (Durao et al., 2009). Also, tags could help form relevant associations between like-minded individuals based on semantic relations (Szomszor et al., 2008). The abovementioned characteristics of tags appear suitable and relevant to facilitate customisation, and may emerge as an alternative or complementary customisation approach.

To explore and evaluate tag-based customisation, a mixed method approach is proposed encompassing two methodologies: software-based prototyping and usability testing. Prior work in the form of a preliminary study is conducted on select online and mobile banking websites to identify and define taggable resources in both online and mobile banking contexts. This information is important, as it is not readily available from the literature. In order to evaluate the customised tag-based interactions in a real-world setting, the software-based prototyping method is employed. A prototype is designed and implemented in both online and mobile banking contexts to demonstrate the different customisation types which are evaluated through a comparative study involving banking users. This facilitates a more

interactive and tangible form of user-centred study, suited to the practical nature of this research project.

The key contribution of this research is the structure and knowledge on the use of tags to facilitate customisation, primarily in the online and mobile banking contexts. Also, the relationship between customisation and banking usability is elucidated along with the challenges of tag-based customisation. The outcome is expected to be useful to financial institutions and Website Designers. For online and mobile banking providers, this research provides insights into a tag-based approach to facilitate customised interactions and also the effect on usability; and for Website Designers, this research highlights the advantages and shortcomings of tag-based customisation using online and mobile banking as an example.

## 1.2    CONTEXT

The research context is online and mobile banking with a broader focus on E-commerce. This thesis explores the use of user-defined tags to facilitate customisation of online and mobile banking interactions. The study is particularly focused in the Australian banking context where both the importance of customisation and a lack of it are highlighted.

The Smart Services CRC under the Financial Services project funds this research. The broad aim of this project is to deliver innovative and engaging user-centric solutions in the financial services domain and also to increase the value of online and mobile services in the financial sector. This work is a need generated from research with a focus on practice.

## 1.3    PURPOSES

This research has a set of purposes that encompass both academic and practical goals. The following are the main purposes of the research:

➢  To explore tag-based customisation in the online and mobile contexts

➢  To investigate the relationship between customisation and usability

➢  To understand the challenges related to tag-based customisation

➢  To provide recommendations to the challenges identified

➢  To develop a tag-based customisation model for use of other E-commerce websites

## 1.4    SIGNIFICANCE

The following are the significance of the research:

> ➢ Establish the knowledge and understanding required to afford tag-based customisation in online and mobile banking, and also other E-commerce websites

> ➢ Enable simple, easy-to-use and customised banking interaction

> ➢ Identify and address challenges related to tag-based customisation

> ➢ Positively affect the perceived usability of online and mobile banking

> ➢ Positively affect the adoption and acceptance of mobile banking

## 1.5    CONTRIBUTION

The main contribution of the research comes in the form of demonstration of the concept of tag-based customisation in the E-commerce domain, primarily online and mobile banking; and the impact of this approach on usability.

The following are the theoretical contributions of the research:

> ➢ A conceptual model that extends the present understanding and use of tagging systems in the personal information management context to facilitate customisation

> ➢ Empirical evidence that suggests customisation can improve perceived usability of both online and mobile banking; and is most appealing to inexperienced users thus having the potential to positively affect adoption and acceptance of mobile banking

> ➢ Empirical evidence that reaffirms the finding from the literature that customisation is a key determinant of user satisfaction in the banking context

> ➢ Empirical evidence that reaffirms the finding from the literature that perceived usability is potentially more influential and is not directly related to actual usability

The following are the applied contributions of the research:

> ➢ A customisation model that provides a guideline for the implementation of tag-based customisation in E-commerce websites

> ➢ Design and implementation of a tag-based prototype that demonstrates the different customisation types in the online and mobile banking contexts; and the challenges identified

## 1.6    THESIS OUTLINE

Rest of the thesis is structured as follows. Chapter 2 presents the literature review. This chapter aims to highlight related work and research gaps. Chapter 3 outlines a conceptual model that forms the basis of the research. This chapter presents an extended tagging model along with a customisation model, both based on the literature. Chapter 4 discusses the design of the research. This chapter encompasses the methodologies, participants, instruments, analysis strategy, test procedure, ethical considerations and limitations. Chapter 5 describes the preliminary work carried out. This chapter outlines the case study, prototype design and implementation; and pilot study. Chapter 6 presents the design of the main study and updates made to the research design particularly the procedure and prototype with reference to the pilot study. Chapter 7 reports the results of the main study and provides the statistical significance of the results. Chapter 8 provides a discussion of the results and challenges with reference to prior work. Chapter 9 presents a tag-based customisation model. Chapter 10 concludes the research with a discussion on implications for research and practice, limitations and future work.

## 1.7    SUMMARY

This chapter presented an overview of the thesis by first introducing the research and objectives. Then, the context of this study is established. Next, the purposes of the research are outlined, followed by the significance. Finally, the contributions for research and practice are mentioned, along with a thesis outline for the remaining chapters.

# Chapter 2. Literature review

This chapter reviews literature on the following topics: Tags (Section 2.1) [Overview of tags and tagging model, purposes of tagging and challenges related to the use of tags], Online and Mobile Banking (Section 2.2) [The current state of online and mobile banking and the use of tags in financial services and banking]; Customisation (Section 2.3) [The definition and motivation of customisation, overview of customisation broadly and specifically in the context of E-commerce/banking]; and Usability (Section 2.4) [The definition of usability according to ISO, the different aspects of usability and the impact of customisation on usability constructs]. Section 2.5 provides an overall discussion on the reviewed topics and the research questions/gaps.

## 2.1    TAGS

Tags are essentially keywords assigned to online resources by users to annotate, manage and share information. The use of tags has been widely adopted and applied in various systems with different themes and purposes. A total of 28% of U.S Internet users have used tags across many different applications and a rise in the popularity of tags is conceivable as more users become aware of the concept (Rainie, 2007). Although, the use of tags is nothing new, especially to experts dealing with categorization and classification work such as librarians and indexers, the concept has clearly been redefined and expanded from its earlier context by allowing non-experts to tag resources (Hayman et al., 2007). Tags facilitate the association of user-assigned text to diverse Internet resources, such as web pages, photos, videos, documents, books and email.

Tags are comprised of three key elements, which are known as the 'triples model': user, resource and tags (Figure 1). A tagger assigns tags to a resource of interest such as photo, video or web page, and this, in turn, acts as metadata for the resource. Once applied, tags can be kept private or shared across a network of users, offering both personal and collaborative resource management. According to O'Reilly (2005), in the Web 2.0 era tags will effectively succeed directories as a means for organizing resources. This transition highlights the shift from a strongly-coupled and formal classification system to a more loosely-coupled and flexible classification system, where users assign a set of keywords as tags to items, view and navigate tagged items through a tag cloud, search for tagged items based on assigned tags, and manage tags independent of their tagged resources.

The notion of leveraging tags primarily for resource organization appears to have gained much acceptance of late. Many Web sites use tagging for resource management, such as Flickr[1] for online photo-sharing, YouTube[2] for online video-sharing and Delicious[3] for online social bookmarking. The application of tags is also prevalent in the financial space. For example, personal financial management tools such as Mint[4] and Yodlee MoneyCenter[5] support tags for the purpose of organizing and managing financial transaction data, joining the current pool of Web 2.0 applications. These online tools allow users to plan, manage and monitor their personal expenses through tags.
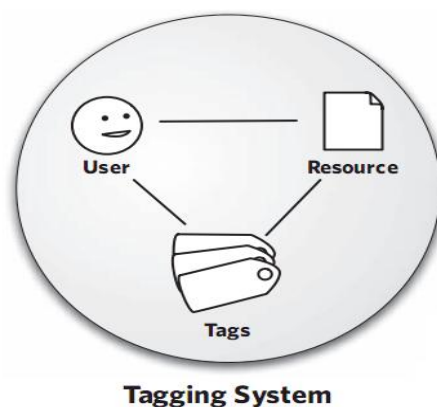


Figure 1 Triples model (Source: (Smith, 2007 p.14))

Figure 1 illustrates the ability of tags to provide a personal association to an online resource.  Such an association appear suitable to facilitate custom interactions that are unique to every user. This will enable users to interact via their own tags assigned to resources without the need to directly manipulate resources (see Chapter 3.1 – Extended Tagging Model). However, to date, no known work addresses the use of tags to facilitate customised interactions. This thesis explores this opportunity and proposes that users are likely to find interacting with tags simpler, easy-to-use and more personal (referred to as *tag-based customisation* herein) than directly interacting with resources provided in a website. Indirectly, tag-based interaction enables users to better associate themselves within a website interaction context. For example, funds transfer between two accounts in online banking is normally conducted through selection of the two bank

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[1] Flickr, http://www.flickr.com

[2] YouTube, http://www.youtube.com

[3] Delicious, http://www.delicious.com

[4] Mint, http://www.mint.com

[5] Yodlee MoneyCenter, http://www.yodlee.com

accounts represented as banking products (i.e., Savings and Everyday) however, through tags the accounts can be instead represented in a personalized and contextualized manner, unique to the user needs (i.e., Savings as 'Car' and Everyday as 'Income'). Tag-based interaction can aid websites to be customised to individual users and influence the usability of websites. This in effect facilitates the transition from a provider- or resource-focused interaction to a user-focused interaction.

### 2.1.1    Purposes

The use of tags varies according to the context (e.g., personal and social) and the nature of the resources tagged (e.g., video, photo, people, etc). Generally, personal organizational and social needs have been cited as the main purposes for tags and the incentives that drive these motives include future retrieval, contribution and sharing, attraction of attention, entertainment, self-presentation and expression of opinion (Marlow, et al., 2006). This thesis is primarily focused on the personal aspects of tags that can be leveraged for the purpose of customisation.

The nature of tags essentially offers many advantageous properties that contribute to their ease of use such as the ability to assign multiple tags to a resource, construction of tags with minimal cognitive effort, and effective representation of indexed information via a tag cloud (Tang et al., 2008). The versatility and utility of tags has lead the concept to be adapted in many different contexts, grouped as 5 different category of systems (see Table 1).

Additionally, tags also serve as means of visual information retrieval especially when represented in a tag cloud (Hassan-Montero et al., 2006). Visually weighted tags based on frequency of use are a powerful way for users to comprehend popular resources while not losing sight of the less popular resources. Also, such an interface can help users to quickly discover important resources that are of interest to them. Furthermore, the visualisation of tags also facilitate website navigation (Kaser et al., 2007). Since tag clouds represent resources in a system, they can effectively ease access to the resources that they are associated with as well as providing an indication of the popularity or frequency of tags. This, in turn, reduces the amount of effort required from the user to view a particular item on the website, enhancing the overall experience.

| Category | Application | Type | Purpose |
|---|---|---|---|
| Personal information management | Gmail | Email | Tag email |
| | Microsoft Photo Gallery | Photo | Tag photos |
| Social bookmarking | Delicious | Social | Tag and share resources of interest |
| | Citeulike | Academic | Tag and share academic resources of interest |
| Collecting and sharing digital objects | Flickr | Photos | Tag and share photos |
| | Youtube | Videos | Tag and share videos |
| | Librarything | Books | Tag and share books |
| Improving the e-commerce experience | Etsy | Online Store | Tag items (also used for navigation) |
| | Buzzilions | Online Store | Tag product review/rating |
| | Amazon | Online Store | Tag products (also used to build customer communities) |
| Others | ESP Game | Games | Game-based on photo tagging |
| | Wesabe | Finance | Tag financial transaction data |
| | Wordpress | Blogs | Tag blog content |

Table 1 Categories of tagging systems (Source: (Smith, 2007))

The literature on tagging purposes is helpful in that the various motivations to tag are outlined according to different domains.  In particular, the improvement of user experience is cited as the main reason for the use of tags in E-commerce websites. The notion of customised interactions via tags is yet to be studied as a purpose of tagging, particularly in the online and mobile banking contexts. Such a study may further aid the delivery of an improved user experience in the E-commerce domain. Similar to Wesabe's goal (see Others –

Table1), an important purpose of tagging in online and mobile banking is to tag financial transaction data.

### 2.1.2   Challenges

There are many challenges related to tag usage that appear to impede its efficacy. One of the prominent challenges of tagging is closely related to the various ways of using keywords (Marchetti et al., 2007). These include polysemy, single word with many meanings; synonyms, multiple words with the same meaning; different lexical forms such as plurality, conjugation, name-adjective and acronym; spelling including both wrong and alternate spelling; differing levels of precision; and differing levels of association. This shortcoming with use of keywords is closely associated with meaningfulness or semantics of tags, and according to Suchanek et al. (2008), 50% of tag applications could be classified as not meaningful. But, this problem could potentially be alleviated through consultation with lexical or semantic databases such as YAGO[6] and WordNet[7], and also large third-party resources such as Wikipedia[8] (Marchetti, et al., 2007; Suchanek, et al., 2008).

In addition, keywords used by users also tend to be ambiguous in many circumstances that lead to the next challenge, tag ambiguity, where a set of keywords used as tags might be in the incorrect context. Ambiguous tags have been investigated by Weinberger et al. (2008) and they suggest a probabilistic model as a way to identify ambiguous tags and propose tag suggestion as a technique to disambiguate tags. Yeung et al. (2009) attempted to address this issue by first identifying 20 ambiguous tags from Delicious (tags with more than a single context such as opera, soap, etc) and then performing a graph-based clustering analysis. Based on the study, a tag context similarity network is suggested as the most congruent approach to reveal the context of applied tags in order to achieve disambiguation of tags. Another perspective to this challenge is offered by taxonomic relations analysis (ontology) as performed by Ulicny et al. (2010) where the dynamic relations of tags could potentially be discovered through semantic processing of triples, proposed as a better alternative than clustering.

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[6] YAGO, http://www.mpi-inf.mpg.de/yago-naga/yago/

[7] WordNet, http://wordnet.princeton.edu/

[8] Wikipedia, http://www.wikipedia.org

While the research community seeks to understand and deal with challenges emerging from tags through a range of technical and system-based approaches, some posit that the solution may as well lie in educating and training users on best practices. A compelling reason to advocate this approach is the mere fact of tagging being a user-based activity and knowledge of tagging prior to assigning tags to resources could prove valuable. Research undertaken by Lee et al. (2009) supports this view as low familiarity with tagging among users for both personal and social use entailed low quality and less effective tags. Users with prior knowledge of tagging tag effectively, consequently reducing or eliminating any issues that otherwise may be prevalent.

The literature on tagging challenges is useful to understand the inherent issues and potential methods to address those issues. However, specific challenges towards the use of tags in the financial context remain unknown. Given the transactional nature of online banking, there may be select challenges that impede use of tags in this context. Also, apart from tagging itself, the challenges related to the use of tags as an interface element to facilitate customisation is not clear. This thesis aims to address this gap and identify potential solutions to the challenges found.

## 2.2    ONLINE AND MOBILE BANKING

Internet-based electronic banking or simply known as online banking is arguably one of the most compelling e-commerce applications available today. According to Malhotra and Singh (2010), there are well over 30 banking services offered as part of Internet banking that fulfil a spectrum of financial needs from various category including personal banking, corporate banking, insurance, brokerage, trading, and investment. Some of the common services include funds transfer, balance inquiry, bills payment, credit card payment, tax payment and online shopping.

Banks view online banking as a distribution channel that can diminish costs, boost user base and mass customize their financial products and services(Kam et al., 2007). This is the case due to lower transaction costs cited for Internet transaction compared to ATM or branch transactions and the ability to overcome geographical and demographical barriers for marketing and distribution, bolstered by 24/7 service availability. In turn, this enables banks to offer competitive rates for their financial products and services, which makes them more attractive to consumers in addition to other advantages such as convenience and efficiency.

Currently, Internet banking is said to be offered in three different forms: information, communication and transaction (Perumal et al., 2004). An information focused site attempts to deliver information about financial products and services of a bank to potential users, while a communication focused site places emphasis on facilitating or enhancing the interaction between users and the bank and a transaction focused site is concerned with enabling users to carry out transactional activities online. The security implications for these different kinds of Internet banking progress from low to high for information to transaction-based sites, respectively. In general, transaction based Internet banking sites are the most common and appeal the most (Perumal, et al., 2004).

According to Fox et al. (2006) and Horrigon (2008), Internet banking is a mainstream online activity, that is steadily growing alongside Internet usage generally, among different age and income groups. Consumers worldwide particularly within developed countries manifest the impact of online banking through the soaring adoption rate. According to Nielsen (2007), Australia has the highest Internet users banking online with over two thirds (68%) of its Internet users banking online once a week or more, which is cited as one of the highest levels around the globe, 25% above the global average. Australian customers prefer Internet banking over ATM, phone and branch, and online banking is an important part of their online activity (Nielsen, 2007).

Mobile banking is an emerging and fast growing part of online banking. According to Berg Insight[9], users of mobile banking and related services increased by two-folds between 2008 and 2009 to 55 million. The global customer base of mobile banking is expected to reach close to one billion users by 2015[10] (see Figure 2). These figures underscore the significance of mobile banking as a part of online banking. Although mobile and online banking share similar functionalities, mobile banking offers convenience, enabling users to access and complete banking transactions anytime, anywhere (Kwon et al., 2010). It is an easy, fast, simple and secure banking option. The growing number of smart phones and increasing mobile web usage are likely to further drive consumers towards mobile banking. According to Google[11], Australia has the second highest smart phone usage in the world, only second to Singapore. Given the rise in

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[9] Berg Insight, http://www.berginsight.com/News.aspx?m_m=6&s_m=1

[10] FSOkx Research,
http://www.fsokx.com/ResearchAndAnalytics/ResearchInsights/ShowResearchInsights.aspx?InsightsID=41

[11] Google, http://google-au.blogspot.com.au/2011/09/smartphones-at-dinner-table-smartphone.html

mobile banking uptake, online banking users are possibly more satisfied with and may prefer banks that offer mobile banking service.
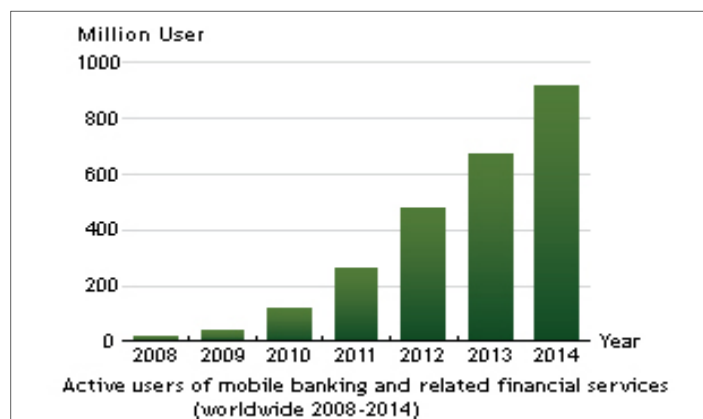


Figure 2 Mobile banking (Source: FSOkx Research)

Apart from the prominence of online and mobile banking, another key reason to explore this domain is the widespread use of tags in the financial services domain to aid personal financial management. Personal financial management is supported through both external tools such as Mint[12] and bank provided tools such as Australia-New Zealand (ANZ) Bank's MoneyManager[13] service. These tools enable users to assign tags to annotate transactional data for purposes such as budgeting, expense tracking, cash flow analysis, tax returns management, etc. However, they only allow tags to be assigned to financial transactions at a high level as category or description, but not at a granular level for resources such as bank account or biller. There may be compelling advantages in doing so particularly in the online and mobile banking contexts, opening doors to tag-based customised interaction alongside personal financial management.

From a more general perspective, improvements in terms of usability, especially satisfaction can broadly influence banking adoption and acceptance, especially in the mobile context. This is particularly true because satisfaction affects the user's intention to use a system or website (Kargin et al., 2009). The availability of tags from the online context to the mobile context can also simplify users' banking tasks in particular new and repeating banking needs such as bill payment. Additionally, tag-based customisation may alleviate concerns related to mobile banking use. Wessel and Drennan (2010) note that mobile banking adoption in Australia is

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[12] Mint, http://www.mint.com

[13] ANZ MoneyManager, http://www.anz.com/ANZ-moneymanager/default.asp

impeded by several issues namely security and privacy concerns. The ability to use personal keywords to interact may positively affect users' perceived security and privacy. This is probable as users only view their tags on their mobile screens. Furthermore, given the personal nature of tags, they are less likely to be meaningful to other individuals. As a result users may be more comfortable carrying out banking tasks via their mobile devices especially at public places.

## 2.3     CUSTOMISATION

Customisation is described loosely as the ability for a website to be shaped in a way that better fulfils the wants of individual users (Rahim, et al., 2009). Scholars from different fields (e.g., marketing, health communication, psychology, e-commerce and user modelling) refer to this concept using different terms such as personalization, matching, adaptation and individualisation (Kalyanaraman, et al., 2006). Despite differences in terms of context and application, these terms are essentially the same (Kalyanaraman, et al., 2006), centred on delivering unique user experiences. Thus, in this study, these terms are regarded as synonymous, hence used interchangeably to refer to the broad notion of tailoring a website for individual users at different levels (e.g., user interface, interaction, content, features, etc). Some examples of customisation include BBC's individualized news delivery, Priceline's customised travel itinerary offering for airline customers and LANDS' END's various options to personalize fabrics (Kalyanaraman, et al., 2006).

### 2.3.1   Motivation

According to Fung (2008), the focal aim of customisation is binding users into a long-term relationship despite a short-term discomfort. This has been agreed by other scholars (Mittal et al., 1996; Riecken, 2000) and in the e-commerce domain such relationships are said to be vital as they directly translate into on-going profits (Peppers, et al., 1996). In the banking context, Hiltunen et al. (2004) suggest that customisation is highly valuable as users are more likely to purchase a new product or service from their existing bank compared to a new bank.

Several studies indicate that customisation is imperative to user satisfaction in online systems (Horan et al., 2006; Wang et al., 2003). Customised sites better satisfy users by meeting their needs and offering assistance in achieving their objectives. This notion is consistent with the literature where users find websites that offer customisation more attractive, engaging and positive, compared to websites that offer low levels of customisation (Kalyanaraman, et al., 2006). As a result, users are willing to revisit customizable websites as they provide a gratifying overall experience.

In addition to satisfaction, loyalty is cited as a key factor to ensuring a continued relationship regardless of any dissatisfactory experience (Fung, 2008). The absence of loyalty could even see satisfied users discontinuing the relationship as a result of being compelled by a new or better product or service in the market. Two vital elements at work are perceived cost and affective attachment (Fung, 2008). Perceived cost forms a sense of entrapment among users due to switching costs associated with migration to another product or service provider. This cost, however, is likely to be higher than that of non-customisable website as users inevitably invest time and effort to afford customisation. Affective attachment installs a sense of bias or commitment among users, primarily motivated by attraction, satisfaction and task facilitation. Through delivery of unique user experiences customised websites strive to shape such connection.

Customisation in the online banking context is highly relevant as users are regarded as frequent users, who can be identified through their association with a particular financial institution (Hiltunen, et al., 2004). However, users are reluctant to spend time setting up sophisticated personalization features and want to get things done as soon as possible (J. Nielsen, 1998). Thus, it is important to find a balance between functionality (usefulness) and the easiness of using the functionality (ease of use), to ensure a positive customisation.

## 2.3.2   Overview

Based on the literature, a customisation framework is derived (Figure 3), which offers an overview of the customisation domain, and position of the work described in this thesis (highlighted in Figure 3). For the purpose of literature review, a broad understanding of customisation is adopted defined as "the ability for a website to be shaped in a way that better fulfils the wants of individual users" (Rahim, et al., 2009).

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                              ┌──────────────┐
                              │ Customization│
                              └──────────────┘
              ┌────────────────────┼──────────────────┐
        ┌──────────┐         ┌──────────┐        ┌──────────┐
        │ Category │         │  Source  │        │  Action  │
        └──────────┘         └──────────┘        └──────────┘
      ┌──────┼──────┐       ┌──────┐            ┌──────┐
┌─────────┐┌─────────┐┌──────────┐│ Explicit │  │  User │
│  User   ││Interaction││Content & ││          │  │       │
│Interface││ Process  ││ Features ││          │  │       │
└─────────┘└─────────┘└──────────┘└──────────┘  └──────┘
┌─────────┐┌─────────┐┌──────────┐┌──────────┐  ┌──────┐
│ Layout  ││Remembering││Information││ Implicit │ │System│
└─────────┘└─────────┘└──────────┘└──────────┘  └──────┘
┌─────────┐┌─────────┐┌──────────┐
│Look&Feel││Comprehension││ Link  │
└─────────┘└─────────┘└──────────┘
┌─────────┐┌─────────┐
│Navigation││Associative│
└─────────┘└─────────┘
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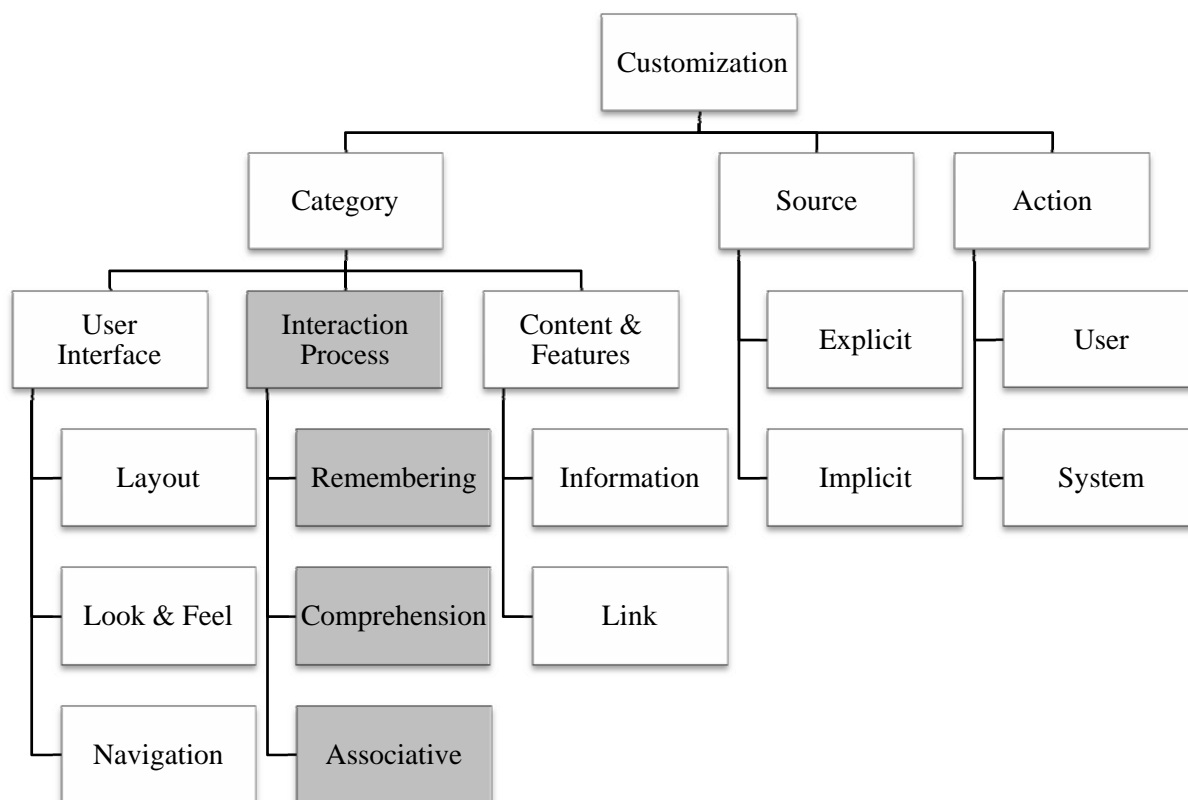
Figure 3 Customisation framework

Figure 3 is derived from the literature based on previous work on performance personalization system (Riemer et al., 2003), user interface customisation (Bunt et al., 2007), interaction process customisation (Fung, 2008) and personalization framework (Wu et al., 2003).

The diagram illustrates three key dimensions of customisation: category, source and action. Three *categories* of customisation are *user interface*, *interaction process* and *content & features*. These categories can be further expanded into finer attributes or levels. *Sources* used to facilitate these different customisation categories can be divided into two: *explicit* and *implicit*. The former includes data sources that are personal and overt such as cookies, user profiles and personal tools. The latter covers data sources that are complex which provide latent information about user's website usage or behaviour such as usage logs or purchase history. The *action* of initiating and carrying out customisation is the responsibility of the *user* or the *system*. Customisation initiated and carried out by the user is generally known as static application of customisation, while system initiated and executed customisation is commonly described as dynamic application of customisation. However, in some instances customisation may be initiated by the user and carried out by the system or vice-versa. Arguably, these entities are inseparable and equally important hence their inclusion in some stage of the customisation process is advantageous for an inclusive result.

### 2.3.3   E-commerce/Banking customisation

The body of literature on customisation in the e-commerce domain indicate two segments of work, one focused on the content and features of a website (Kalyanaraman, et al., 2006) and the other on customisation with regards to aspects of interpersonal communication (Y. Moon, 2000; Y. Moon et al., 1996). According to Fung (2008), the former approach tends to result in a more static application of customisation in websites, reliant on the preference information collected from the user. This, however, is said to downplay the impact of more dynamic types of customisation such as service personalisation based on user use of the system. Meanwhile, in the latter approach, concepts from the more established domain of human-human interaction are extended to the human-computer context. The goal is to ensure a more social interaction between users and the e-commerce website, where the website as a service employee relates to users individually (Kalyanaraman, et al., 2006).

As part of a study into the effects of customisation on user attitude and behaviour, Kalyanaraman & Sundar (2006) investigated customisation through a set of pre-defined levels: low, medium and high. Each level encompassed a set of customisable items on MyYahoo![14] (an online customisable portal) based on the interest level of participants on various themes on the portal, elicited through a pre-test questionnaire. Such an approach is a common form of customisation that is explicit and user-based (provided by user e.g., during registration), focused on the delivery of personalized content and features. This is suitable for websites that offer a wide range of content and features. However, the drawback of this approach is that customisation is treated as a fixed, one-off process instead of a continually evolving one. Given that user needs are not fixed and they evolve continually as do user preferences and interests, the process of customisation should be able to address this concern to remain relevant and beneficial to users.

More recently, Fung (2008) studied the impact of customisation on website commitment in the online and mobile banking contexts. Firstly, the author highlighted the lack of conceptualisation around dynamic customisation largely from a cognitive and human-computer interaction perspective, proposing the levels-of-processing framework as a suitable reference model. Based on the *levels-of-processing framework* (F. Craik, 2002), the author conceptualises customisation as three distinct forms of qualitative processing: remembering, comprehension and associative. These customisation types reflect the unique forms of qualitative processing

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[14] MyYahoo!, http://my.yahoo.com/

undertaken during message parsing and the way in which a website reacts to users' information and behaviours. The study, an experiment based on a banking scenario (bill payment), asserted a positive overall outcome for customisation, especially comprehension-type and associative-type. The findings suggest that these customisation types have a significant impact over remembering-type customisation due to their ability to extend beyond users' overt information and behaviour to recognize latent meanings and associations. Such forms of customisation are said to increase users' commitment towards the banking website. This approach overcomes the weakness of static customisation by framing a dynamic approach to customisation.

While Fung's work highlights the significance and effects of customisation on banking website commitment and the individual appeal of each customisation types, the effects on usability remain unknown. Also, the customisation approaches used ranging from simple presentation of historical data to Web usage analysis were entirely system-based which is in contrast to a hybrid approach put forward in this thesis. A hybrid approach encompasses both user- and system-based approaches. A user-based approach, through active engagement of users is likely to yield a higher perceived cost and affective attachment in a banking website (Fung, 2008). The engagement of users may also result in a more inclusive and dynamic solution. However, a user-based approach demands increased overall effort from users, especially in the early stages of website use.

The different bodies of work and approaches of customisation seen in the literature do not appear to overlap with the proposed tag-based method. The tag-based approach is dynamic and puts users in control, as they normally would be in a social interaction. This is relevant and echoed by Web 2.0, by which the horizon of social interaction is broadened through a set of principles and technology that not only advocate rich human-computer interaction through the *architecture of participation* (O'Reilly, 2005) but also better enable human-human communication through enhanced social connectivity (Parameswaran et al., 2007). The delivery of a unique experience to users through participation, either actively or passively as part of a community is desirable and may lead to a better sense of affective attachment and perceived cost.

## 2.4    USABILITY

According to the ISO9241-11[15] standard, "usability" is defined as "the level of effectiveness, efficiency and user satisfaction when a given product is used to achieve a specific aim by a specific user in a specific usage situation". The standard defines effectiveness as "accuracy and completeness with which users achieve specified goals", efficiency as "resources expended in relation to the accuracy and completeness with which users achieve goals" and user satisfaction as "freedom from discomfort, and positive attitudes towards the use of the product". Figure 4 depicts the usability model according to the ISO standard.
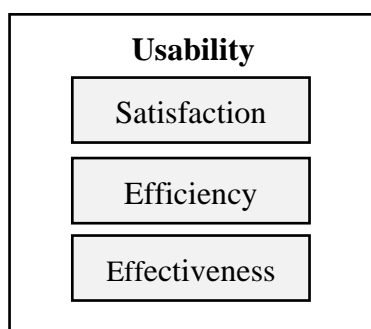


Figure 4 Usability model

According to the literature, usability can be divided into two dimensions: *perceived (PU)* and *actual (AU)* (see next section). Perceived usability is understood as a subjective aspect of usability that is determined by satisfaction. Thus, if a user is satisfied with a system, he/she perceives it as usable and vice-versa. Conversely, actual usability is understood as an aspect of usability that can be objectively measured which encompasses effectiveness and efficiency. Figure 5 depicts the association between the aforementioned usability elements and the two dimensions of usability.
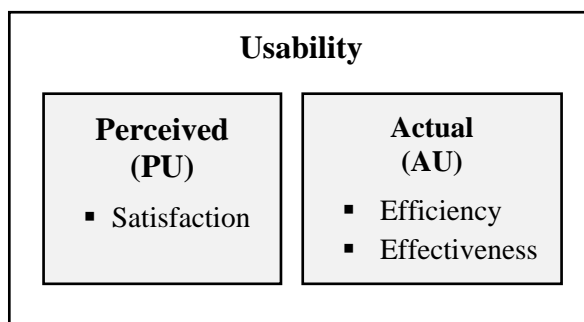


Figure 5 Usability model (PU & AU)

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[15] International Standard Organization, http://www.iso.org/iso/

### 2.4.1   Perceived and Actual

There are two widely discussed aspects of usability: perceived (subjective) and actual (objective). Perceived usability may be defined as the usability of a website or system according to users' judgement or perception (Reinecke et al., 2011). Alternatively, actual usability is the usability of a website or system based on users' performance of specific tasks in a real operational environment (Lew et al., 2010). In HCI, evaluation of websites or online systems generally constitutes both aspects, measured through various methodologies. Some of the methods used to measure perceived usability are questionnaires, interviews and focus groups; and some of the methods used to measure actual usability include user observation, logging use, think aloud protocols and usability testing (Gena, 2005) .

Perceived usability is often more influential than the actual usability of an interface (Phillips et al., 2009). For example, Tractinsky, Katz & Ikar (2000) studied ATM interfaces and found that users judged how usable the interfaces were based on their aesthetic appeal, regardless of actual usability. Brady and Phillips (2003) found that websites with consistent balance and colour schemes were rated as more usable by participants than websites with uneven and poor colour schemes. According to Hassenzahl (2004), once a user perceives a website as usable, even differences in efficiency are not likely to have a strong impact on users and may go unnoticed. In other words, users generally do not mind spending more time on a website that they perceive as usable. However, this may not be the case if users experience low levels of effectiveness and in turn are unable to complete a task successfully (Hassenzahl, 2004). In such an instance, the actual usability is likely to negatively influence the perceived usability of a website. The inability to complete a task on a website commonly depicts poor usability, even though the website may be well designed. Therefore, both perceived and actual usability play an important role in the overall usability of a website, although perceived usability may be more influential than actual usability since users may not necessarily identify the latter with usability (e.g., task completion time, number of errors, number of clicks, etc).

### 2.4.2   Usability-Customisation

There appears to be a correlation in the literature between usability and customisation, particularly in the e-commerce domain. Previous studies on customisation indicate a positive impact on user satisfaction through improved overall appeal, engagement and commitment towards a website (Fung, 2008; Hiltunen, et al., 2004; Horan, et al., 2006; Kalyanaraman, et al., 2006; Wang, et al., 2003). Additionally, through customisation, the needs and goals of users are

better met, with reduced time and effort, resulting in improved efficiency and effectiveness. For example, customisation increases the likelihood of users finding the right product or service that they wish to buy or use as a result of accurately tailored or narrowed choices which in turn lowers search costs (Srinivasan et al., 2002; Thirumalai et al., 2011; Yoo et al., 2011). In the transactional environment customisation can offer the ability to conduct new or repetitive tasks in a simpler and intuitive manner (Fung, 2008). Some of the forms of customisation found in the literature that aid usability include product or service recommendation, tailor-made ads and promotions, item individualization, and interactive assistance.

The following sections describe the usability constructs in the usability model in the context of online finance and banking.

### 2.4.3   Satisfaction

Satisfaction is a user's perception of the degree to which his/her expectations have been fulfilled (Yoon, 2010). The literature around this concept in online banking is well developed. Its ability to influence users' perceptions on banks' ability to innovate and accommodate the ever-changing demands of users makes it essential (Rahim, et al., 2009). Also, user satisfaction has been acknowledged to have a positive effect on both loyalty and positive word-of-mouth (Casaló et al., 2008). Furthermore, according to a survey study (Foresee results survey, 2005), satisfied online banking users have a higher tendency to purchase additional products and services from their bank than unsatisfied online banking users.

According to Yoon (2010), the antecedents of user satisfaction encompass six distinct variables, drawn from the literature namely *ease-of-use*, *transaction speed*, *design*, *security*, *information content* and *user support service*. These aspects were identified as part of the study on the antecedents of user satisfaction and moderating effects of experience with online banking in China. The findings indicate that design, security, speed and content have strong influence on user satisfaction of users with high experience, whereas user support makes the difference for users with low experience. However, ease of use is insignificant to both groups.

In the Australian context, Rahim & Li (2009) initially put forward thirteen dimensions from the literature that may affect user satisfaction in online banking. Subsequently, they systematically examined and filtered these dimensions using a mixed-method approach to just six dimensions: *user-friendliness*, *response time*, *up-to-date information*, *information personalization*, *customisation* and *user support*. These dimensions were empirically confirmed as significant to measuring user satisfaction in the online banking context with customisation and user support emerging as the most significant dimensions. They found that variables such as

security and accuracy do not carry any relevance with regard to satisfaction towards online banking. Likewise, dimensions akin to perceived convenience and user demographics also appear to be irrelevant. One possible explanation offered is that these dimensions lose their significance after the adoption phase especially when users are familiar with and use online banking on a regular basis.

Based on the antecedents proposed by Yoon (2010) and Rahim & Li (2009), an apparent overlap can be seen. For instance, the concept of ease-of-use and design closely mirror user-friendliness. Likewise, response time and transaction speed are essentially similar concepts. The notion of information content encompasses up-to-date information and information personalization dimensions. Despite the obvious overlaps, Rahim & Li (2009) highlight a distinctive concept - *customisation* as an influential user satisfaction dimension, which has not been widely discussed particularly in the online/mobile banking context.

### 2.4.4   Efficiency

Efficiency in online banking is the resources required to undertake banking tasks that can be separated into two: *task efficiency* and *operational efficiency* (Rahim, et al., 2009; Yoon, 2010). Task efficiency can be described as the time and effort required by a user to carry out a banking activity, while operational efficiency is closely related to bank's processing and response times (Bevan et al., 1994). Hence, banking efficiency encompasses speed, performance and productivity of both online banking user and provider. Given the nature of the domain and its emphasis on security, operational latency and slower response times are inevitable to a certain extent. However, from a user's point of view, a user-friendly and easy to use online banking interaction is essential to complete their banking needs more efficiently (Rahim, et al., 2009; Yoon, 2010). An online banking interface that is not usable can affect the task completion times and further frustrate users.

Today, banking efficiency, particularly task efficiency is pivotal in the mobile context where users can fulfil their banking needs anywhere and anytime via their mobile devices. Mobile banking users are able to conduct banking activities as and when required without the need to delay until they get before their home computer, for example. For this reason, mobile banking puts forward a case for a more efficient interaction compared to its counterpart in the online context. This need is further substantiated by the challenges presented in the mobile context such as smaller screen sizes and increased focus on task completion in smaller time frames. Nevertheless, it is important to provide a usable interface for both contexts that delivers high performance and productivity.

### 2.4.5   Effectiveness

Effectiveness in the online banking context can be seen as the degree to which users are able to successfully conduct a banking activity. This includes the users' level of accuracy and task completeness (Bevan, et al., 1994). Much like efficiency, this aspect of usability is also closely tied to the user-friendliness and ease of use of a banking interface (Rahim, et al., 2009; Yoon, 2010). A complex interface can impede effectiveness, resulting in poor usability and low adoption and acceptance (Wang, et al., 2003; Wessels, et al., 2010). For this purpose, online banking interface is generally kept as simple as possible with clear labels and error messages.

Much like banking efficiency, mobile banking effectiveness is an important consideration compared to its counterpart, online banking. Banking users are likely to feel more comfortable and confident with online banking compared to mobile banking, given their experience in online banking and lack of experience in mobile banking. It is therefore important to deliver a comparable level of comfort and confidence in both contexts to encourage adoption and acceptance. A possible solution to this challenge is customisation of online and mobile banking websites. Customisation of websites can improve engagement and positively affect the experience of users (Kalyanaraman, et al., 2006).

### 2.5   DISCUSSION

The literature review presented as separate discussions on tags, online/mobile banking, customisation and usability is aimed at highlighting the opportunity to investigate the use of tags to facilitate customised interaction for E-commerce (banking) sites that may lead to improved usability. The existing body of work does not indicate similar work using tags, however, presents a model for interaction customisation that has been applied in the banking context (see Chapter 3.2 Interaction Customisation). This model is relevant and suitable, hence used as a theoretical basis for the investigation.

This thesis aims to explore a number of research questions, which can contribute to the present understanding of the topics reviewed. Firstly, the use of tags to facilitate customisation mainly in online and mobile banking websites and other E-commerce sites. Present discussions on the use of tags and tagging in general do not discuss this purpose. Secondly, the challenges related to the use of tags in the interaction context are unknown. These challenges are important to determine the practicality and usability of the approach. Thirdly, the relationship between customisation and usability appears to be implicit, where the effects of customisation on the three dimensions of usability: satisfaction, effectiveness and efficiency, is unclear.

In the next chapter, a conceptual model is presented that encompasses an extended tagging model and a customisation model from the literature. The conceptual model explicates the notion of tag-based customisation over the Web, and  informs rest of the work presented in the forthcoming chapters.

## 2.6    SUMMARY

This chapter presented literature review on related topics: tags, banking, usability and customisation. The review on tagging literature included a tagging model, motivation for and challenges of tags. The review on banking literature covered the present state of online and mobile banking, and also the application of tags in the financial services domain. The review on customisation literature looked at definition and motivation, followed by different types of customisation found in the E-commerce domain. Finally, the review on usability literature presents the definition, multiple constructs of usability and the effects of customisation. Based on the literature review, the gaps for further research are then discussed.

# Chapter 3. Conceptual Model

In this chapter, a conceptual model is presented that shows how the proposed notion of tag-based customisation fits and extends the present tagging model in the Web domain. Section 3.1 outlines the extended tagging model based on the triples model (see Figure 1). Section 3.2 presents and elaborates on the interaction customisation model adopted from the literature.

## 3.1    EXTENDED TAGGING MODEL

The characteristics of tags, particularly *personal* and *contextual* appear suitable to afford customised interactions, unique to every individual based on tags assigned to resources. This notion is simply referred to as *tag-based customisation*. The ability to represent resources in user's own keywords presents the opportunity to interact and carry out website features through tags which also extends the present understanding and use of tags beyond information management (see Figure 6). Figure 6 depicts the existence of a tagging system in the form of the aforementioned triples model (see Figure 1) in a Web domain such as social bookmarking or finance. This facilitates the well researched and understood notion of information management made possible via tags. However, tags can in turn facilitate tag-based customisation as an alternative or extension to the present Web interaction afforded by standard HTML objects such as dropdown boxes, menus, tables, etc.
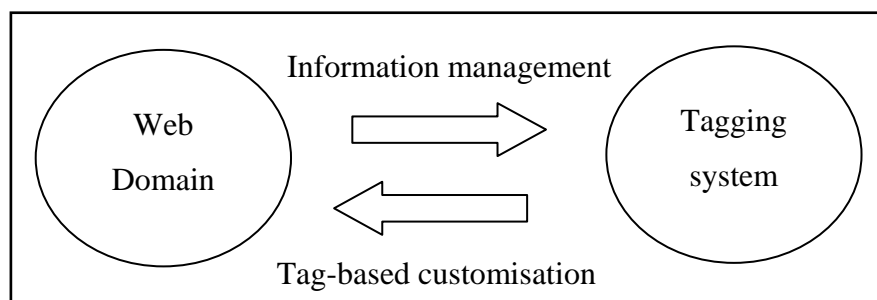


Figure 6 Extended tagging model

The process of tag-based customisation shown in Figure 6 is illustrated in Figure 7. Figure 6 depicts the use of tags as input for the interaction process and consequently the tag-based customisation model produces the output that enables quick and easy access of website features through customisation. In other words, the customisation makes it possible for users to interact with a particular website just by using tags. Thus, website features are customised to individual

users through the model, which in turn minimize effort and alleviate the need for users to recognize and decide the appropriate features to fulfil their goals or needs.
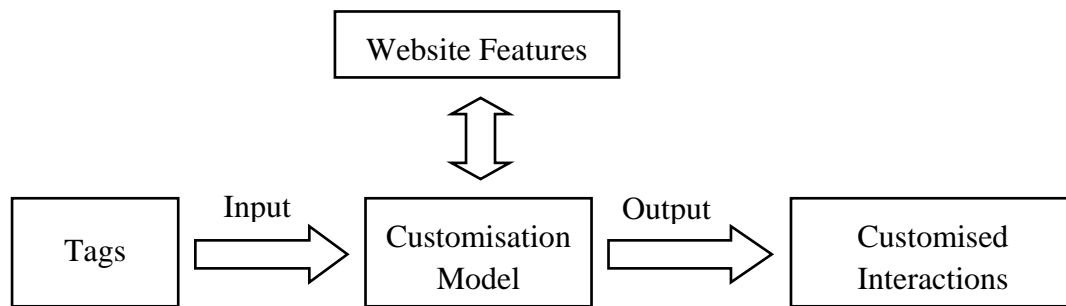


Figure 7 Tag-based customisation process

The tag-based customisation process shown in Figure 7 is useful to ease and simplify interaction in a Web domain. This thesis proposes that this can positively impact usability of existing websites, particularly in terms of satisfaction, efficiency and effectiveness. The customisation model is independent of domain or website features hence it may be applied to a wide range of domains. However, for the purpose of this study, the model is applied and evaluated in a specific E-commerce domain – online and mobile banking. The tag-based customisation model provides the knowledge and understanding to extend and support the use of tags as a means of customised interaction over the Web with the goal of positively affecting usability. The different types of customised interaction types are outlined below.

## 3.2    INTERACTION CUSTOMISATION

This thesis explores customisation through user-defined tags based on the interaction customisation model conceptualised by Fung (2008) for his work on banking customisation. The customisation model comprises of three distinct customisation types derived from the levels-of-processing framework (F. I. M. Craik et al., 1972). The levels-of-processing framework offers an approach to process messages in the human-computer interaction context. The processing is divided into three levels and each level signifies a particular type of qualitative processing carried out on a message (F. Craik, 2002). These three levels of processing vary from simple (shallow) to complex (deep), and the move from one level to another marks change of processing qualitatively. The sequence of processing is not linear rather each level exists separately from the other. As such each level of processing represents a specific kind of expansion on the message (F. Craik, 2002).

The following section presents the three types of customisation. They are known as *remembering*, *comprehension* and *associative*. Important characteristics of these customisation

types include non-sequential processing, unique ways of interpreting users' knowledge and attitudes, and non-dependant qualitative processing (Fung, 2008). Below are the customisation types conceptualised based on adaption and modification of the levels-of-processing framework.

### 3.2.1   Remembrance-based

This customisation type is derived from cognitive processing which uses *recognition* to process messages during interaction. This type of processing, in the communication context for example, simply needs an individual to recognise and acknowledge the presence of the incoming message, without any other form of elaboration (Fung, 2008).

The first customization type, labelled as remembrance-based, refers to a website that is customised for users based on simple remembrance of user's information gathered during registration or based on the recurrence rate of a particular action on a website (e.g., most-frequently used website feature) without the website necessarily understanding the meaning of the information. For instance, a website keeping track of user visits to a page and consequently, customising the front page of the website to the most frequently visited page for subsequent user visits is an implementation of remembrance-based customisation.

This customisation is visible with MyYahoo.com where based on the user's information provided at the time of registration, the Web content is customised in the form of personal greeting and content tailoring according to the user's interests and location. The user information is stored in a database as it is without any other processing and retrieved when required.

### 3.2.2   Comprehension-based

This customisation type is derived from cognitive processing that uses *analysis* to process messages during interaction. This type of processing takes places when an individual assigns meaning to the incoming message through analytical elaboration (Fung, 2008). Through analysis, an individual grips the underlying idea being passed on through the message. In a social interaction context, when someone in an air-conditioned meeting room says, "I am feeling very cold" then immediately other individuals in the room discover the notion behind and assign the meaning that the air-condition needs to be turned off, for instance.

The second customisation type, simply known as comprehension-based, refers to a website that recognises user's behaviours by assigning meanings and contingent attempts to provide assistance towards fulfilling the user's needs. The facility to identify user's behaviours as part of a procedure on a website and to subsequently comprehend the meaning of that behaviour

through analytical elaboration is a clear application of comprehension type customisation (Fung, 2008).

An illustration of this customisation is MS Office's 'Office Assistant', where the program based on a user's typing behaviour attempts to provide assistance directed at satisfying the user's needs. For example, typing the phrase "Dear" and hitting enter triggers the Office Assistant where a pop up is shown asking whether the user requires help to write the letter. If the user clicks the "yes" button, a letter wizard will be shown to guide the user. As a result of analysing the typing behaviour (e.g., the word "Dear") and discovering the underlying meaning as letter writing, the feature is customised to ease the task of letter writing.

### 3.2.3   Association-based

This customisation type is derived from cognitive processing that uses *reflection* to process messages during interaction. This type of processing is considered deep and occurs when an individual forms an association on the incoming message through reflective elaboration (Fung, 2008). Essentially, an individual looks for similarities in the message content and semantics stored in his/her memory. Using this as a basis, the individual then develops an associative link between the message content and stored semantics allowing for reflection on the implication of the message.

The last type of customization, referred to as association-based, refers to a website that provides customisation through association of a user's behaviour with other individuals who have similar behaviours to reflect on the similar needs the user might have in common. The website attempts to locate similar behaviours from a database to match a specific user's behaviour in order to provide associative customisation (Fung, 2008).

A simple and straightforward example is Amazon.com's personal recommendation where a list of books purchased by other users is displayed along with the search result for a book requested by a user. Comparing and contrasting a particular user's search behaviour to all other users' search behaviours in the database achieve this. Amazon.com forms an association by reflecting on a user's searching behaviour to other like-minded people's search behaviours captured in a database.

### 3.3   SUMMARY

This chapter presented a conceptual model that extends the present tagging model found in the literature to support the notion of tag-based customisation. To facilitate this course, a

customisation model from the literature is adopted, which has been applied in the banking context in previous studies.

In the forthcoming chapters of the thesis, the application of tags to facilitate each of the above mentioned customisation types are discussed.  The proposed tag-based approach is explicit and both user- and system- based. The user initiates the customisation process implicitly via tags and the system performs the customisation based on the tags assigned. Examples of each types of customisation are provided in the Preliminary Work chapter (Chapter 5). A detailed explanation of the tag-based approach in other E-commerce domains for two other contexts (retail and travel), using online and mobile banking as a reference is presented in the Customisation Model chapter (Chapter 8).

# Chapter 4. Research design

This chapter describes the initial design adopted by this research to achieve the aims and objectives stated in Section 1.3. Section 4.1 presents the research questions explored; Section 4.2 provides an overview of the methodology and presents the research plan, outlining the different phases and key outputs; Section 4.2 details the participants of the study; Section 4.3 lists all the instruments to be used for the study and justifies their use; Section 4.4 outlines the procedure to be used and the timeline for completion of each stage of the study; Section 4.5 discusses how the data will be analysed; finally, Section 4.6 discusses the ethical considerations of the research and study limitations.

## 4.1    RESEARCH QUESTIONS

There are four main research questions addressed.

The first research question is related to the range of taggable resources available in online and mobile banking. Based on the literature review, it is not clear what information could be tagged in the banking domain. However, we know that personal financial management tools afford tagging of financial transactions. From observation of a few of these tools, it appears that present tagging of financial data is at a high level as category or description for information management purposes. This is particularly useful to facilitate financial management where users have an overall or categorical understanding of their expenses. Though, in the online and mobile banking contexts, for the purpose of customisation, a more detailed level of tagging are potentially useful that can extend the use of tags beyond financial management. Therefore, this research question explores tagging of resources at a lower level to determine the range of resources that are available in the online and mobile banking contexts, specifically for personal banking.

**RQ1. What is the range of taggable resources?**

The second research question is about the impact of customisation on usability, both perceived and actual in online and mobile banking. The impact of customisation on usability is not well understood and is not clear from the literature review. Despite customisation being identified as a key determinant of satisfaction in the literature, there is little or no empirical evidence that elucidate the relationship between customisation and usability. Customisation

however, through the ability to simplify and ease interaction appears to have an assumed positive relationship with usability. This research question aims to explicate this assumed positive relationship in two dimensions: perceived and actual. These two dimensions, represent the different constructs of usability (satisfaction, effectiveness and efficiency) as defined by ISO that encompass the user's view on usability (perceived) and system's view on usability (actual).

### RQ2. What is the impact of customisation on usability?

#### RQ2.1. What is the effect on perceived usability (satisfaction)?

#### RQ2.2. What is the effect on actual usability (efficiency and effectiveness)?

The third research question is concerned with the challenges that are related to the use of tags for customisation in the online and mobile banking contexts. As seen in the literature, there are a number of common issues found with the use of tags in other websites, for which a set of solutions have been put forward. These issues are likely to continue to be a challenge for banking websites as well. However, in addition to the common issues, it is not known what sort of challenges may emerge specifically with regards to the use of tags to facilitate customisation in the online and mobile banking contexts. This further begs the question of what needs to be done to address the challenges. Hence, the research question also explores the potential solutions for the challenges that are identified.

### RQ3. What are the challenges? How can they be potentially addressed?

The fourth and final research question is related to generalisation of the proposed tag-based approach to E-commerce websites with reference to online and mobile banking. This is important to ensure that tag-based customisation is relevant and applicable to other websites apart from banking. At present, there are no known models or frameworks in the literature that facilitate the use of tags to deliver customised interaction. For this purpose, a customisation model that enables the application of tags beyond information management to facilitate customisation of websites will be useful. This model aims to provide a guideline for websites that both use or do not use tags at present. For the purpose of illustrating the use of the model, two case studies involving a retail and travel website is presented.

### RQ4. How can the approach be generalised to E-commerce websites?

The research questions mentioned above are explored and addressed in the following chapters:

➤ RQ1is addressed through a website analysis study in Chapter 4 – Preliminary Work

➤ RQ2 and 3 are addressed through a comparative usability study reported in Chapter 6 – Results and Chapter 7 – Discussion

➤ RQ4 is addressed through a tag-based customisation model in Chapter 9 – Customisation Model

## 4.2    METHODOLOGY

An empirical approach is taken towards addressing the research problem, to primarily find evidence that either supports or rejects the notion that a tag-based customisation approach can improve the usability of online and mobile banking websites, and more broadly of E-commerce websites. Due to the practical aims and nature of this study, a mixed method approach is employed encompassing three methods: website analysis, software-based prototyping and usability testing. These methods are introduced at different stages of the research to best address the research needs. De Groot (1969) empirical research cycle (observation, induction, deduction, testing, and evaluation) is used as a reference model for the study.  Figure 8 depicts the entire research process of the study with individual research objectives and the key outputs.
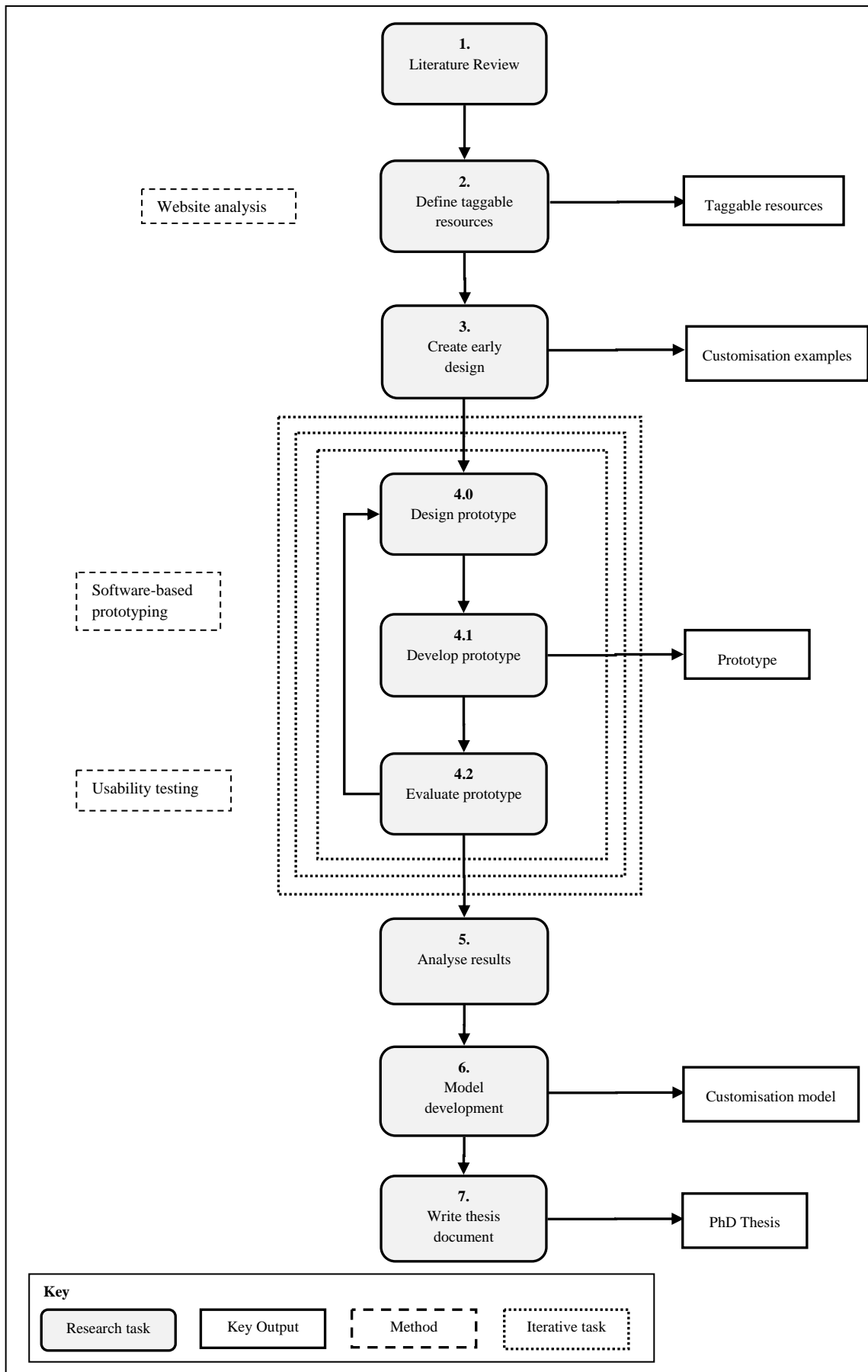
Figure 8 Research phase

The research starts with a literature review and the identification of the research focus. In this stage relevant literature is analysed, gaps in existing approaches are identified, and relevant research questions and hypotheses are formulated (1). Also, a conceptual model is proposed that extends the current tagging model to facilitate customisation via a customisation framework adopted from the literature. The conceptual model informs the research by providing the theoretical foundation and structure.

The next phase is to define the range of taggable resources available in online and mobile banking websites. This phase addresses the first research question (see RQ 1 in Section 3.7) through a website analysis method (see Section 4.1.1). The analysis informs the range of taggable resources in the online and mobile banking websites of two leading Australian banks, Commonwealth Bank and Suncorp Bank. This activity is useful to discover resources that can be annotated to facilitate customisation (2).

Following the definition of taggable resources, examples illustrating tag-based customisation are developed, which form the early design of the prototype (3). The goal of this phase is to illustrate the potential use of tags to facilitate banking customisation through the construction of examples based on simple banking scenarios. The customisation examples demonstrate the tag-based approach for each type of customisation.

Based on the early design, the software-based prototype is designed, developed and evaluated (4). The purpose of this prototype is to address the second research question (RQ 2) with regards to the impact on usability. The customisation is based on two common banking activities: fund transfer and bill payment. An iterative approach is employed to address unplanned conditions and also to incorporate learning from deficient design for a more reliable and valid outcome. Each iteration encompasses three phases: design, development and evaluation. A total of three iterations are planned. In every iteration, during the evaluation, logs detailing participants' actions are recorded on both online and mobile contexts for measuring actual usability. Subsequently, after the evaluation, participants will be asked to complete a post-test usability questionnaire, which will measure the perceived usability. Later, a debriefing session is carried out to gather additional feedback. Based on the feedback, improvements and adjustments will be made to the prototype.

The effect of tag-based customisation on usability is compared based on a set of analysis criteria for both online and mobile contexts. The significance of the result is analysed using paired t-test analysis. Based on the analysis, the results are discussed along with data gathered from user observation and debriefing.

Based on the findings, a customisation model that aims to aid the implementation of tag-based customisation for E-commerce websites is outlined (6). The model explains the various aspects of tag-based customisation with reference to the prototype. To illustrate the model's use, it is applied to two other E-commerce websites. A set of taggable resources is identified in both websites and the potential customisation are discussed.

In the final phase, the outcomes from the research are compiled and documented as a thesis document (7).

### 4.2.1   Website Analysis

To explore the first research question (see RQ1 in Section 3.7) on taggable resources in online and mobile banking websites, manual analysis of select websites is performed. The analysis identifies potential resources that can be annotated by users in online and mobile banking websites. The banks chosen as case studies are two leading banks in Australia: Commonwealth Bank[16] and Suncorp Bank[17]. The online banking and mobile banking websites of both banks are examined manually to identify taggable resources. The examination specifically focused on personal banking as it appeals to a larger audience. Refer to Section 5.1 for details on the taggable resources identified. Although the information gathered is contextual and specific to the case selected, it may be generalised across different online and mobile banking websites. This is primarily due to the competitive nature of the industry that compels banks to be on par with each other in terms of product and service offerings.

The analysis procedure to identify the range of taggable resources in online and mobile banking websites is conducted manually using three simple criteria. Two key banking activities are considered as part of the analysis: fund transfer and bill payment. Below are the criteria:

   a. **Is the resource central to the banking activity?  and/or**

   b. **Is the resource a reference to the banking activity?  and**

   c. **Is the resource static or semi-static by nature?**

The criteria above provide an indication as to whether it is useful to tag a particular resource. The criteria are used in conjunction with the information (resources) needed to carry out a banking

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[16] Commonwealth Bank, http://www.commbank.com.au

[17] Suncorp Bank, http://suncorp.com.au

activity, which are represented as form fields requiring user input such as bank account, biller, description, etc. The first criterion helps to determine the relevance and importance of the resource to the activity. For instance, the bank account and biller are essential resources to a bill payment activity. The second criterion aids to recognise if the resource is a reference of the activity instead. For example, the transaction description is a reference to the bill payment activity. The third criterion is useful to ensure the resource tagged is fixed (static) such as the bank account or partially static (semi-static) such as the bill description where re-use is still possible for analogous bills. The goal of this final criterion is to avoid tagging dynamic resources that are unique and not very meaningful such as payment date.

The website analysis method is also used to partly address the fourth research question (see RQ4 in Section 3.6) related to generalising the tag-based customisation approach to other E-commerce websites. Much like online and mobile banking websites, two case studies involving an online retail store (Coles[18]) and travel booking (AirAsia[19]) websites are examined to identify potential resources that may be annotated by users. Refer to Section 9.2.2 and 9.2.6 for details on the taggable resources identified.

### 4.2.2   Software-based prototyping

In order to address the second and third research questions (see RQ2 and RQ3 in Section 3.6) pertinent to usability and challenges related to tag-based customisation, the software-based prototyping methodology is employed. Prototyping supports a more interactive and tangible form of user-centred study (Fallman, 2003). Users can appraise and provide feedback on a system or a particular feature based on their 'real' experience. Also, when performed in an iterative fashion, prototyping allows the design to be improvised in stages. Figure 9 shows the iterative prototyping method used with a total of three iterations. In the first iteration the prototype is evaluated internally, while the second and third iterations through a pilot study and main study, respectively. Refer to Appendix G for the software prototype.

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[18] Coles, http://www.coles.com.au
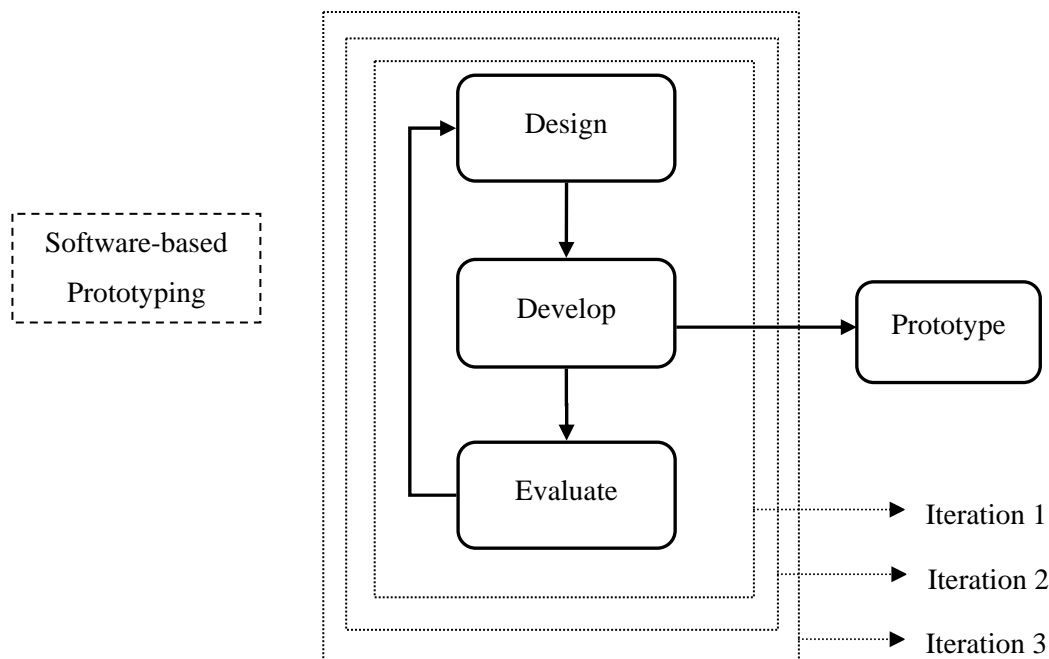[19] AirAsia, http://www.airasia.com

Figure 9 Iterative prototyping

### 4.2.3    Usability testing

To examine the usability of the tag-based prototype (see RQ 2) and also to identify the challenges related to the tag-based customisation (see RQ 3), the usability testing methodology is used. Usability testing is primarily useful to ensure that people can find and use the provided functions to fulfil their needs (Dumas et al., 1999). The usability test took place in a laboratory environment with individual participants in the presence of a facilitator.

A comparative usability evaluation is conducted to evaluate the tag-based prototype against the present banking interface. The present banking interface mimics the design and interaction of the online/mobile banking websites of Commonwealth Bank and Suncorp Bank. Participants of the usability evaluation are required to evaluate both interfaces by carrying out a set of evaluation tasks (see Table 2). The evaluation tasks are generic in nature, which are identified from a pilot study. The evaluation considered both online and mobile contexts, and as a result the participants conducted two sets of tasks on each context. To evaluate the usability of the interfaces in a real-world setting, especially the tag-based interface, little explanation was given on the customisation offered, instead the participant is left to "discover." Explanations are only given in the event the participant experienced difficulties in completing a particular task. This strategy is used to tease out design issues and make the interaction as intuitive as possible.

A scenario-based design is used to engage and immerse participants in the usability evaluation by providing a suitable context and purpose. The scenario employed outlines that there is a new online banking provider evaluating the usability of two interfaces. The participants were

informed that they were a select group of users who were selected to be part of the evaluation. For the purpose of the evaluation, participants were told that he/she owned five accounts: Savings, Everyday, MasterCard, Visa, and Cheque. To ensure the absence of any pre-meditated associations in terms of experience and brand commitment with participants, a fictional banking website is used called *XBANK Online Banking*. Additionally, to familiarise participants with the interfaces, a practice session is included. This practice session included two tasks that required participants to carry out a fund transfer and bill payment activity with both interfaces. That data from these practice tasks are excluded from analysis. Following the practice tasks, participants continued with the evaluation tasks.

### 4.2.4    Collection of user's opinions

Two methods are used for collecting user's opinions: post-test usability questionnaire and post-test debriefing. Both these methods are carried out after the actual testing. The post-test usability questionnaire helps to gather user's perception on the usability of the interfaces evaluated. While the post-test debriefing assists in making sure that the completed usability questionnaire correctly reflect user's opinions and also in gathering additional feedback from participants on various aspects of the interfaces.

### 4.2.5    Observation and monitoring usage

Two methods are used for collecting data based on real usage during the usability test: user observation (qualitative) and logging use (quantitative). The user observation involves observing participants at work and maintaining an observation log. The observation log contains information such as user errors, design issues and user preferences. Based on the observation log, the usability of the interfaces is interpreted. The usage logging method is used to capture participant's actions on the interfaces for the given evaluation tasks. The log files recorded task completion, user error and tagging behaviour.

### 4.3    PARTICIPANTS

The population of interest for the study is online and mobile banking users. The study participants are recruited from the university who encompass students and staffs. A convenient sample of 8 users is used to for the pilot study and a simple random sample of 30 users is used for the main study. The target population is from 21 to 50 years of age with basic online banking experience. A larger number of participants are from the younger age group (21-30) who are pertinent to this study as banking customisation is most appealing and relevant among this age group (Rahim & JieYing, 2009).

The recruitment process is conducted through emails sent to university staffs and students. In order to compensate participants for their contribution, a gift card worth $15 is offered to each participant. Participation in the study is entirely voluntary and participants are required to provide written consent to participate in the study.

## 4.4    INSTRUMENTS

Below are the instruments used for this study:

### 4.4.1    System Usability Scale (SUS)

To evaluate the usability of the interfaces, the System Usability Scale (SUS) (Brooke, 1996) is adapted by replacing *system* with *website*. The SUS is a 10-item questionnaire, with Likert scales, that gives an overview of perceived usability in terms of efficiency, effectiveness, and satisfaction. The tool asks users to rate their level of agreement or disagreement to 10 statements (see Appendix A) - half worded positively, half negatively - about the software or interface under review.

According to Tullis and Stetson (2004) who compared SUS against other usability questionnaires specifically for website usability assessment, SUS yields among the most reliable results across sample sizes. To yield reasonably reliable results, at least 12-14 participants should be used in a study. Furthermore, as an extension an 11th item is added on "user-friendliness" with adjective descriptions of rating levels of 1-7 (Worst Imaginable, Awful, Poor, OK, Good, Excellent, and Best Imaginable). The purpose of this item is to inquire about the summative experience of participants. This strategy is suggested by a study that empirically evaluated nearly 10 years worth of SUS data collected on numerous products in all phases of the development lifecycle (Bangor et al., 2008). The study regarded SUS as a highly robust and versatile tool used in more than 200 studies for usability evaluation. To further ensure SUS is a suitable instrument for the study, a pilot study is carried out with a small group of banking users. Refer to Appendix A – SUS.

### 4.4.2    Software-based prototype

The tag-based prototype is called *TagNBank*. The prototype works in both online and mobile contexts. The client-side library jQuery and jQuery mobile are used for this purpose, to render the user interface (UI) according to the contexts. The server-side is developed using PHP scripting language and MySQL database.The prototype has two banking features: fund transfer and bill payment; and supports the assignment of tags to three banking resources: bank accounts, billers and references. Additionally, the prototype logs user activity in both contexts. From the

initial design, the prototype is improved based on the issues observed and user feedback received from the pilot study.

For the purpose of the comparative usability evaluation (see Section 4.1-iii) , a test website that mimics the present banking interface is also built with reference to the online/mobile banking websites of Commonwealth Bank and Suncorp Bank (case study for the website analysis activity – see Section 3.1.1).

### 4.4.3   Debriefing questions

The debriefing questions are primarily used as a mechanism to reaffirm the user's overall experience with the interfaces evaluated as indicated in the SUS response and also to confirm that his/her intentions were correctly captured. Additionally, the questions are also used to gather user feedback and preference on design elements of the interfaces especially tag-based. Refer to Appendix B – Debriefing questions.

### 4.5   PROCEDURE AND TIMELINE

The usability testing is divided into six stages: briefing, test A (online), SUS (A), test B (mobile), SUS (B) and debriefing. In between each of these stages a few minutes break is given. Figure 10 shows the evaluation procedure and timeline. The entire evaluation takes around 80 minutes without breaks per participant.

Stage 1 is briefing and this stage takes about 15 minutes. In this stage, firstly the participant is given a pre-test questionnaire that collects demographic details along with computer, Internet, and online banking experience (see Appendix C – Post-test questionnaire). Then the participant is briefed about the study via an information sheet that details the study's goals, objectives and procedures. Finally, to familiarize the participant with the interfaces evaluated in the study, a brief demo and a test activity is given. The participants assigned tags to banking resources on their own with the tag-based interface.

Stage 2 is the first phase of testing. This phase only covers the online (desktop) context and takes about 20 minutes. In this stage, the participant carries out a set of evaluation tasks on each of the interfaces. Table 2 lists the evaluation tasks.

Stage 3 involves administering the SUS questionnaire to the participant and subsequently the participant scores each interface according to the scale provided for the online context. This stage takes about 5 minutes.

Stage 4 is the second phase of testing. This phase only covers the mobile context and takes about 20 minutes. Similar to stage 2, the participant carries out the same set of tasks as shown in Table 2 on each of the interfaces.

Stage 5, akin to stage 3 involves administering the SUS questionnaire to the participant and the participant scoring each interface for the mobile context. This stage takes about 5 minutes.

Stage 6 is the final stage of the evaluation. In this stage, a debriefing session is conducted with the participant to gather additional feedback about their experience and potential improvement to the interfaces. This stage takes about 15 minutes.
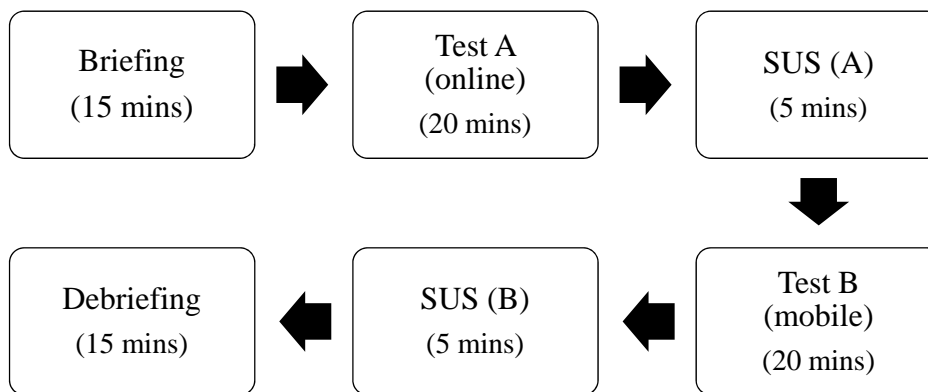
Figure 10 Evaluation procedure

| Task | Task type | Task details |
|------|-----------|--------------|
| T1 | Rent transfer | Funds transfer to a real estate agent |
| T2 | Phone bill payment | Bill payment to a mobile provider |
| T3 | Charity contribution | Funds transfer to a charity |
| T4 | Foreign money transfer (Forex) | Bill payment to a money transfer service |
| T5 | Rent transfer (recurring) | Recurring funds transfer (similar to T1) |
| T6 | Phone bill payment (recurring) | Recurring bill payment (similar to T2) |

Table 2 Evaluation tasks

Table 3 provides a detailed description of the evaluation tasks listed in Table 2.

| Task | Description |
|------|-------------|
| T1 | Monthly rent transfer from **Everyday** account to **Century21** real estate agent for the amount of **$1200.00**. |
| T2 | Mobile bill payment from **Everyday** account to **Vodafone** for the amount of **$60.00**. |
| T3 | Occasional charity contribution from **Savings** account to **Auscharity** for the amount of **$30.00**. |
| T4 | Foreign money transfer payment from **Savings** account to **OzForex** for the amount of **$1000.00**. |
| T5 | Past/recurring monthly rent transfer from **Everyday** account to **Century21** real estate for the amount of **$1200.00**. |
| T6 | Past/recurring mobile bill payment from **Everyday** account to **Vodafone** for the amount of **$49.99.** |

Table 3 Evaluation task description

## 4.6    ANALYSIS DESIGN

The data gathered through the various instruments is analysed using statistical analysis methods. To determine the significance of the results, the paired t-test analysis is used to compare the two interfaces. Only two means are compared for each category/criterion to avoid Type 1 error (false-positive). Below are the data categories and analysis criteria for each category.

    **a.**    **SUS scores and ratings**

- By banking context (online / mobile)
- By experience (inexperienced / experienced)

    **b.**  **Task completion**

- By banking context (online / mobile)

The SUS scores and ratings are analysed based on three criteria. First, by the banking context where data is ordered into two groups: online and mobile. Second, based on user experience with mobile banking where data is ordered based on two groups: inexperienced and experienced.

The task completion rates and times are analysed based on banking context where data is grouped according to online and mobile banking.

The quantitative data analysed is compared and contrasted with the qualitative data recorded through user observation and post-test debriefing to detect inconsistencies. Also, the qualitative data is used to provide explanations to outcomes of the analysis.

## 4.7    ETHICS AND LIMITATIONS

This study involves humans through their participation in the usability testing. Participants are required to participate in a usability test to evaluate the tag-based prototype developed as part of this research project. The participants complete a post-test questionnaire after completing the test and also engage in a debriefing session. This type of research, under QUT's research guidelines[20], is considered low-risk since it doesn't involve any more risk than a potential discomfort. The participants for the usability test are QUT students and staffs. Ethical clearance for this study has been obtained (Approval Number: 1100001005).

There are a few limitations to this study:

The first limitation is the evaluation tasks used for the usability testing. The tasks only cover two common banking activities, funds transfer and bill payment. This restricts the examination scope to functional tasks and excludes non-functional tasks such as check balance or

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[20] QUT Research Guidelines, http://www.research.qut.edu.au/ethics/humans/faqs.jsp

view history. Also, although the evaluation tasks are meant to be generic, participants who had conducted similar tasks in real life to the ones given during the study might be able to better relate to and personally engage with the tasks as opposed to others who have not. This may affect the tags assigned to the tasks and also the perceived usability of the customisation.

The second limitation is participants' lack of experience and familiarity with tagging specifically in the financial context. Furthermore, tagging of banking resources at a lower level supported by the tag-based prototype further adds to this limitation. As a result, the study participants are subject to a learning curve, which is likely to have negatively impacted the usability especially user efficiency. Likewise, the notion of evaluating the usability of the interfaces in a real-world setting by offering minimum information on the customisation is also likely to have had a similar effect on the findings.

## 4.8     SUMMARY

This chapter presented the research design for the study. First, the research questions are outlined with a discussion on their link to the gaps found in the literature review. Second, the research methods applied for the research are detailed which include website analysis, software-based prototyping, usability testing, collection of users' opinions and observation and monitoring usage. The phases in which these methods are introduced and their key outputs is subsequently explained. Next, details on the participants of the study are provided. Then, the research instruments used namely usability scales, prototype and questionnaire, are presented. This is followed by the procedure and timeline for each stage of the evaluation. Subsequently, the data analysis design is mentioned. Finally, a discussion on the ethical aspect of the research along with the limitations of the design is provided.

# Chapter 5. Preliminary Work

This chapter describes the preliminary work that underpins this research. Section 5.1 details the website analysis conducted to identify and define the range of taggable resources found in online and mobile banking. Section 5.2 presents the design and implementation of the conventional interface. Section 5.3 presents the design and implementation of the tag-based interface. Section 5.4 outlines the results and implications of the pilot study.

## 5.1    WEBSITE ANALYSIS

The range of taggable resources in the online and mobile banking websites is not available in the literature. The purpose of this approach is to address this gap by identifying taggable resources in online and mobile banking websites. Subsequently, based on the identified taggable resources, different customisation types are explored.

The analysis focused on two leading Australian financial institutions, the Commonwealth Bank[21] and Suncorp Bank[22]. The Commonwealth Bank offers retail banking, premium banking, business banking, institutional banking, funds management, superannuation, insurance, investment and sharebroking products and services. The Commonwealth Bank group is one of the largest listed companies on the Australian Stock Exchange and is included in the Morgan Stanley Capital Global Index. Well-known for its innovative financial solutions, Commonwealth Bank received two Canstar Innovation Awards[23] in 2010. Likewise, Suncorp is also a major and innovative Australian bank that offers personal banking, business banking, insurance, investment and superannuation. Suncorp-Metway Ltd is Queensland's largest listed corporation and one of Australia's top 25 listed companies. Commited to innovation, Suncorp is a financial industry partner of the Smart Services Cooperative Research Centre (CRC), the funding body of this research.

While Commonwealth Bank and Suncorp Bank provide different types of online and mobile banking namely personal, business and corporate, this study is focused on personal

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[21] Commonwealth Bank, http://www.commbank.com.au
[22] Suncorp Bank, http://www.suncorp.com.au
[23] Canstar Cannex 2010, http://www.canstar.com.au/innovation-awards-2010/

banking. This is because personal banking is a common banking facility that appeals to a larger audience. Through direct observation of Commonwealth Bank's and Suncorp Bank's Internet banking, a number of taggable resources were identified: account, description, biller, application and message. Table 4 lists and describes the resources (see Appendix D and E for screenshots of the resources).

| Resource Id | Category | Type / Description | Context |
|---|---|---|---|
| R1 | Account | Personal – User owned accounts (e.g., everyday, savings, cheque, credit card, business, etc) | Online and Mobile |
| R2 | | Payee – Linked (Personal Account) or Other (3$^{rd}$ party - internal, external and overseas account) | Online and Mobile |
| R3 | Reference | Personal – Description of transaction type (e.g., offline such as EFTPOS; online such as BPay, fund transfer, shopping, etc; direct debit, etc) for personal reference | Online and Mobile |
| R4 | | Payee – Description of transaction for recipient's reference | Online |
| R5 | Biller | All types of registered or unregistered biller | Online and Mobile |
| R6 | Application | All types of financial products (e.g., account, credit card, loans, etc) | Online and Mobile |
| R7 | Message | Personal communication between customer and bank | Online |

Table 4 Taggable resources

### 5.1.1   Discussion

The website analysis informs the range of taggable resources in the online and mobile banking websites of Commonwealth Bank and Suncorp Bank. A total of seven resources were identified, grouped into five categories: *account*, *reference, biller*, *application* and *message*.  The first two resources (R1 & R2) related to bank accounts and the fifth resource (R5) related to biller are found in both banks and contexts (see Appendix D1-2 & E1-2). The third and fourth resources (R2 & R3) provide description to transactional activities such as bill payment, external

transfer, etc in both contexts (see Appendix D3-4 & E3-4). However, personal reference (R3) is the only resource supported by both banks, while payee reference (R4) only by Commonwealth Bank, exclusively in the online context. Analogously, the sixth resource (R6) linked to application is only present with Commonwealth with limited support for mobile – view only (see Appendix D6 & E5). These two additional resources (R4 & R6) suggest that Commonwealth Bank covers a wider range of features as part of its personal banking service. The seventh and final resource (R7) associated with message is offered only in the online context by both banks (see Appendix D7). This could be due to the intent of both banks to only provide key transactional features on the mobile platform.

## 5.2    CONVENTIONAL INTERFACE

For the purpose of the comparative evaluation, a conventional interface is designed with reference to the online and mobile banking websites of Commonwealth Bank and Suncorp Bank (case study banks). The interface mimics the conventional interactions for two activities: bill payment and fund transfer.

The conventional interface is implemented using a set of Web development tools namely Javascript, PHP and MySQL. For the user interface (UI), the client-side library jQuery and jQueryMobile are used to render the Web UI according to the online and mobile contexts. Figures 11 and 12 show a fund transfer example in the online and mobile contexts.

The conventional interface is based on standard HTML objects (dropdowns, checkboxes, buttons, menus, etc).  A tab-based menu[24] is used to ease navigation between features in the online context, akin to the banking websites analysed. While in the mobile context, a mobile slide-based menu (listview[25]) is used (see Appendix H - Prototype Screenshots). Details related to the implementation of the customisation types are presented in Section 5.2.2.

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[24] http://jqueryui.com/tabs/

[25] http://jquerymobile.com/demos/1.2.0/docs/lists/docs-lists.html

Figure 11 Fund transfer (online)



Figure 12 Fund transfer (mobile)

In order to illustrate the way in which the conventional interface works, activity diagrams for a new and recurring bill payment activity are presented. ***Note**: clear background – required activity / dark background – optional activity.
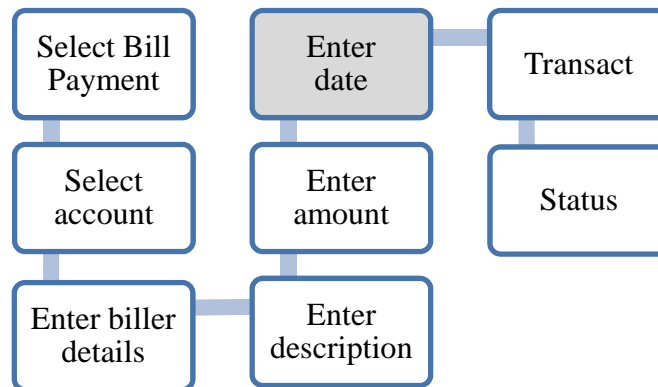


Figure 13 New bill payment

Figure 13 illustrates a new bill payment activity with the conventional interface. First, the user selects the bill payment option from the menu. Subsequently, the user selects an account to pay from and the biller to which the payment is directed. Next, the user enters the description for the payment and the bill amount. This is followed by an optional activity of selecting a specific payment date (by default the current date is selected). Finally, the user submits the transaction for processing and receives a status update.
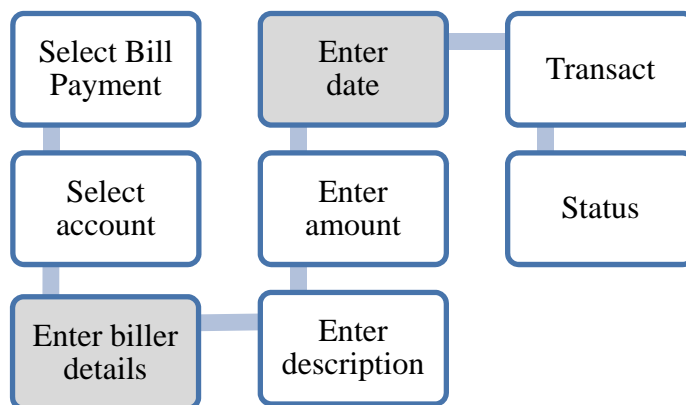


Figure 14 Recurring bill payment

Figure 14 shows a recurring or past bill payment activity with the conventional interface. This activity is almost identical to a new bill payment, however, the biller details are remembered by the system thus the user only needs to select the appropriate biller (remembrance-based customisation).

### 5.2.1    Customisation design

As aforementioned, the conventional interface is based on standard HTML objects (dropdowns, checkboxes, menus, etc). Through the HTML objects, the conventional interface only supports remembrance-based customisation (see Section 5.2.2-a).

### 5.2.2    Customisation implementation

The implementation of the remembrance-based customisation is provided in the next section.
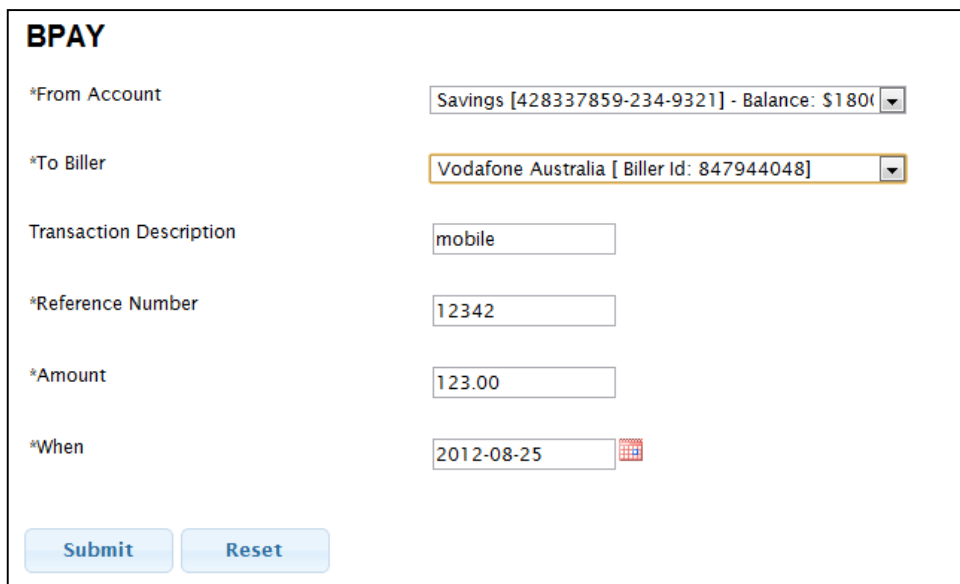
### a.    Remembrance-based customisation

This customisation type is achieved via dropdown selection where previously entered information is remembered. For instance, when a user selects a biller that he or she has paid to before from the dropdown selection, the biller details are automatically populated, avoiding the need for the user to re-enter the biller details. The figures below depict the mentioned example in the online context.



Figure 15 Bill payment (initial form)

Figure 16 Bill payment (auto-filled form)

## 5.3    TAG-BASED INTERFACE

For the purpose of demonstrating the tag-based customisation approach, a tag-based prototype is developed. The prototype is an implementation of a tag-based interface, which utilises tags as individual and aggregated interface objects. Similar to the conventional interface, a tab-based menu is used in the online context, while a slide-based menu in the mobile context (see Appendix H - Prototype Screenshots).

For the purpose of designing a tag-based interface, the well-known Shneiderman's "Eight golden rules of interface design" (Shneiderman et al., 2004) is adopted. Additionally, in the mobile context, an extension to Shneiderman's guideline specifically targeting mobile interfaces proposed by Gong and Tarasewich(2004) is used. Please see Section 5.3.1 Interface design.

According to the customisation types proposed by Fung (2008), the tag-based prototype customises the online and mobile banking interaction for two activities: fund transfer and bill payment. In the early stages, to develop a better understanding of the mechanics of the customisation types, a set of scenario-based examples are designed. Subsequently, a comparison of a non-customised interaction for the same scenario is given. This effectively forms the initial and basic design of the prototype (see Appendix F - Customisation examples).

The tag-based prototype is implemented using a set of Web development tools namely Javascript, PHP and MySQL. For the user interface (UI), the client-side libraries jQuery and jQueryMobile are used to render the Web UI accordingly for the online and mobile contexts. Details related to the implementation of the customisation types are presented in Section 5.3.2.

### 5.3.1   Interface design

Designing usable interface has been widely discussed and over the years, researches and user interface (UI) experts alike have put forward a wide range of principles for designing user interface. One of the many well acknowledged guidelines is Shneiderman's "Eight golden rules of interface design" (Shneiderman, et al., 2004). He proposes a collection of principles that are derived heuristically from experience and applicable in most interactive systems after being properly refined, extended, and interpreted. Below are the rules:

| Shneiderman's "Eight Golden Rules of Interface Design" |
|---|
| 1. Strive for consistency |
| 2. Enable frequent users to use shortcuts |
| 3. Offer informative feedback |
| 4. Design dialog to yield closure |
| 5. Error prevention and simple error handling |
| 6. Permit easy reversal of actions |
| 7. Support internal locus of control |
| 8. Reduce short-term memory load |

Table 5 Golden rules of interface design

Source: (Shneiderman, et al., 2004)

Although these rules have been largely targeted and applied on computer-based interfaces, they are also applicable to mobile interface design. However, Gong and Tarasewich(2004), suggest a few modifications to the rules namely consistency, reversal of actions, error prevention and handling and reduction of short-term memory load. The proposed modifications take into consideration additional dimensions unique to the mobile environment and also the use of mobile devices. The authors put forward a separate set of guidelines for mobile interface design. This is consistent with Nielsen's (2011) view that in order to improve the mobile experience it is best to design a separate mobile site with clear links from the full site to the mobile site and vice-versa.

| Mobile interface design guidelines |
| --- |
| 1. Design for multiple and dynamic contexts |
| 2. Design for small devices |
| 3. Design for limited and split attention |
| 4. Design for speed and recovery |
| 5. Design for "top-down" interaction |
| 6. Allow for personalization |
| 7. Design for enjoyment |

Table 6 Mobile interface design guidelines

Source: (Gong, et al., 2004)

According to the design guidelines above, personalization/customization is an integrated part of user interface design (No. 6), particularly in the mobile setting as mobile devices are more personal compared to computers. This guideline is central and parallel to the notion of tag-based customisation to facilitate personalised interaction in the mobile context.

### 5.3.2   Customisation design

The customisation examples (see Appendix F) are not intended to be specific to a particular banking website. Despite differences in website design and layout especially in terms of forms and navigation style, the information requested or provided by banks for financial activities is relatively standard due to regulatory requirements. Therefore, the customisation examples are illustrated based on a single banking website. For this purpose, the Commonwealth Bank Australia (CBA) banking website is chosen for a few reasons including familiarity (earlier work) and comprehensiveness (offers a wider range of features/services).

The customised interaction is compared against the present, non-customised interaction (see Appendix F  - Customisation examples). Steps that facilitate customisation are highlighted in grey. Optional steps are highlighted in blue while important tags pertinent to a scenario are highlighted in red.

The following figures 17 and 18 illustrate the way in which the tag-based interface work through activity diagrams for a new and recurring bill payment activity. ***Note**: clear background – required activity / dark background – optional activity.
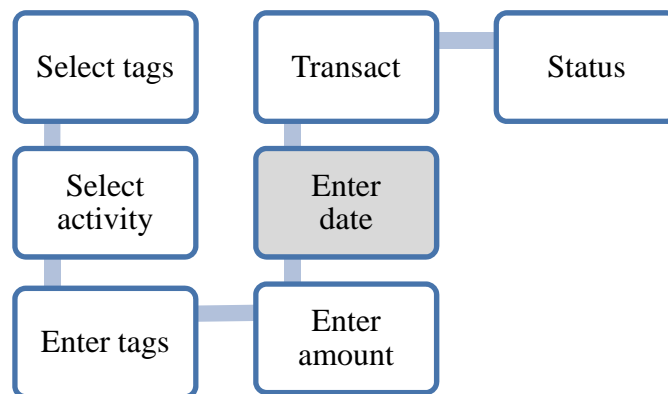


Figure 17 New bill payment

Figure 17 illustrates a new bill payment activity with the tag-based interface. First, the user selects the relevant tags for the bill payment which typical include the account and biller tags. Subsequently, the user selects an activity from the suggested list of actions (comprehension-based customisation). Next, the user enters tags for the payment and the bill amount. This is followed by an optional activity of selecting a specific payment date (by default the current date is selected). Finally, the user submits the transaction for processing and receives a status update.
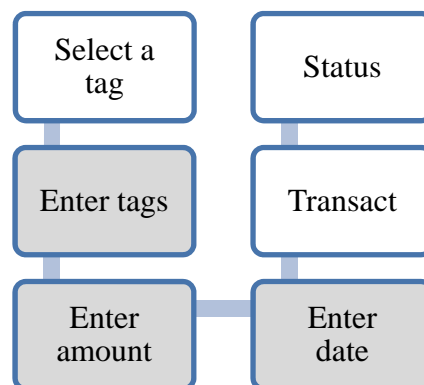


Figure 18 Recurring bill payment

Figure 18 shows a recurring or past bill payment activity with the tag-based interface. This activity is almost identical to a new bill payment, however, the entire transaction details is remembered and automatically populated when a reference tag is selected (remembrance-based customisation). Thus, the activity of entering tags and amount for the payment are optional.

### 5.3.3   Customisation implementation

The implementation of each customisation type is provided below. Refer to Section 9.1 – Tag-based customisation model for a more detailed explanation on the aspects and components useful to implement the different customisation types.

### a.   Remembrance-based customisation

This customisation type is defined as the ability to provide customisation through simple remembering of a user's information based on the recurrence rate of a particular action on a website (Fung, 2008).

Remembrance-based customisation is achieved through tags assigned to resources that are presented as tag clouds. This provides a visual retrieval interface that can simplify and ease the execution of past or recurring transactions. Simply by clicking on a tag, related information about a transaction that the tag is associated with can be retrieved and displayed. If a selected tag is associated with two or more tags then the tag cloud can be filtered to show tags, which are co-occurring with the selected tag. This removes the need to navigate to a different page or perform a manual search query. This also means for carrying out a past or recurring transaction, users will only need to update necessary information such as amount (if different) and possibly retain other details such as bank accounts and description.

Based on user's tagged resources namely transaction description, remembrance-based customisation is introduced. The following example assumes a user pays a monthly mobile bill and tagged the transaction as "mobile" in the first month, and the following month the user returns to carry out the same activity.

*Scenario 1: Mobile bill payment. User clicks on "mobile" tag (1) from the tag cloud. As a result, the bill payment form is automatically completed.*

Figure 19 Bill payment (initial form + user click (1))



Figure 20 Bill payment* (completed form)

*The selected tag ("mobile") from the tag cloud is highlighted (underline) and the transaction details are loaded and the account and biller tags ("Everyday" & "Vodafone") are automatically selected (tick icon).

### b.   Comprehension-based customisation

This customisation type is defined as the ability to recognize user's behaviours and provide assistance towards fulfilling the user's needs (Fung, 2008).

Comprehension-based customisation is achieved by inferring banking actions like fund transfer based only on tags selected by the user. Such inference is possible particularly for tags with certain types of relations such as two bank accounts. These relations when combined with simple pre-defined rules can aid in populating relevant actions. A sample pre-defined rule is the ability to transfer funds from savings account to credit card account but not the other way around due to nature of the accounts. However, it would be possible to transfer two-ways between a savings account and a current account. The default choice for the suggested actions can be made based on past user actions to closely reflect user's needs. However, as a key HCI design rule, it is important not to automatically carry out an action to ensure the locus of control remains with the user (Shneiderman, et al., 2004).

This customisation is realized through user selection of tags, where a set of actions are inferred by analysing the relations between tags selected. This allows users to carry out their banking activities with minimal effort. This is achieved by examining the tripartite structure of tags comprising of user, tag and resource and subsequently, applying pre-defined rules to the underlying resources. Rules are defined for a particular resource owned by a user such as bank account based on account type. For example, a savings account would have three rules: transfer_from, transfer_to and view, which denotes that the account can be used to send or receive money, and be viewed. Meanwhile a credit card account (e.g., "Visa") would only have two rules: transfer_to and view, which denotes that the account can only receive money and be viewed. Similarly, a payee account (e.g., "Dad") would also have the same set of rules as the credit card account. The account with 'transfer_from' action will always act as the sender/primary account while the account with 'transfer_to' action will act as the recipient/secondary account. In the event tags of two accounts with 'transfer_from' action are selected, it would be possible to have identical actions of transferring and receiving funds between both accounts. In order to reduce the overall complexity involving multiple accounts, a limit for the number of selectable tags particularly for personal accounts is desirable (see Table 4 for account types).

The following examples show the ability of conducting an internal and external fund transfers just by selecting tags. Although the examples only illustrate fund transfers to a single account, it is possible to carry out fund transfers to multiple accounts at once.

*Scenario 2: Internal fund transfer from Savings to Everyday account. User clicks on "Savings" (1) and "Everyday" (2) tags, a set of possible actions for these accounts are populated. The suggested actions are 1) 'Transfer from Savings to Everyday', 2) 'Transfer from Everyday to Savings' and 3) 'View transaction history of Savings and Everyday'.*
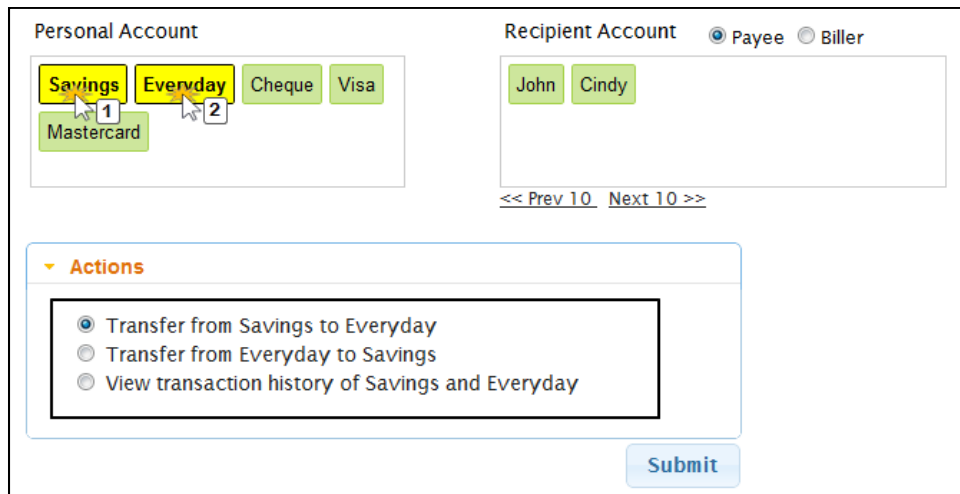


Figure 21 Internal fund transfer

*Scenario 3: External fund transfer from Everyday to John's account. User clicks on "Everyday" (1) and "John" (2) tags, a set of possible actions for these accounts are populated. The suggested actions are 1) 'Transfer from Everyday to John' and 2) 'View transaction history of Everyday and John'*



Figure 22 External fund transfer

### c.   Association-based customisation

This customisation type is defined as the ability to provide customisation through association of user's behaviour with other individuals who share similar interests or needs(Fung, 2008).

Association-based customisation is achieved through tag recommendation to users primarily as suggestions in the form of dropdown box or visually through the use of tag clouds to display related tags. The semantics of tags can be used to find closer association between tags across the network and to select/rank the most relevant sets of tags based on similarity score (Durao, et al., 2009). Based on the derived tags, information about related services may also be aggregated. This information can possibly aid the discovery of services which otherwise may not been known to users. This is particularly appropriate in light of an integrated online banking bill payment service such as BPay[26] in Australia, participated by merchants and service providers throughout the country.  However, aggregation of services based on tag-relatedness is more likely to be useful only for services that can be easily abandoned.

The associations are divided into tag suggestions and tag-based service aggregation. Both these associations are based on two sets of tags: personal and public (cross-network). For tag suggestions, personal tags take precedence over public tags, and the most relevant public tags are suggested based on number of associations to a resource. For the purpose of this study, top five relevant tags are suggested to users, sorted based on the frequency of use. These tags encompass both user assigned and system default tags for banking resources. Initially, the prototype provides tag suggestions based on system default tags and later on personal and public tags are included (when available) as part of the recommendation.

To improve the relevance of tags suggested to an individual, analysis of semantic relatedness is useful (Durao, et al., 2009). Additionally, by analysing the semantics relatedness of tags, similar services may be discovered and aggregated. This is based on the notion that tags with high semantic relatedness are likely to represent a similar type of biller. In order to ascertain the similarity of discovered billers, further validation can be carried out based on attributes such as industry type, nature of business, etc. For this purpose, semantic databases like Freebase[27] and local business directories can be used. Although semantic analysis of tags can aid in personalizing

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[26] BPay, http://www.bpay.com.au/

[27] Freebase, http://www.freebase.com/

tag recommendation (Durao, et al., 2009), it is subject to good levels of semantics in tag sets. The outcome of semantic analysis can be undermined by the presence of idiosyncratic tags that carry strong personal connotations. One possible solution is tag reuse through tag suggestions (Sood et al., 2007), which can reduce the use of idiosyncratic tags over time. Also, the utility of tag-based service aggregation may entail reciprocal action from users to tag with a reduced personal sense.

The following examples illustrate this customisation by assuming a user carries out two select bill payments to two billers: Vodafone (mobile service provider) and OzForex (foreign currency exchange service provider).

*Scenario 4: Tag recommendation for multiple bill payment (mobile and money transfer). User clicks on "Vodafone" (1) and then "OzForex" (2) biller tags, and clicks to enter a description tag (3). As a result, a set of related tags are recommended that are used in the context of the selected billers.*
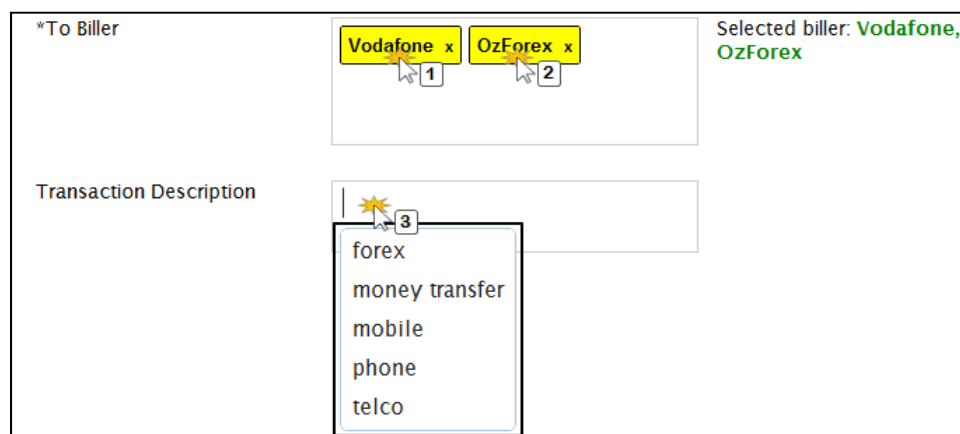


Figure 23 Tag recommendation (suggestion)

*Scenario 5: Tag-based services recommendation. User clicks on "forex" (1) tag, related services are populated with aggregated information on service usage.*
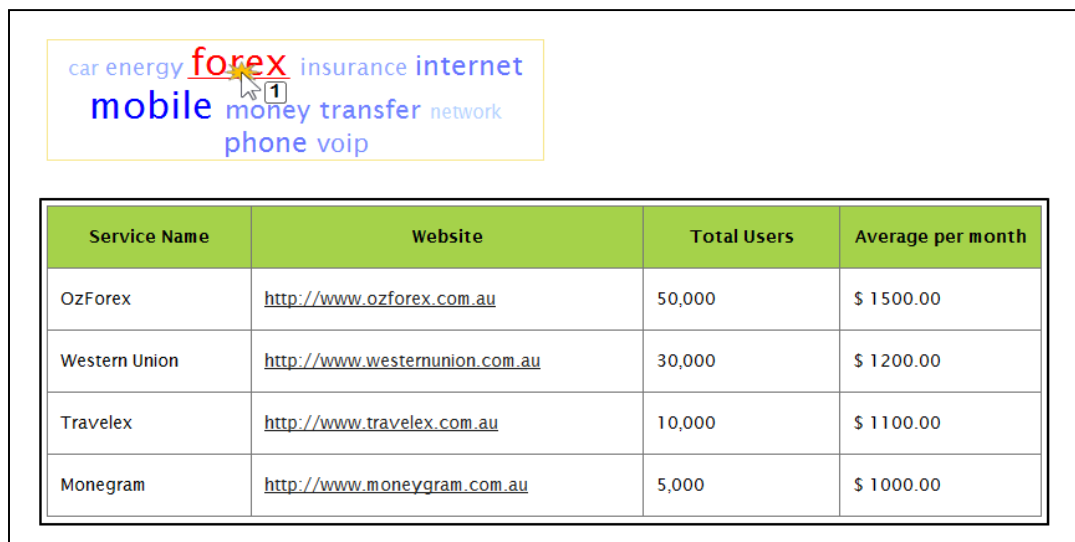
Figure 24 Tag recommendation (service aggregation)

Figure 24 shows a table of foreign currency exchange services with aggregated information such as total users and average per month. Such information enables users to discover related services with the aggregated details serving as a practical rating for services. In the above context, the service with the highest users and average may be perceived to offer a more competitive exchange rate than the rest. Even in cases where the aggregated information is not very useful, users may still benefit solely from discovery of related services.

### 5.3.4    Discussion

For the purpose of usability testing, association-based customisation is simplified by offering tag suggestions only (excluded tag-based service aggregation). Apart from simplicity, other reasons include the need for a reasonable data set to afford aggregated information and inability to directly associate with the evaluation tasks of the comparative study. Given that the goal of this research is to primarily evaluate the usability of the tag-based customisation and not the affordance of new features, the simplification is appropriate and does not affect the research outcomes.

### 5.4    PILOT STUDY

The pilot study involved a group of eight banking users. The goal of the pilot is to tease out early design impediments and other usability issues prevalent in both interfaces, and to debug the test procedure. Each participant is asked about he/she's five most common online and/or mobile banking tasks. The pilot study is used to assess the adapted and extended SUS questionnaire and its ability to offer a reflective and consistent view of users' perceived usability

in the online and mobile contexts. The results show that users' views were reflective and consistent of their feedback gathered during debriefing. There is a notable difference between the SUS scores for the conventional and tag-based interfaces. The difference is especially apparent with banking users without prior experience in mobile.

### 5.4.1    Objectives

The goals for the pilot study are:

- To tease out early design issues and other issues present in the prototype
- To debug the test procedure

The research questions for the study are:

- RQ1: What impact does tag-based customisation have on usability?
- RQ2: What are the challenges of tag-based customisation?

### 5.4.2    Methodology

The methods outlined in the research design chapter (see Section 3.1) are employed. However, anticipating a number of issues with the prototype for the pilot study, user errors are not logged.

### 5.4.3    Procedure and timeline

The procedure and timeline described in the research design chapter is followed (see Section 3.4).

The evaluation tasks listed in Table 2 are manually selected based on internal discussion within the research group. To reaffirm these tasks are generic and common, common banking activities and their frequencies are solicited from participants as part of the test procedure (briefing phase).

For the purpose of the usability tests, the tasks evaluated are introduced in the same order on both interfaces. Likewise, the interfaces evaluated are also introduced in a logical order, starting with the conventional interface followed by the tag-based interface.

### 5.4.4    Participants

A total of 8 online banking users were recruited from the university: 6 males and 2 females between the age group of 21 to 40. All of the participants had at least one active online banking account at the time of participation and were familiar with online banking with at least one year of experience. However, only half of the participants had prior experience in mobile

banking. According to our pre-test questionnaire, the most common banking activity carried out by the participants through their online and mobile banking is fund transfer, bill payment, transaction history and check balance. All participants had comparable levels of experience in computer and Web.

### 5.4.5   Instrumentation and data analysis

The same instruments described in the methodology chapter (see Section 4.4) are used. Analysis of the SUS scores and ratings; and task completion are performed. However, due to a small number of participants, errors present in the prototype and limitations of the pilot study, the statistical significance is subject to lower levels of external validity.

### 5.4.6   Preliminary results

The following figures 25 and 26 show the computed SUS scores and the summative experience ratings by banking context for each participant (Px). The SUS score range is 0-100 and the summative experience rating range is 1-7 (1 = Worst Imaginable, 2 = Awful, 3 = Poor, 4 = Ok, 5 = Good, 6 = Excellent, 7 = Best Imaginable).
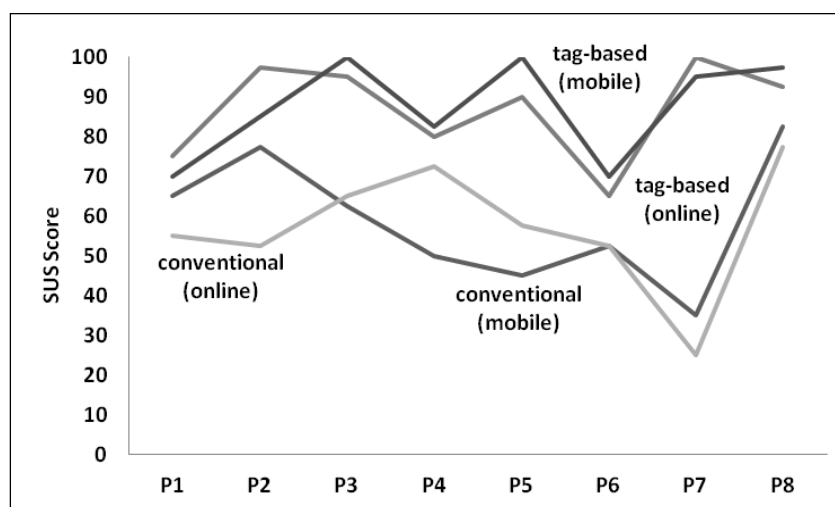


Figure 25 Average SUS scores
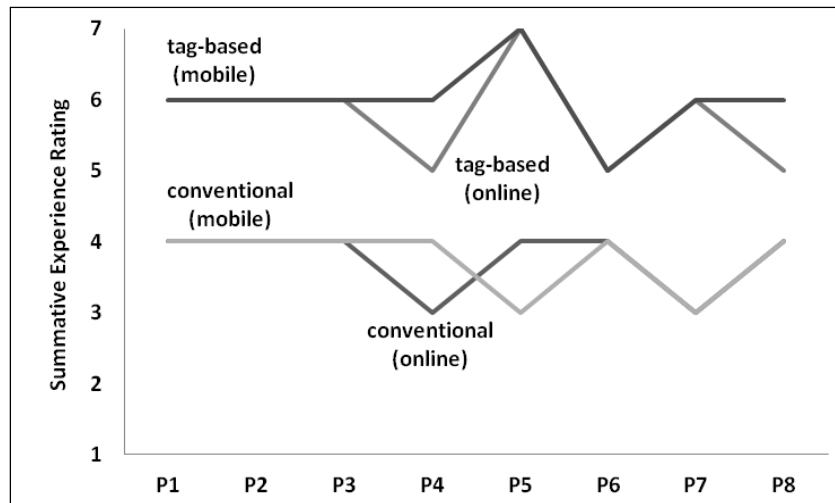
Figure 26 Average experience ratings

Figures 25 and 26 indicate improved overall score/rating for tag-based interface compared to conventional interface in both online and mobile banking. The mean SUS score for tag-based interface is 86.9 and 87.5, and the mean summative experience rating is 6 (Excellent) for both contexts. In contrast, the mean SUS scores for conventional interface are 58.8 and 57.5, and the mean summative experience rating is 4 (Ok) for both contexts. To test the significance of the result, a paired t-test analysis was conducted with an alpha value of 0.05 (CI: 95%). The t-test analysis showed the difference in the scores is significant (p<0.05) in both online (p=0.002) and mobile (p=0.001) contexts.

The following figures 27 and 28 show the average SUS scores and summative experience ratings by experience with mobile banking given that not all participants had prior experience in mobile banking. Participants were grouped into two basic categories: inexperienced and experienced.
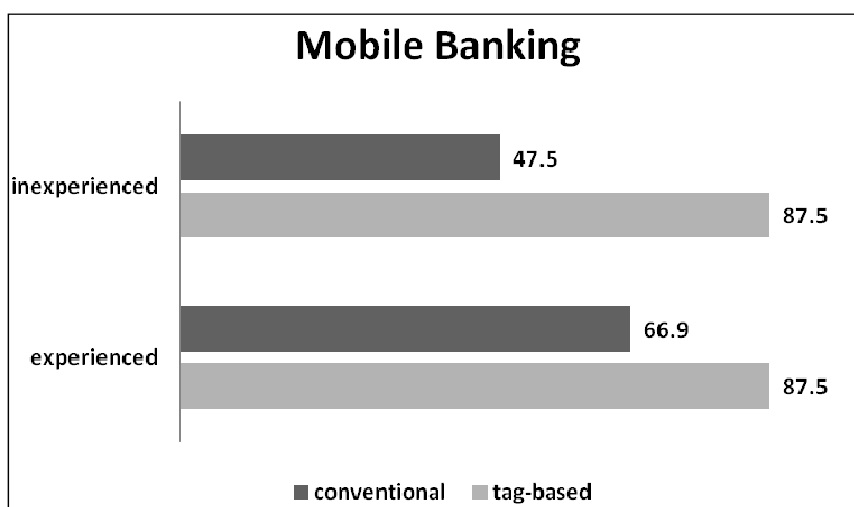


Figure 27 Average SUS scores by mobile banking experience
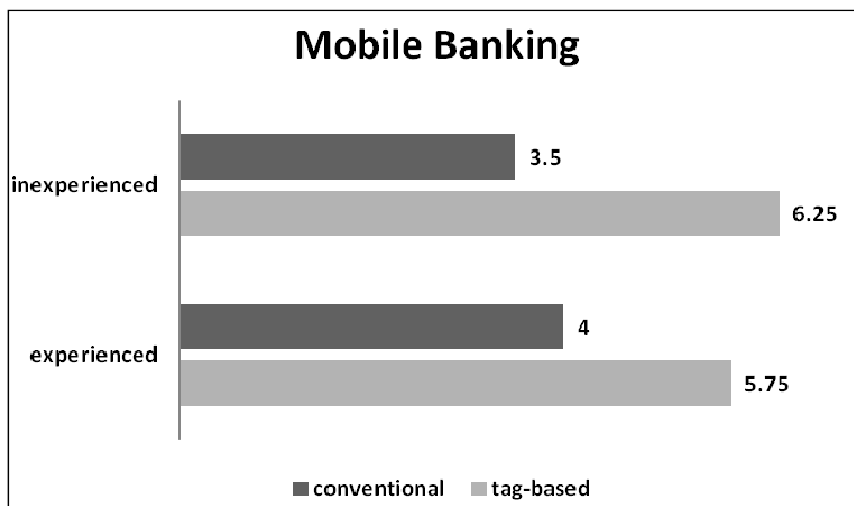
Figure 28 Average experience rating by mobile banking experience

Figure 27 shows the average SUS scores for participants without prior experience are 47.5 and 87.5 for the conventional and tag-based interfaces, respectively. For participants with experience, the mean SUS scores are 66.9 and 87.5. This indicates that participants without prior experience in mobile banking experienced the biggest difference of 40%, while the experienced participants recorded a difference of 20.6%. Figure 28 lends support to this outcome by recording an increase of 2.75 among inexperienced participants with an overall individual rating of 3.5 and 6.25 for the conventional and tag-based interfaces, respectively. This is one rating higher compared to the increase of 1.75 seen with experienced participants with an overall individual rating of 4 and 5.75.

**Task completion**

The figure below shows the average time spent on each task in seconds by all participants in the online and mobile contexts. Participants completed all tasks in both contexts hence there is no difference in terms of effectiveness between both interfaces.
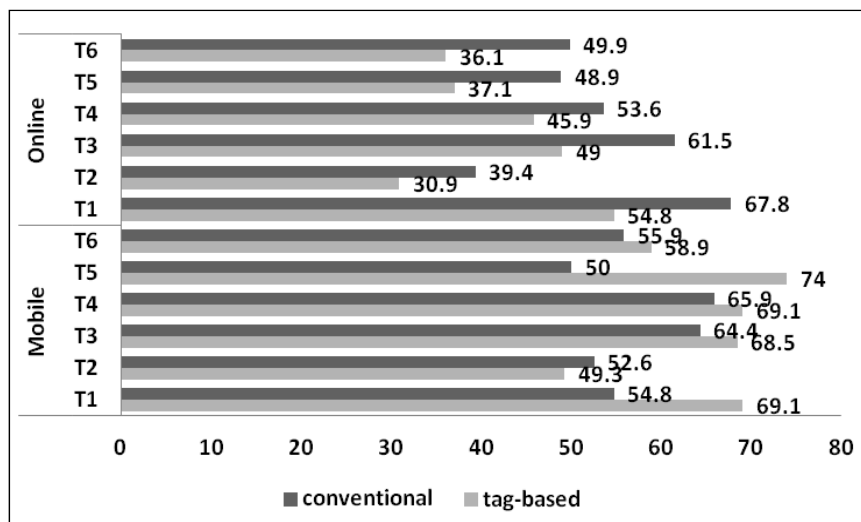
Figure 29 Average task completion times

Figure 29 illustrates that participants in general completed their tasks within a shorter period of time online compared to mobile. Overall, tag-based interface yielded a higher performance online for all tasks, but is on the slower side in the mobile context. Participants are quicker on the conventional interface in mobile for just about all tasks. For tag-based interface, participants spent the most amount of time on task 5 (74s), but spent relatively less time (about 15s) for subsequent comparable task 6 (58.9s).

## 5.4.7   Discussion

The results from this study support the hypothesis that tag-based customisation improves satisfaction (perceived usability) of online and mobile banking. However, no evidence is found to support the hypothesis that tag-based customisation improves effectiveness and efficiency (actual usability) of online and mobile banking. The observed effect of tag-based interface on usability warrants further investigation and needs to be rigorously tested for statistical significance with a larger sample.

Based on the SUS scores, participants are generally more satisfied with tag-based interface than the conventional interface. This outcome is even more evident in the mobile context compared to the online context. This is possibly due to the ability to carry out transactions by selecting tags, which reduces the effort required from users on mobile devices. Participants also perceived the tag-based interface as more user-friendly (summative experience ratings) compared to the conventional interface in both contexts. This may be the case as participants find it easier and more intuitive to interact via their own tags.

Interestingly, participants with no prior experience in mobile banking are more satisfied with the tag-based interface compared to experienced participants (see Figure 27 & 28). This may

have a positive impact on the adoption and acceptance of mobile banking, particularly from a usability perspective. According to Global Industry Analysts (GIA)[28], the global customer base of mobile banking is expected to reach close to one billion users by 2015. This highlights both the relevance and importance of mobile banking and the need for an interface with good usability.

The notion of providing tag suggestions on as a way to encourage the user to tag and re-use tags already present in the system is well received especially in the mobile context where many find it cumbersome to tag. From observations and debriefing with participants, it is obvious that they preferred to select suggested tags that were appropriate in their view than typing their own, however if they did, they expect their tags to be shown first in the list of suggested tags.

Participants in general preferred viewing minimal information on screen (tag-based) rather than detailed information on screen (conventional). However, during the debriefing session, participants highlighted that an obtrusive and easier way to view information related to tags without having to click and view on a separate window is highly desirable. This is especially significant in relation to the conventional interface where users are provided detailed financial information for decision-making. Such a technique would also enable users to quickly distinguish tagged resources in the event similar tags co-exist and are displayed on screen.

The actual user performance indicates overall improvements only in the online context, while participants appear to have spent more time on mobile. However, the questionnaire results for mobile do not reflect this and participants appear to be more satisfied and inclined to use the tag-based interface than the conventional interface. They perceive the tag-based interface as one that can improve their performance. One possible explanation is the unfamiliarity and lack of experience with the new tag-based interaction style, further exacerbated by smaller display. As seen with task 5, participants seem to have spent more time using tag clouds to carry out a past transaction, however they spent relatively less time for task 6, which is akin to task 5. Nevertheless, longer task completion times are anticipated for this study partly due to the way the study is carried out (see Limitation section).

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[28] GIA, http://www.prweb.com/releases/2010/02/prweb3553494.htm

### 5.4.8    Limitation

There are a few limitations to this study apart from those mentioned in the methodology chapter (see Section 4.7).  These limitations are addressed in the main study.

First of all, being a pilot study, only a sample size of 8 participants is used. According to Tullis & Stetson (2004), who conducted a similar type of study, conclude that to yield reasonably reliable results, at least 12-14 participants should be used in a study. However, the sample size of the pilot study is a suitable to discover most usability problems in an interface (Turner et al., 2006).

Secondly, the pilot study did not take into consideration the order in which the tasks and interfaces are introduced. Instead, a logical order is followed where the conventional interface is introduced first, followed by the tag-based interface. This approach however may have affected the external validity of data.

Thirdly, the evaluation tasks used represent only 80% of the common banking tasks gathered from the pilot study participants. As such participant's familiarity to the evaluation tasks may have also affected the results. Although the inclusion of common banking tasks does not guarantee familiarity among the participants, it does however increase the chances of achieving the best levels of familiarity with the tasks.

Finally, many participants of the pilot study appeared slightly confused with the evaluation tasks during the testing, particularly those who did not conduct such tasks in the past. Even though the tasks are explained clearly in the information sheet, many participants only quickly glanced through the information, not fully understanding the nature and purpose of each task.

### 5.5    SUMMARY

This chapter reported preliminary work for the research that includes identification of taggable resources, prototype design and a pilot study. The taggable resources are identified via a website analysis performed on select online and mobile banking websites. Subsequently, the work on prototype design elaborated on the UI and implementation aspects of the conventional and tag-based interfaces. Finally, the design of the pilot study is outlined and the evaluation results are reported and discussed. The limitations of the pilot study are also mentioned.

# Chapter 6. Main study

This chapter describes the main study, particularly highlights the changes made to the research design based on the pilot study. Section 6.1 mentions the methodology for the main study. Section 6.2 outlines the procedure and timeline for the main study. Section 6.3 and 6.4 present the updated prototype evaluated in the main study. Section 6.5 outlines the updated data categories and analysis criteria. Section 6.6 details the participants of the main study.

## 6.1   METHODOLOGY

The same methods mentioned in the research design chapter are used (see Section 4.1).

## 6.2   PROCEDURE AND TIMELINE

The same procedure and timeline described in the research design chapter are followed (see Section 4.5). However, a few changes are made particularly to the test procedure using the pilot study as a reference.

Firstly, the evaluation tasks are updated based on the data gathered from the pilot study. The changes are mainly related to the individual task scenarios in terms of amount and frequency to reflect a more common practice.  For example, rent transfer is normally paid fortnightly rather than monthly according to the participants of the pilot study. Hence the recurring rend transfer scenario is modified to reflect this. Additionally, one of the tasks is replaced with a new task. Task 4, a foreign money transfer is substituted with an insurance premium payment. The reason for this update is participants' familiarity between the two banking activities. The evaluation tasks for the main study are listed in Table 7.

Secondly, for the usability testing, the order in which the tasks and interfaces evaluated are introduced in the main study is counterbalanced. This update is to ensure validity of data collected.

Thirdly, for the main study each participant is walked through the evaluation tasks, clearly explaining the nature and purpose of each task beforehand so the participant is not confused during the evaluation.

Fourthly, the SUS scoring template (McLellan et al., 2012) is used to detect miscues in the SUS scoring and rating. This ensures that the user's perception about the interface is correctly captured.

| Task | Task type | Task details |
|------|-----------|--------------|
| T1 | Rent transfer | Funds transfer to a real estate agent |
| T2 | Phone bill payment | Bill payment to a mobile provider |
| T3 | Charity contribution | Funds transfer to a charity |
| T4 | Insurance premium | Bill payment to an insurance provider |
| T5 | Rent transfer (recurring) | Recurring funds transfer (similar to T1) |
| T6 | Phone bill payment (recurring) | Recurring bill payment (similar to T2) |

Table 7 Evaluation tasks (main study)

Table 8 provides a detailed description of the evaluation tasks listed in Table 7.

| Task | Description |
|------|-------------|
| T1 | Fortnightly rent transfer from **Everyday** account to **Century21** real estate agent for the amount of **$400.00**. |
| T2 | Mobile bill payment from **Everyday** account to **Vodafone** for the amount of **$60.00**. |
| T3 | Occasional charity contribution from **Savings** account to **Auscharity** for the amount of **$30.00**. |
| T4 | Insurance premium payment from **Savings** account to **ING Insurance** for the amount of **$500.00**. |
| T5 | Past/recurring fortnightly rent transfer from **Everyday** account to **Century21** real estate for the amount of **$400.00**. |
| T6 | Past/recurring mobile bill payment from **Everyday** account to **Vodafone** for the amount of **$49.99.** |

Table 8 Evaluation task description (main study)

### 6.3    CONVENTIONAL INTERFACE

Since the conventional interface is developed with reference to the online and mobile banking websites of Commonwealth Bank and Suncorp Bank, minimum number of usability issues pertinent to the conventional interface is discovered. However, similar to the tag-based interface, small improvements are made to the heading, default keyboard type (alphanumeric or numeric) and error management. This is primarily to ensure a standard look and feel between both the interfaces.

### 6.4    TAG-BASED INTERFACE

Based on the usability issues discovered from the pilot study, two important updates are made to the tag-based prototype. This includes a dynamic tooltip popup to deliver information on-demand in an unobtrusive and a simple fashion (see  Update #1); and display of tag suggestions with a default selection based on a user's past selection or history (see Update #2). Both these updates are largely targeted at the mobile context, to improve the usability of the tag-based interface.

**a.**    **Update #1**
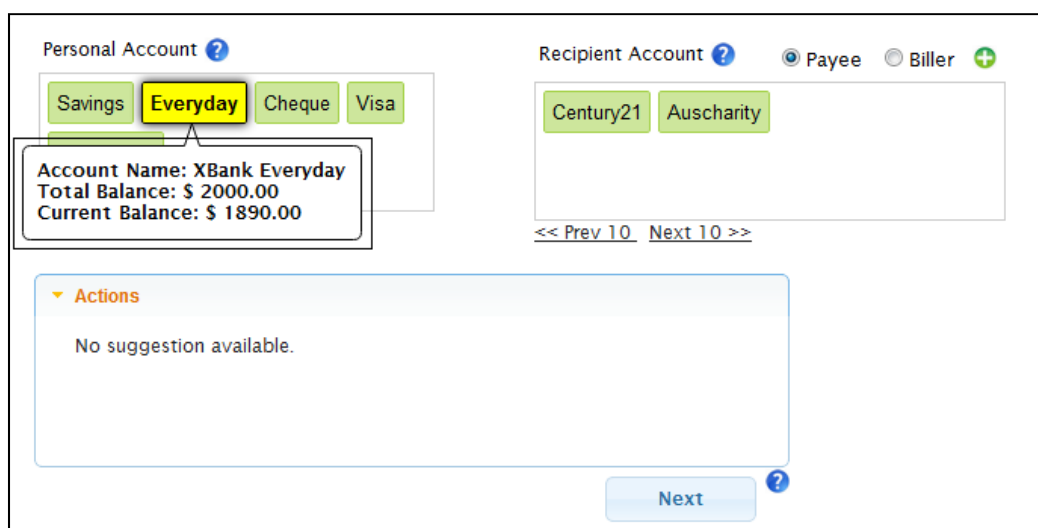


Figure 30 Dynamic tooltip popup (online)
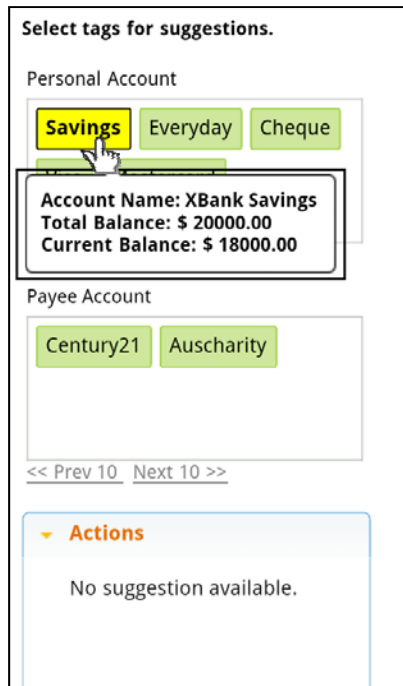
Figure 31 Dynamic tooltip popup (mobile)

**b.      Update #2**



Figure 32 Tag suggestions with default selection (online)
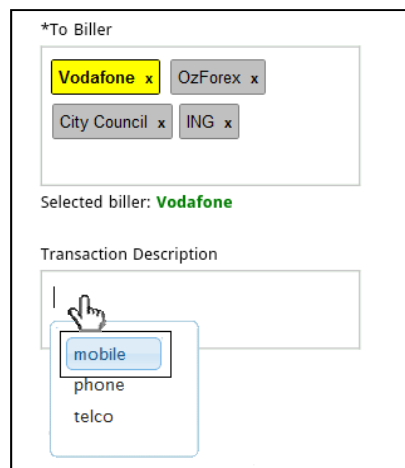
Figure 33 Tag suggestions with default selection (mobile)

Apart from the aforementioned updates, based on the feedback gathered from participants, minor modifications are also made to the tag-based interface to improve usability. These modifications include better headings, automatic selection of appropriate keyboard type (alphanumeric or numeric) on mobile devices and improved error control. Furthermore, to minimise potential errors with new users, the number of selectable tags on the tag-based screen is limited to a maximum of three at any one time.

The bugs discovered with the prototype during the pilot study related to functionality and user activity logging are addressed appropriately. The prototype was re-tested with the research team before the main study.

## 6.5    ANALYSIS DESIGN

The analysis design proposed in Chapter 3 is further extended for the main study. To determine the significance of the results, paired t-test analysis is used for comparing two means of the conventional and tag-based interfaces for each category. Below are the extended data categories and analysis criteria for each category.

### 6.5.1    SUS scores and experience ratings

- By banking contexts (online / mobile)
- By age groups (21-30 / 31-40 / 41-50)
- By mobile banking experience (inexperienced / experienced)

### 6.5.2    Task completion

- By individual tasks
- By age groups (21-30 / 31-40 / 41-50)
- By mobile banking experience (inexperienced / experienced)

- By task types (fund transfer / bill payment)
- By task modes (new / recurring)

The SUS scores and ratings are analysed based on four criteria. First, by the banking context where data is ordered into two groups: online and mobile. Second, by the age group where data is ordered according to three ranges: 21-30, 31-40 and 41-50. Third, based on user experience with mobile banking where data is ordered based on two groups: inexperienced and experienced.

The task completion is analysed based on five criteria. First, by banking context where data is grouped based on online and mobile banking. Second, by age group where data is ordered according to three ranges: 21-30, 31-40 and 41-50. Third, by mobile banking experience where data is ordered based on two groups: inexperienced and experienced. Fourth, by task type where data is ordered based on the two banking activities: fund transfer and bill payment. Fifth, by task mode where data is ordered based on new and recurring activity.

The quantitative data analysed is compared and contrasted with the qualitative data recorded through user observation and post-test debriefing to detect inconsistencies. Also, the qualitative data is used to provide explanations to outcomes of the analysis.

## 6.6    PARTICIPANTS

A total of 30 banking users were randomly recruited from the university: 17 males and 13 females between the age group of 21 to 50 (21-30=60%, 31-40=33%, 41-50=7%; See Figure 34). Altogether, there were 22 students and 8 staffs who participated in the study. The larger number of participants from the younger age group (21-30) is pertinent to this study given banking customisation is most appealing and relevant among this age group (Rahim & JieYing, 2009).

The recruitment process is conducted through email. A total of 50 responses were received from university students and staffs and only 30 participants were selected based on first come first serve basis. Participation was entirely voluntary, and each individual gave written consent to participate in the study. In order to compensate participants for their time and contribution, a gift card worth $15 was offered.

According to the pre-test questionnaire, all participants had at least one active online banking account at the time of participation and were familiar with online banking with no less than one year of experience. However, not all participants had prior experience in mobile banking. Figure 35 shows the mobile banking usage and only 54% of the participants had prior experience with mobile banking, while 46% of the participants had never used mobile banking

before. Figure 36 shows the percentages of participants who had prior experience in mobile banking by age groups. A total of 69% of experienced participants were from the 21-30 age group and the rest from the 31-40 age group. No participants from the age group 41-50 had prior mobile banking experience. Figure 37 shows the percentages of participants who had never used mobile banking before by age groups. A total of 50% of inexperienced participants were from the 21-30 age group, 36% from the 31-40 age group and the remaining 14% from the 41-50 age group. Some of reasons cited for not using mobile banking include security and privacy concerns, high risk of mistyping on a mobile device, and preference for a bigger display screen. Figure 38 shows the most common banking activities carried out by participants via their online/mobile banking provider, which include fund transfer (24%), bill payment (24%), check balance (21%), view history (17%), and credit card payment (14%).
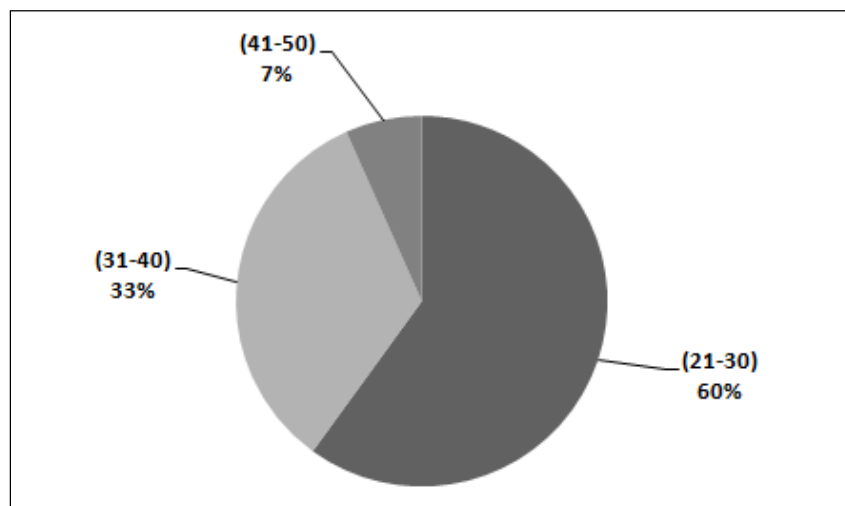


Figure 34 Age group of participants
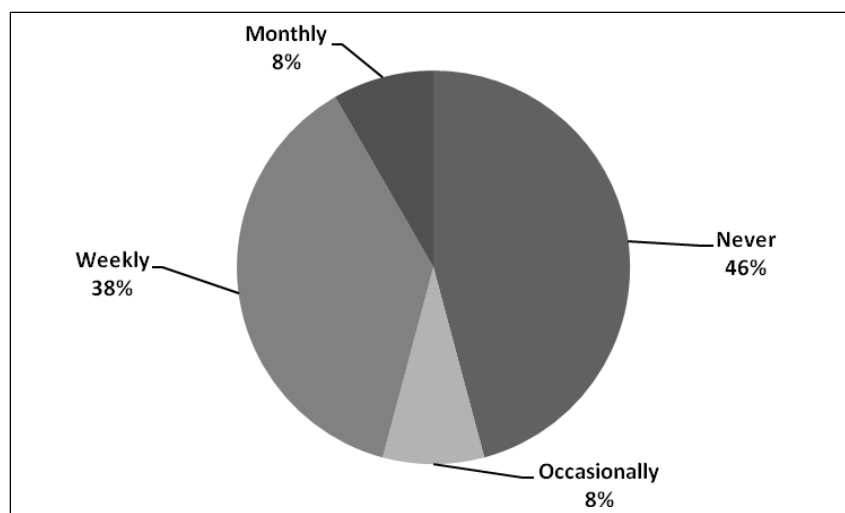


Figure 35 Mobile banking experience
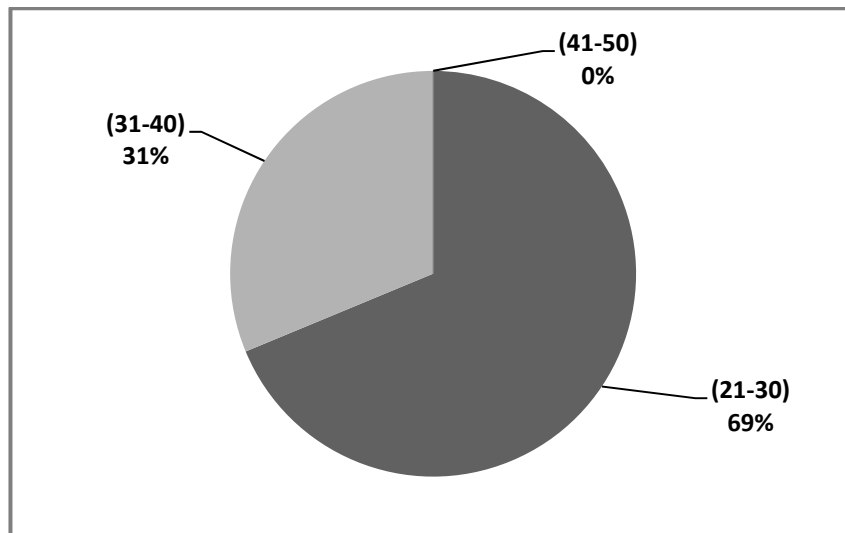
Figure 36 Mobile banking experience by age group
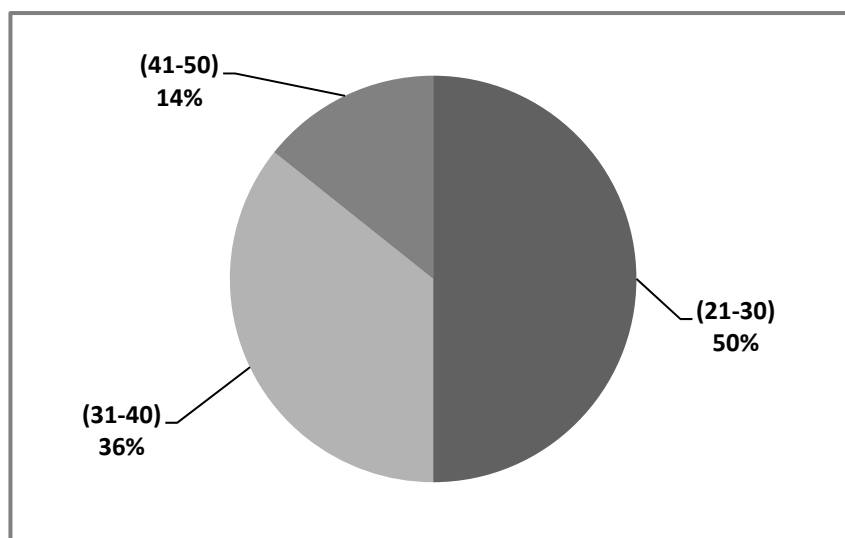


Figure 37 Mobile banking inexperience by age group
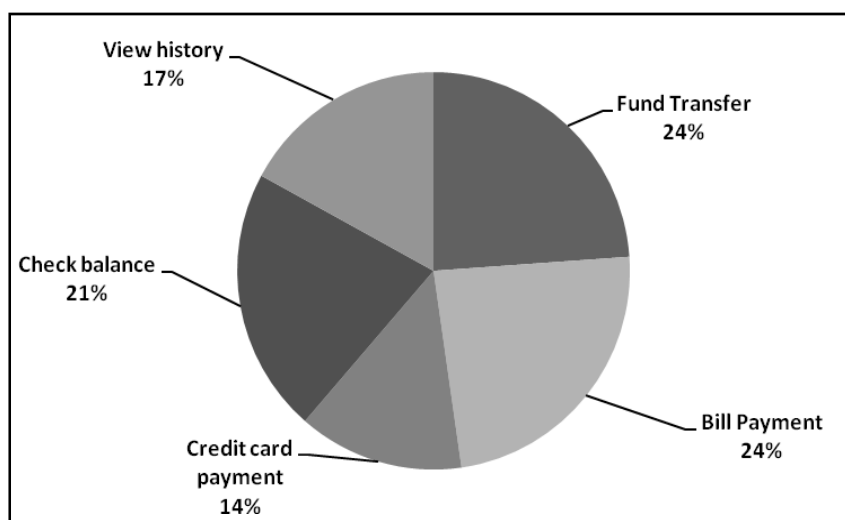


Figure 38 Banking activities

Table 9 (i,ii & iii) shows the results of the pre-test questionnaire related to participants' experience with computers, Internet/Web and tagging.

According to the computer experience questionnaire, all participants are experienced with IBM PC. They use computers at work or university or school and also at home. They also spend a total of more than 30 hours per week on their computer. Participants have indicated that they use word processors and spreadsheets on a daily or weekly basis. However, a majority of them rarely or never use databases and about three quarters of them rarely or never use graphic/web design tools or play games. Regardless of the frequency of use of computer programs, all participants indicated that they enjoy using computers.

Based on the Internet and Web experience questionnaire, all participants spend a total of more than 30 hours per week on the Internet. They frequently use Email, Web and Internet Messaging services mostly on a daily basis. Majority of the participants use Mozilla Firefox as their browser, followed by Chrome and Internet Explorer. All participants indicated that they enjoy using the Internet.

According to the tagging experience questionnaire, the majority of participants have tagged some sort of Web resource before. As expected, most of the participants tagged in Facebook and a small number participant in other websites namely YouTube and Flickr. However, none of the participants have tagged financial data via personal financial management tools. As such the concept of financial tagging is new to the participants.

In general, participants had very similar levels of experience with computers and the Web, and indicated that they enjoy using computers and the Internet. Most participants were familiar with the concept of tags primarily through websites such as Facebook and YouTube, although not in the financial sense. However, this outcome is anticipated, as the notion of financial tagging is only available through external tools and as such not a pre-requisite for this study.

| Computer experience in the past 12 months | | | | |
|---|---|---|---|---|
| 1 | What sort of computer do you usually use? | **IBM PC** | **Mac** | **Unix/Linux** | **Other** |
| | | 100% | 5% | 0% | 0% |
| 2 | Where do you usually use a computer? | **At work/university** | | **At home** | **Other** |
| | | 100% | | 100% | 0% |

| 3 | How many hours per week you usually spend using a computer? | < 5 | 6-15 | 15-30 | > 30 |
|---|---|---|---|---|---|
| | | 0% | 0% | 0% | 100% |
| 4 | Frequency of use of computer programs | **Daily** | **Weekly** | **Monthly** | **Rarely/Never** |
| | i. Word processors | 90% | 10% | 0% | 0% |
| | ii. Spreadsheets | 40% | 60% | 0% | 0% |
| | iii. Databases | 10% | 0% | 0% | 90% |
| | iv. Graphic design tools | 0% | 5% | 20% | 75% |
| | v. Web design tools | 0% | 6% | 20% | 74% |
| | vi. Games | 3% | 10% | 10% | 77% |
| 5 | I enjoy using computers | **Yes** | | **No** | |
| | | 100% | | 0% | |

Table 9(i) Participants' experience with computers

| **Internet and Web experience in the past 12 months** | | | | | |
|---|---|---|---|---|---|
| 1 | How many hours per week you usually spend using the Internet | **None** | **< 5** | **6-15** | **15-30** | **> 30** |
| | | 0% | 0% | 0% | 0% | 100% |
| 2 | Frequency of use of Internet services | **Daily** | | **Weekly** | **Monthly** | **Rarely/ Never** |
| | i. Email | 100% | | 0% | 0% | 0% |
| | ii. Web | 100% | | 0% | 0% | 0% |
| | iii. Instant Messaging | 90% | | 10% | 0% | 0% |
| 3 | Frequency of use by kinds of activities | **Daily** | | **Weekly** | **Monthly** | **Rarely/ Never** |
| | i. Work/study | 100% | | 0% | 0% | 0% |
| | ii. Entertainment | 90% | | 10% | 0% | 0% |
| | iii. E-commerce | 0% | | 85% | 15% | 0% |

| 4 | Which web browser do you usually use? | **Chrome** | **Internet Explorer** | **Mozilla Firefox** | **Others** |
|---|---|---|---|---|---|
|   |   | 30% | 10% | 60% | 0% |
| 5 | I enjoy using the Internet | **Yes** | | **No** | |
|   |   | 100% | | 0% | |

Table 10(ii) Participants' experience with Internet and Web

| | **Tags/Tagging experience in the past 12 months** | | | | |
|---|---|---|---|---|---|
| 1 | Have you tagged any Web resource (e.g., photo, video, people, etc) before? | **Yes** | | **No** | |
|   |   | 80% | | 20% | |
| 2 | If you answered Yes to the question above, then please name a few websites where you tag resources | **Facebook** | **YouTube** | **Flickr** | **Others** |
|   |   | 80% | 10% | 5% | 5% |
| 3 | Have you tagged financial data via personal financial management tools (e.g., Mint, ANZ-MoneyManager, etc)? | **Yes** | | **No** | |
|   |   | 0% | | 100% | |
| 4 | If you answered Yes to the question above, how often do you tag your financial data? | **Daily** | **Weekly** | **Fortnightly** | **Monthly** | **Rare** |
|   |   | 0% | 0% | 0% | 0% | 0% |

Table 11(iii) Participants' experience with tags

## 6.7    SUMMARY

This chapter provides details of the changes made to the research design for the main study. The updates are largely based on the learning from the pilot study. The updates mainly encompass modifications to the evaluation procedure and timeline, prototype design and data analysis design. The modifications are intended to increase the reliability of the data gathered. Apart from the design changes, details on the study participants are also presented.

# Chapter 7. Results

This chapter presents the results and statistical significance analysis of the main study. Section 7.1 shows the results of the study including the SUS scores and summative experience ratings grouped based on banking contexts, mobile banking experiences and age groups. Section 7.2 presents the task completion times based on banking contexts, age groups, mobile banking experiences, task types and task modes. Section 7.3 outlines the common issues and errors found with the tag-based interface. Section 7.4 presents the tags assigned to evaluation tasks.

## 7.1     SATISFACTION (PU)

The SUS scores and summative experience ratings are used as indicators of user satisfaction. The SUS score range is 0-100, and the summative experience rating range is 1-7 (1 = Worst Imaginable, 2 = Awful, 3 = Poor, 4 = OK, 5 = Good, 6 = Excellent, 7 = Best Imaginable).

### 7.1.1   Banking context

The following figures 39 and 40 show the computed average SUS scores and summative experience ratings in the online and mobile contexts.
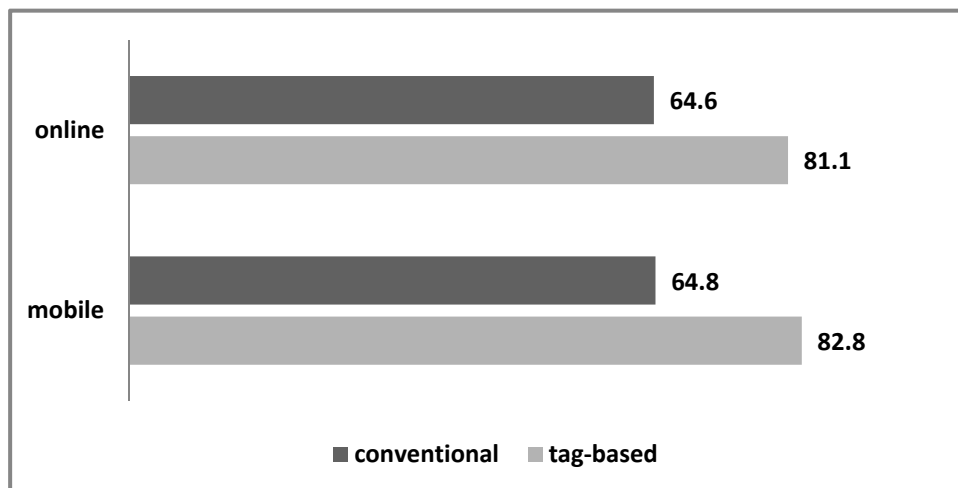


Figure 39 Average SUS scores
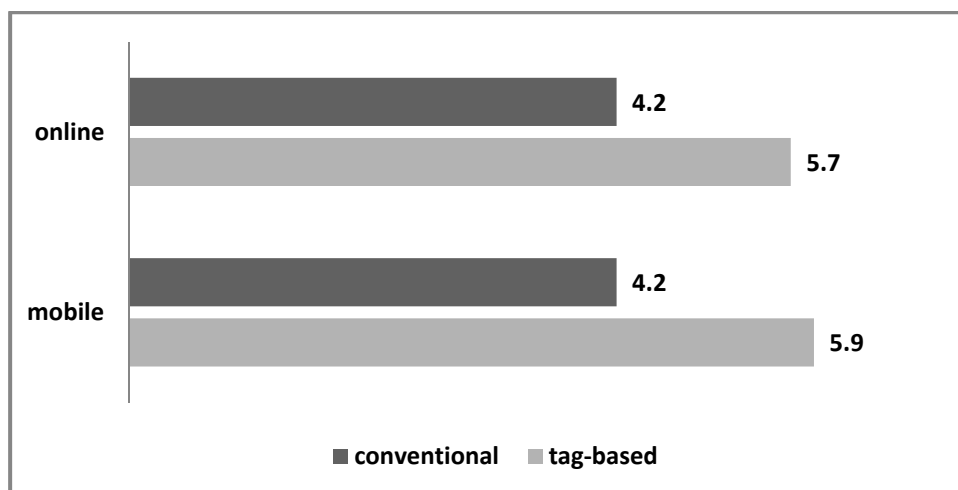
Figure 40 Average experience ratings

Figures 39 and 40 show higher SUS scores and ratings for the tag-based interface compared to the conventional interface in both online and mobile banking. The average SUS scores for the tag-based interface are 81.1 and 82.8, and the average summative experience rating is 5.7 for online and 5.9 for mobile (both in the Excellent range). In contrast, the average SUS scores for the conventional interface are 64.6 and 64.8, and the average summative experience rating is 4.2 (both in the OK range) for both contexts.

To test the significance of the overall SUS scores and experience ratings, paired t-test analyses were conducted for both contexts with an alpha of 0.05 (CI: 95%).

In the online context, there is a significant difference in the scores for conventional (M=64.6, SD=17.7) and tag-based (M=81.1, SD=13.5) interfaces; t(29)=-3.61, p=0.0015. Similarly, there is also a significant difference in the ratings for conventional (M=4.16, SD=0.69) and tag-based (M=5.52, SD=0.82) interfaces; t(29)=-5.28, p<0.001. These results suggest that the tag-based interface improves usability of online banking over the conventional interface.

In the mobile context, there is a more significant difference in the scores compared to the online context for conventional (M=64.8, SD=16.2) and tag-based (M=84.8, SD= 13.4) interfaces; t(29)=-4.0, p<0.001. Likewise, there is also a more significant difference in the ratings compared to the online context for conventional (M=4.2, SD=0.82) and tag-based (M=5.9, SD=0.75) interfaces; t(29)=-6.53, p<0.001. These results suggest that the tag-based interface also improves usability of mobile banking over the conventional interface, with a better statistical significance than the online context.

Overall, the results suggest that a tag-based interface improves perceived usability in online and mobile contexts. To further examine the SUS scores and experience ratings, more analysis based on several other categories/criteria is presented in the sub-sections below.

## 7.1.2 Age group

Based on the age groups of the participants (21-30, 31-40 and 41-50), the average SUS scores and summative experience ratings are reported for each banking context.
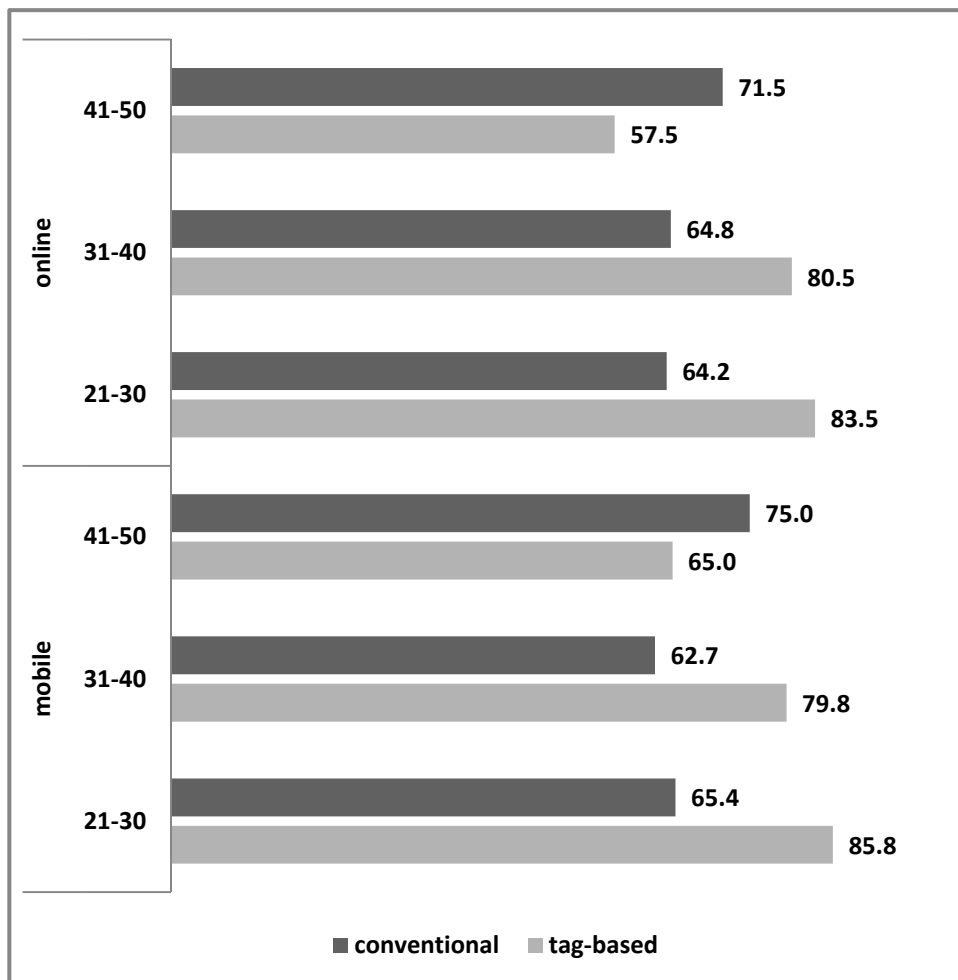


Figure 41 Average SUS scores by age group
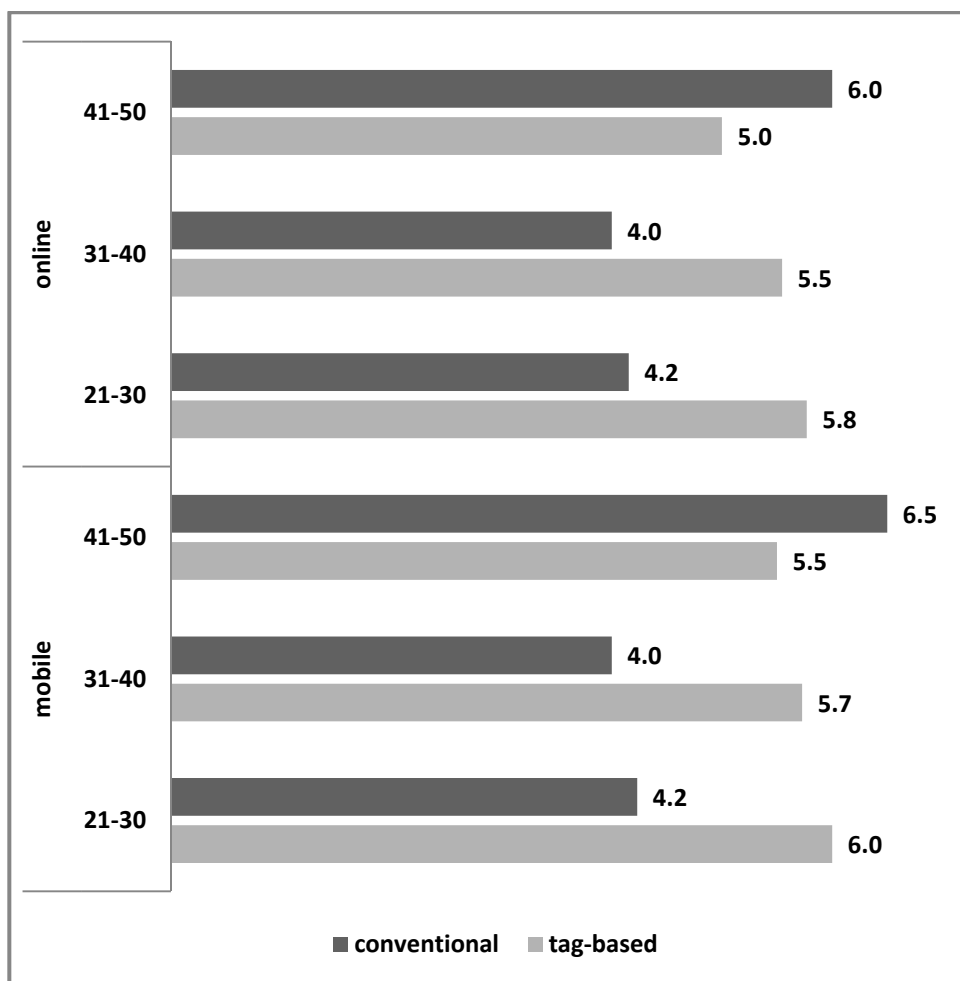
Figure 42 Average experience ratings by age group

Figures 41 and 42 show the average SUS scores and experience ratings for the conventional and tag-based interfaces based on age groups of participants: 21-30, 31-40 and 41-50. Both figures indicate a stronger preference towards the tag-based interface for the younger age group of 21-30 years with a score difference of 19.3 and 1.6 rating points in the online context and a score difference of 20.4 and 1.8 rating points in the mobile context. Likewise, a similar pattern is seen with the middle age group of 31-40 years with a score difference of 15.7 and 1.5 rating points in the online context and a score difference of 17.1 and 1.7 rating points in the mobile context. However, in opposition to the aforementioned trend, the older group of 41-50 years indicate a stronger preference towards the conventional interface with a score difference of 10 and 1 rating points in the online and mobile contexts.

To test the significance of the difference in SUS scores and experience ratings based on age groups, paired t-test analyses were conducted with an alpha of 0.05 (CI: 95%).

In the online context, for the 21-30 age group, there is a significant difference in the scores for conventional (M=64.2, SD=21.1) and tag-based (M=83.5, SD=13.4) interfaces; t(17)=-2.65, p=0.02; and also in the experience ratings for conventional (M=4.15, SD=0.69) and tag-based (M=5.77, SD=0.93) interfaces; t(17)=-4.88, p<0.001 . Similarly, for the 31-40 age group, there is a significant difference in the scores for conventional (M=64.8, SD=14.9) and tag-based (M=80.5, SD=12.6) interfaces; t(9)=-2,76, p=0.02; and also in the experience ratings for conventional (M=4.0, SD=0.45) and tag-based (M=5.5, SD=1.04) interfaces; t(9)=-3.96, p=0.003.

In the mobile context, for the 21-30 age group, there is a significant difference in the scores for conventional (M=64.2, SD=19.97) and tag-based (M=85.8, SD=12.1) interfaces; t(17)=-2.65, p=0.02; and also in the experience ratings for conventional (M=4.23, SD=0.83) and tag-based (M=6.0, SD=0.58) interfaces; t(17)=-6.3, p<0.001 . Similarly, for the 31-40 age group, there is a significant difference in the scores for conventional (M=62.7, SD=10.2) and tag-based (M=79.8, SD=14.4) interfaces; t(9)=-2.9, p=0.016; and also in the experience ratings for conventional (M=4.0, SD=0.63) and tag-based (M=5.7, SD=1.01) interfaces; t(9)=-4.03, p=0.002.

In a summary, the paired t-test analyses show the improvements in the SUS scores and experience ratings in both contexts mentioned above is significant for two age groups: 21-30 and 31-40.   These results suggest that in both online and mobile contexts the tag-based interface is perceived as more usable by participants in the 21-40 age groups, while participants in the 41-50 age group perceive the conventional interface as more usable. This difference is however more apparent in the mobile context compared to the online context. Therefore, the result proposes that the tag-based approach particularly improves perceived usability in the online and mobile contexts for age groups 40 and below.

### 7.1.3   Mobile banking experience

Given that not all participants of the study had prior experience in mobile banking, the SUS scores and experience ratings are grouped by participants' familiarity with mobile banking. As mentioned in Chapter 6 – Main Study (Participants), only 54% of participants were familiar with mobile banking. The varying levels of familiarity among participants are grouped into two basic categories: inexperienced and experienced. Figures 43 and 44 show the average SUS scores and summative experience ratings by familiarity with mobile banking.
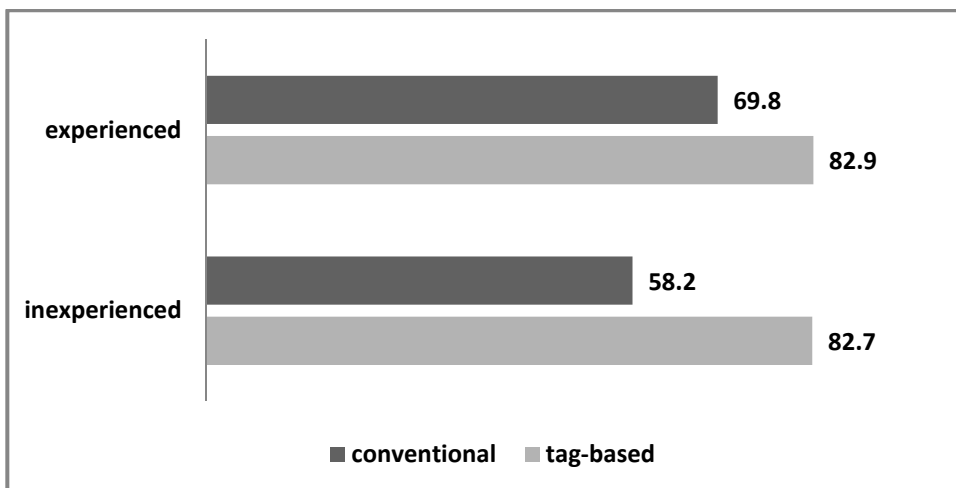
Figure 43 Average SUS scores by mobile banking experience
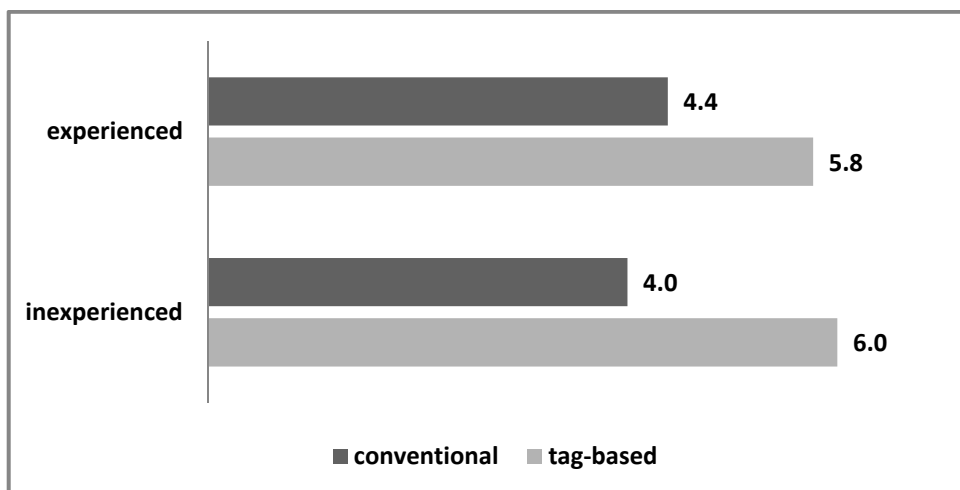


Figure 44 Average experience ratings by mobile banking experience

Figure 43 shows the average SUS scores for participants without prior experience are 58.2 and 82.7 for the conventional and tag-based interfaces, respectively. For participants with experience, the average SUS scores are 69.8 and 82.9, respectively. This indicates that participants without prior experience in mobile banking experienced the biggest difference of 24.5%, while the experienced participants recorded a difference of 13.1%. Figure 44 lends support to this outcome by illustrating an increase of 2 rating points among inexperienced participants with an overall individual rating of 4.0 and 6.0 for the conventional and tag-based interfaces. Those ratings are about one rating higher compared to the increase observed with experienced participants with an overall individual rating of 4.4 and 5.8.

To test the significance of the SUS scores and experience ratings based on mobile banking experience, paired t-test analyses were conducted with an alpha of 0.05 (CI: 95%).

For the experienced category, there is a significant difference in the scores for conventional (M=69.8, SD=14.53) and tag-based (M=82.9, SD=11.86) interfaces; t(15)=-2.66, p=0.021. Similarly, there is also a significant difference in the ratings for conventional (M=4.38, SD=0.93) and tag-based (M=5.77, SD=0.65) interfaces; t(15)=, p<0.001.

For the inexperienced category, there is a more significant difference in the scores compared to the experienced category for conventional (M=59.4, SD=18.9) and tag-based (M=82.1, SD=16.0) interfaces; t(13)=-3.19, p=0.008. Likewise, there is also a more significant difference in the ratings compared to the experienced category for conventional (M=4, SD=0.81) and tag-based (M=5.92, SD=0.99) interfaces; t(13)=-4.81, p<0.001.

The result suggests that the tag-based interface improves usability of mobile banking over the conventional interface, with a better statistical significance for the inexperienced users than the experienced users.

## 7.2    EFFICIENCY (AU)

The task completion times is used as an indicator of efficiency. Task completion times are reported in seconds.

Figure 45 shows the average time spent on the tasks by all participants in the online and mobile contexts. The average completion times for the conventional and tag-based interfaces for the online context are 47.4s and 46.7s; and 53.3s and 56.2s for the mobile context.
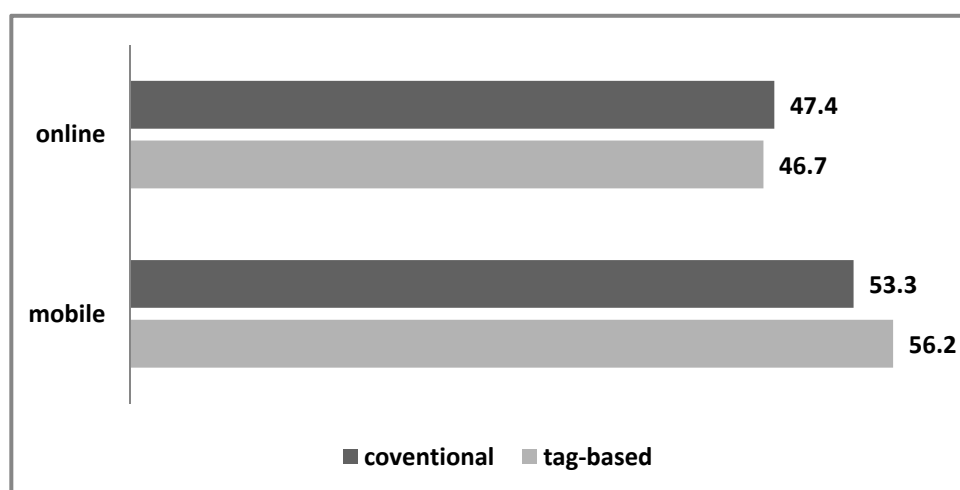


Figure 45 Average task completion times

To ascertain the significance of the task completion times, paired t-test analyses were conducted with an alpha of 0.05 (CI: 95%). The results showed that the differences of the average task completion times are not significant in the online context for conventional (M=46.7, SD=10.73) and tag-based (M=47.4, SD=7.54) interfaces; t(5)=0.55, p=0.61; and also in the

mobile context for conventional (M=53.3, SD=10.34) and tag-based (M=56.2, SD=8.5) interfaces; t(5)=-1.01, p=0.36.

The result suggests that the tag-based interface may not improve actual usability in both online and mobile contexts. To further explain the task completion times, additional analysis based on different categories/criteria are presented in the sub-sections below.

### 7.2.1   Individual tasks

Figure 46 shows the average time spent on each task by all participants in the online and mobile contexts. Participants in general completed the same tasks within a shorter period of time in the online context compared to the mobile context with both interfaces. Overall, the tag-based interface is faster online for 4 out of 6 tasks and 3 out of 6 tasks in the mobile context. In the online context, participants were faster on the tag-based interface for tasks 2, 4, 5, and 6, but slower for tasks 1 and 3. While in the mobile context, participants were faster on the tag-based interface for tasks 2, 3, and 4 but slower for tasks 1, 5, and 6. Participants spent the most amount of time on task 1 on the tag-based interface in both contexts (60.4s and 69.2s, in online and mobile respectively) and a considerably lesser amount of time for the remaining tasks.
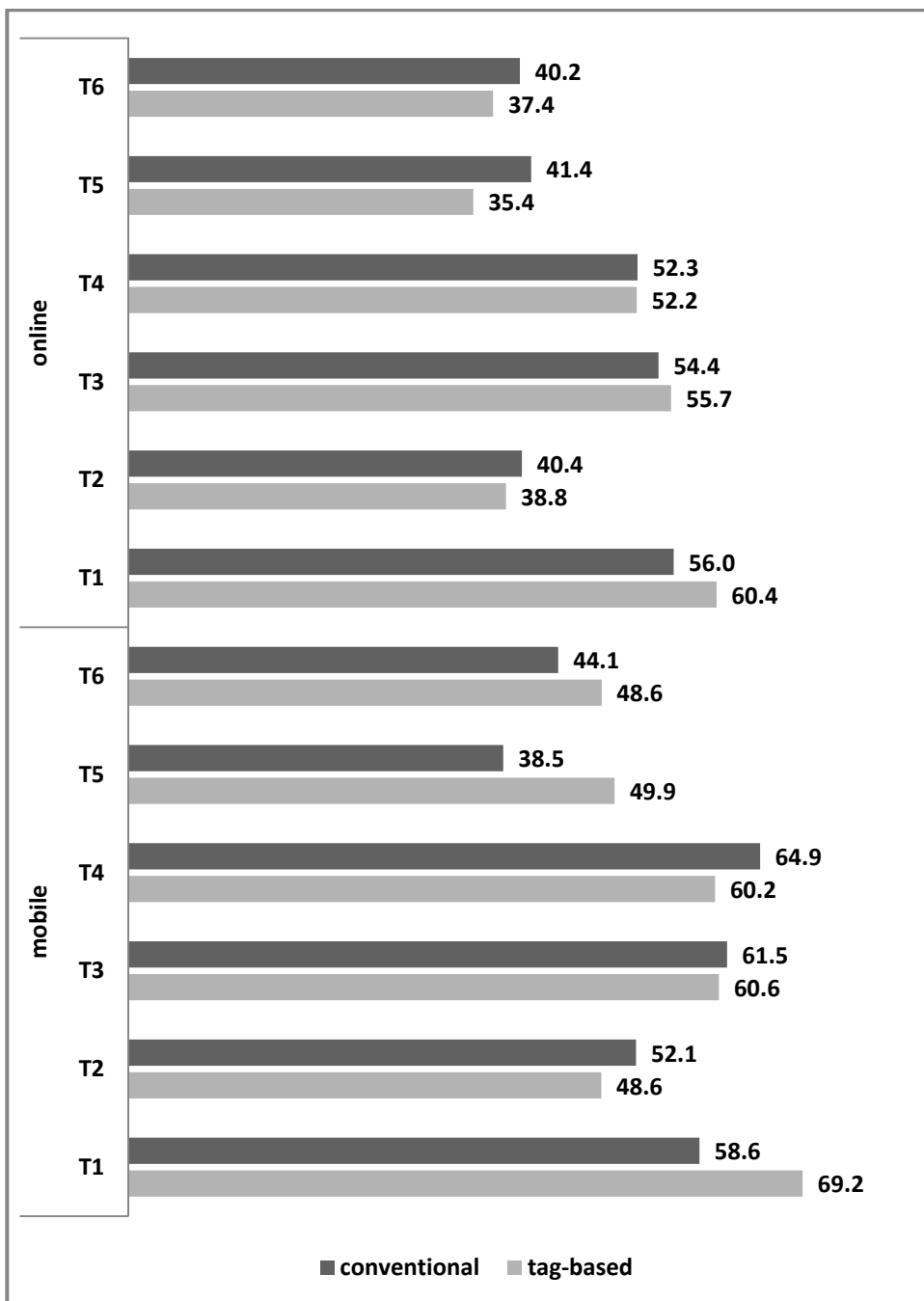
Figure 46 Average task completion times by task

To ascertain the significance of the completion times for each task, paired t-test analyses were conducted with an alpha of 0.05 (CI: 95%).

For task 1, the average task completion times are not significant in the online context for conventional (M=56.0, SD=17.12) and tag-based (M=60.4, SD=19.11) interfaces; t(29)=-0.95, p=0.35; but significant in the mobile context for conventional (M=58.6, SD=17.88) and tag-based (M=69.2, SD=21.96) interfaces; t(29)=, p=0.047.

For task 2, the average task completion times are not significant in the online context for conventional (M=40.4, SD=11.26) and tag-based (M=38.8, SD=12.79) interfaces; t(29)=0.58, p=0.56; and also in the mobile context for conventional (M=52.1, SD=19.85) and tag-based (M=48.6, SD=15.02) interfaces; t(29)=1.17, p=0.25.

For task 3, the average task completion times are not significant in the online context for conventional (M=54.4, SD=14.89) and tag-based (M=55.7, SD=17.41) interfaces; t(29)=-0.31, p=0.76; and also in the mobile context for conventional (M=61.5, SD=26.02) and tag-based (M=60.6, SD=17.17) interfaces; t(29)=0.15, p=0.88.

For task 4, the average task completion times are not significant in the online context for conventional (M=52.3, SD=15.69) and tag-based (M=52.2, SD=17.65) interfaces; t(29)=0.02, p=0.99; and also in the mobile context for conventional (M=64.9, SD=19.99) and tag-based (M=60.2, SD=18.29) interfaces; t(29)=1.14, p=0.26.

For task 5, the average task completion times are not significant in the online context for conventional (M=41.4, SD=23.03) and tag-based (M=35.4, SD=15.38) interfaces; t(29)=1.47, p=0.15; and also in the mobile context for conventional (M=38.5, SD=12.73) and tag-based (M=49.9, SD=32.73) interfaces; t(29)=-1.99, p=0.058.

For task 6, the average task completion times are not significant in the online context for conventional (M=40.2, SD=17.24) and tag-based (M=37.4, SD=12.8) interfaces; t(29)=0.68, p=0.50; and also in the mobile context for conventional (M=44.1, SD=15.39) and tag-based (M=48.6, SD=19.37) interfaces; t(29)=-1.12, p=0.27.

The result suggests that the tag-based interface improves the actual usability (efficiency) for task 1 in the mobile context but not for rest of the tasks.

### 7.2.2   Age group

Figure 47 shows the average task completion times for the three age groups (21-30, 31-40 and 41-50) in both online and mobile contexts. In the online context, a noticeable difference of 3.7s is seen for the middle age group, 31-40. While marginal differences are seen for the remaining two age groups: 21-30 and 41-50. In the mobile context, however, a noticeable difference is observed for two groups: 31-40 and 41-50 of 8.1s and 11.1s, respectively. Similar to the online context, only a marginal difference is seen with the younger age group, 21-30.

To ascertain the significance of the completion times for the age groups with a noticeable difference (31-40 and 41-50), paired t-test analyses were conducted with an alpha of 0.05 (CI: 95%).
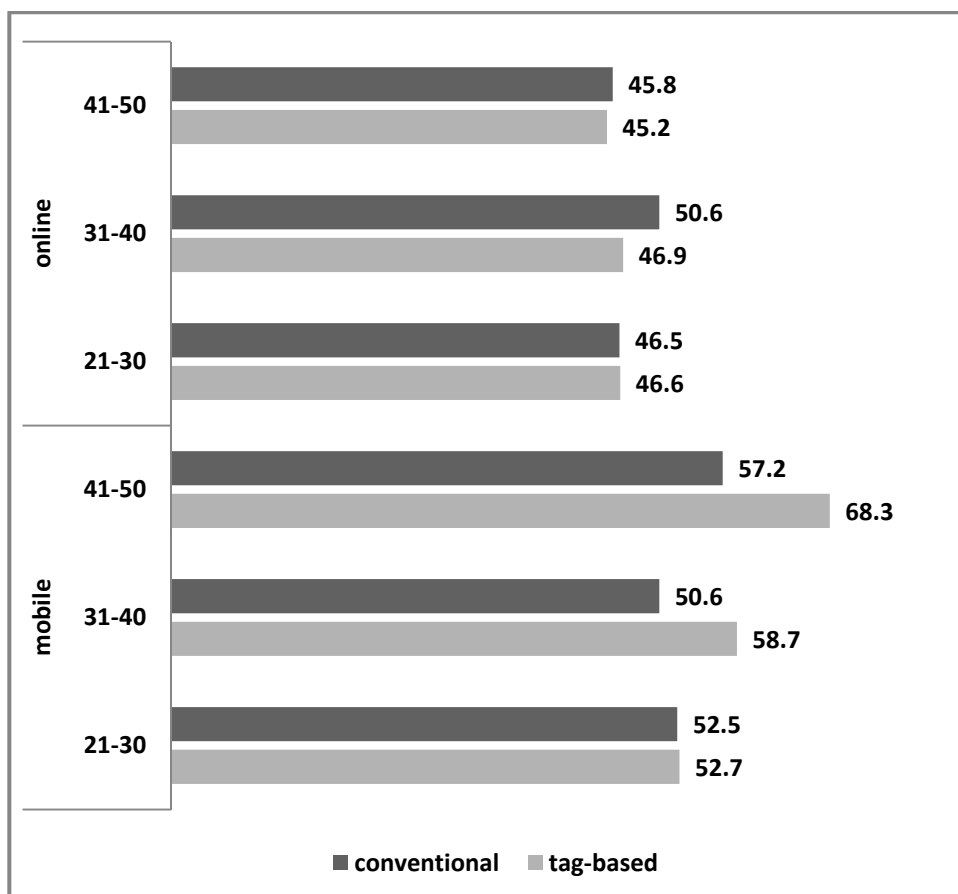
Figure 47 Average task completion times by age group

The results show that the differences of the average task completion times for the middle age group (31-40) are not significant in the online context for conventional (M=50.6, SD=13.6) and tag-based (M=46.9, SD=9.98) interfaces; t(9)=1.23, p=0.25. Likewise, the difference of the average task completion times for the older age group (41-50) is not significant in the online context for conventional (M=45.8, SD=2.83) and tag-based (M=45.2, SD=4.24) interfaces; t(1)=0.12, p=0.92.

The outcome suggests that the tag-based interface does not improve actual usability (efficiency) for all age groups in both online and mobile contexts.

### 7.2.3  Mobile banking experience

Figure 48 shows the average task completion times for the mobile context based on banking experience. In general, the experienced participants spent less time on both the interfaces compared to the inexperienced participants. For the experienced group, a difference of 1.6s is recorded between the interfaces, while a difference of 4.3s for the inexperienced group. The difference between the experienced and inexperienced groups for the conventional and tag-based interfaces is 6.8s and 9.5s, respectively.
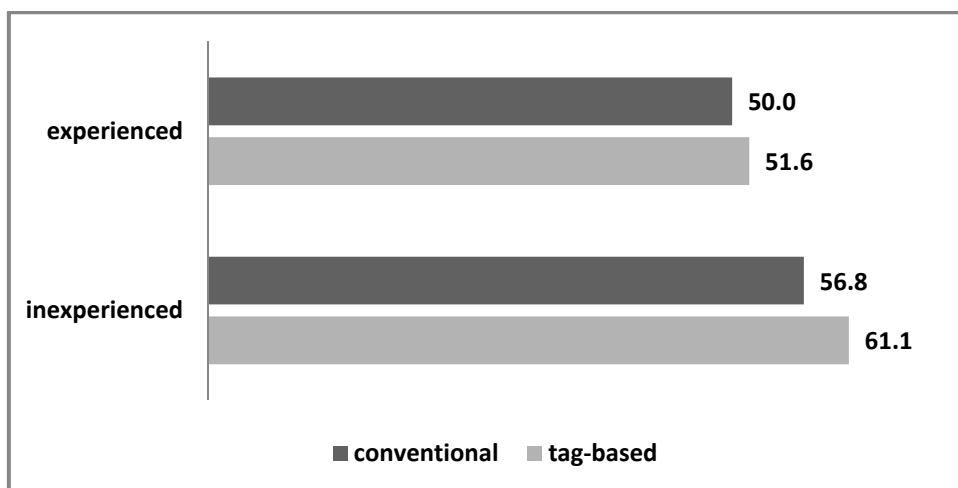
Figure 48 Average task completion times by mobile banking experience

To ascertain the significance of the completion times between the two groups, paired t-test analyses were conducted with an alpha of 0.05 (CI: 95%).

The results show that the differences of the average task completion times for the inexperienced group are not significant for conventional (M=56.8, SD=16.29) and tag-based (M=61.1, SD=14.93) interfaces; t(13)=-1.2, p=0.26; and also for the experienced group for conventional (M=50.0, SD=10.27) and tag-based (M=51.6, SD=12.63) interfaces; t(16)=-0.39, p=0.7.

The outcome suggests that the tag-based interface does not improve actual usability (efficiency) and that experience among subjects do not contribute to this.

## 7.2.4   Task type

Figure 49 shows the average time spent based on the two task types (fund transfer and bill payment) in the online and mobile contexts. There were only marginal differences between the average task completion times of the conventional and tag-based interfaces. The highest difference is for the bill payment task in the mobile context, which is 6.8s, while the smallest difference is 0.1s for the fund transfer task in the online context. A difference of about 1.5s is observed for bill payment in the online context and fund transfer in the mobile context. According to the completion times, the tag-based interface is faster for three out of the four tasks.
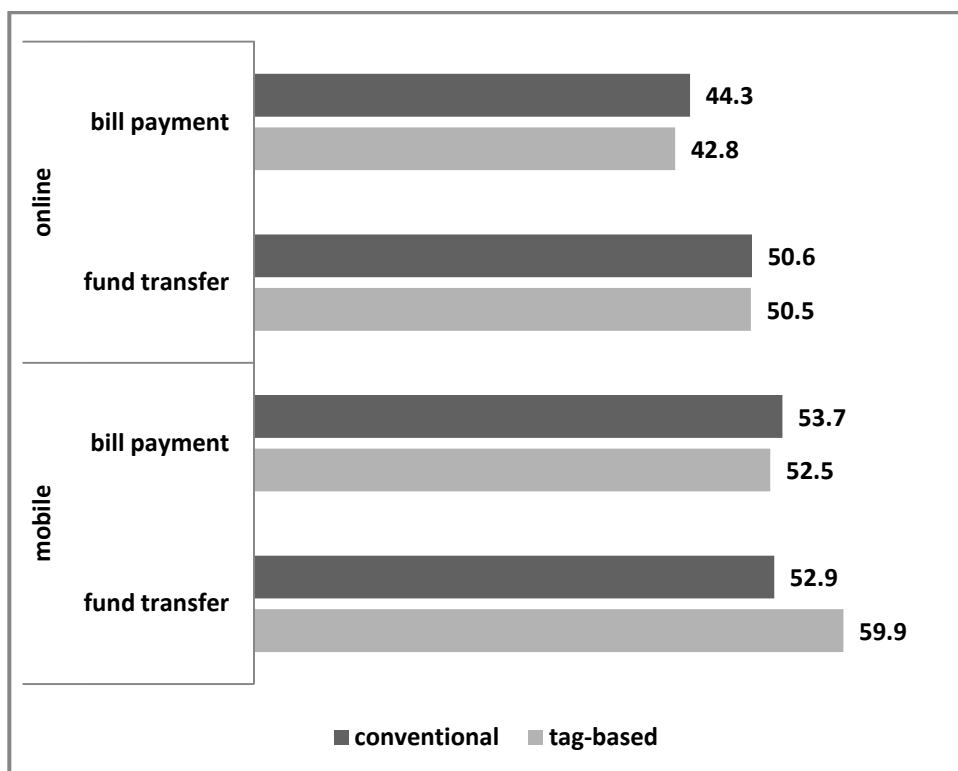
Figure 49 Average task completion times by task type

To ascertain the significance of the task completion times based on task types, paired t-test analyses were conducted with an alpha of 0.05 (CI: 95%).

The results show that the differences of the average task completion times for fund transfer are not significant in the online context for conventional (M=50.6, SD=8.0) and tag-based (M=50.5, SD=13.29) interfaces; t(2)=0.03, p=0.98; and also in the mobile context for conventional (M=52.9, SD=12.52) and tag-based (M=59.9, SD=9.67) interfaces; t(2)=-1.77, p=0.22. Similarly, the average task completion times for bill payment are not significant in the online context for conventional (M=44.3, SD=6.93) and tag-based (M=42.8, SD=8.17) interfaces; t(2)=1.92, p=0.19; and also in the mobile context for conventional (M=53.7, SD=10.5) and tag-based (M=52.5, SD=6.7) interfaces; t(2)=0.43, p=0.71.

The outcome suggests that the tag-based interface does not improve actual usability (effiency) for both task types in both online and mobile contexts.

### 7.2.5   Task mode

Figure 50 shows the average time spent on the two task modes (new and recurring) in the online and mobile contexts. The figure shows two different observations for the new and recurring task modes. There is only marginal difference for new tasks, however a more apparent difference is seen with recurring tasks especially in the mobile context. A difference of 1s and

0.4s is observed between the average completion times with the conventional and tag-based interface in the online and mobile contexts, respectively. While, for recurring tasks, a difference of 4.4s and 8s is seen with the conventional and tag-based interface in the online and mobile contexts, respectively. The conventional interface is faster than the tag-based interface for both contexts except recurring tasks in the online context.
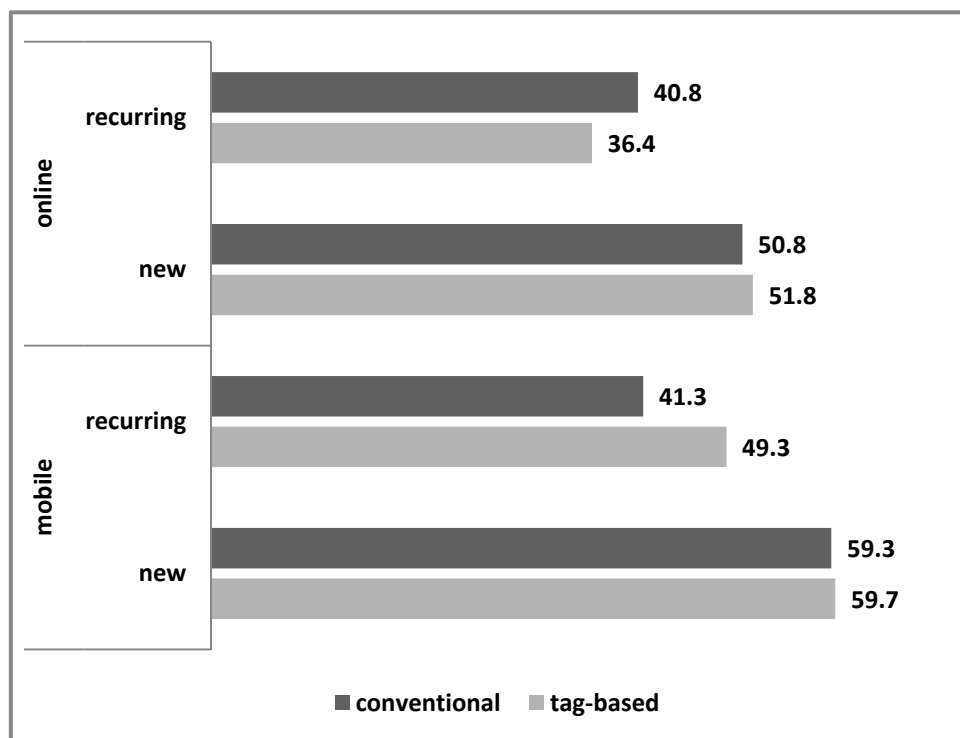


Figure 50 Average task completion times by task mode

To ascertain the significance of the task completion times by task modes, paired t-test analyses were conducted with an alpha of 0.05 (CI: 95%).

The results show that the differences of the average task completion times for new tasks are not significant in the online context for conventional (M=50.8, SD=7.08) and tag-based (M=51.8, SD=9.28) interfaces; t(3)=-0.16, p=0.86; and also in the mobile context for conventional (M=59.3, SD=5.43) and tag-based (M=59.7, SD=8.46) interfaces; t(3)=-0.11, p=0.92. Similarly, the average task completion times for recurring tasks, while being much higher than new tasks are however not significant as well in the online context for conventional (M=40.8, SD=0.85) and tag-based (M=36.4, SD=1.41) interfaces; t(1)=2.75, p=0.22; and also in the mobile context for conventional (M=41.3, SD=3.96) and tag-based (M=49.3, SD=0.92) interfaces; t(1)=-2.3, p=0.26.

The outcome suggests that the tag-based interface does not improve actual usability but instead negatively affects actual usability in online and mobile contexts for both task modes.

### 7.3    EFFECTIVENESS (AU)

Task completion rates and user errors are used as indicators of effectiveness. All participants managed to complete their given tasks in both contexts. Thus, there is no difference in task completion rates between the two interfaces. However, there is a difference in terms of user errors between the two interfaces. Table 8 shows the total errors for each task and context. As expected, a higher number of errors are encountered with the tag-based interface compared to the conventional interface. On average, the number of errors per task for the conventional and tag-based interfaces is low (<10) and medium (>10 & <20), respectively. These errors and other common issues found with the tag-based interface are discussed in the next section.

*\* No of errors (<=10 – Low(1), >10 & <20 – Medium(2), >=20 - High(3))*

| Interface type | Task | No. Of Errors (Online) | No. Of Errors (Mobile) |
|---|---|---|---|
| Conventional | Task 1 | 1 | 2 |
|  | Task 2 | 1 | 2 |
|  | Task 3 | 1 | 1 |
|  | Task 4 | 1 | 1 |
|  | Task 5 | 1 | 1 |
|  | Task 6 | 1 | 1 |
| Tag-based | Task 1 | 2 | 3 |
|  | Task 2 | 1 | 2 |
|  | Task 3 | 1 | 1 |
|  | Task 4 | 1 | 1 |
|  | Task 5 | 2 | 3 |
|  | Task 6 | 1 | 2 |

Table 12 User errors

According to Table 10, user errors are generally in the low range for the conventional interface in both online and mobile contexts. Only two tasks (1&2) are reported to be within the medium range for the conventional interface. While for the tag-based interface, user errors are

low to high, with a higher number of errors observed in the mobile context. Tasks 1 and 5 are the most error prone for the tag-based interface, where they are found to be in medium and high ranges in the online and mobile contexts, respectively. Two tasks (2&6) are in the medium range in the mobile context and rest of the tasks are within the low range for the tag-based interface.

The result shows that the conventional and tag-based interfaces have the same task completion rate, and the tag-based interface recorded a higher number of user error in both contexts.

## 7.4    CHALLENGES

Based on user observation, a set of common user errors and design issues has been identified with the tag-based interface (see Table 11). These errors and issues are scored according to their frequency and severity in the online and mobile contexts. The ratings (Low to High) are based on the number of occurrences, indicated as frequency and also the likely effect on user performance, particularly the ability to conduct banking tasks, indicated as severity.

*\* Frequency / Severity (1 – Low, 2 – Medium, 3 - High)*

| Common Errors / Issues | Frequency (Online) | Frequency (Mobile) | Severity |
|---|---|---|---|
| 1.  Not able to work out tagged resources based on tag names (minimal information) | 1 | 1 | 3 |
| 2.  Difficulty in carrying out past/recurring transactions via tag clouds | 1 | 2 | 3 |
| 3.  Trouble associating tags with tasks | 1 | 1 | 2 |
| 4.  Selection of wrong tag(s) from the tag list | 2 | 2 | 1 |
| 5.  Assignment of ambiguous or unmeaningful tags | 2 | 2 | 3 |
| 6.  Assignment of overly generic tags | 2 | 2 | 2 |
| 7.  Tagging behaviour related to use of conventional interface | 2 | 1 | 1 |
| 8.  Incorrect transaction amount | 1 | 1 | 1 |
| 9.  Incorrect transaction date | 1 | 1 | 1 |

Table 13 Issues and Errors

The first challenge is an issue as a result of users not being able to determine tagged resources such as bank accounts based on their tag names. This issue has a low occurrence rate, however has a high severity rate as it negatively affects the ability to carry out a bill payment, for example.

The second challenge is an issue related to the use of tag clouds for carrying out a past transaction is apparent in both online and mobile contexts, but is more obvious in the mobile context. The difficulty primarily stems from the inability to recall transactions from tags. Similar to the first issue, this issue is also highly severe and can disrupt the user from conducting a banking activity.

The third challenge is concerned with users having trouble associating tags with evaluation tasks, which is found in both contexts with low frequency and medium severity. Here, the user needs to decide whether the bank accounts involved for a particular task which include personal, payee and biller accounts. Since this information is not provided in a structured manner (i.e., menu and dropdown selection), rather tags are displayed as selectable boxes, the user need to scan through both horizontally and vertically a list of tags and find the right tag for the task.

The fourth challenge is an error involving the selection of wrong tags from a tag list. This error occurs quite frequently in the online and mobile contexts but is not severe mainly because users can easily recover from it.

The fifth and sixth issues are related to assignment of tags. These issues have a medium level of frequency in both online and mobile contexts. The issue of ambiguous or not meaningful tags is the first with a high severity, while overly generic tags are another with a medium severity.

The seventh issue is concerned with the user's tagging behaviour, which appears to be directly connected to the use of the conventional interface. This issue is caused by lengthy tags entered by the user as reference tags for transactions, much like a description in the conventional interface. A medium frequency is seen in the online context, while a low frequency is found in the mobile context. The issue has a low severity.

The eighth challenge is an error due to the input of incorrect transaction amount. This issue has a low frequency in both online and mobile contexts. Likewise, it has a low severity as users can easily recover from the error by requesting for modification in the transaction confirmation page.

The ninth and final challenge is an error due to the input of incorrect transaction date. Similar to the previous challenge, this is a low frequency and severity issue found in both online

and mobile contexts. This error is only detected for past/recurring tasks where a date change is required.

## 7.5    TAGS

Table 12 shows the tags assigned to the evaluation tasks in the online and mobile contexts. The tags are divided into two categories: system and user tags. System tags are pre-defined tags (taxonomy) for a transaction based on a payee or biller resource. User tags are personal keywords assigned by users to a transaction. The frequency of the tags is provided along with the tag names.

*\* Refer to Table 6 for description of tasks T1-T6*

| Task | System tags | | User tags | |
|---|---|---|---|---|
| | name | frequency | name | frequency |
| T1 & T5 | rent | 50% | rental | 20% |
| | lease | 4% | unit rent | 8% |
| | | | fortnight rent | 8% |
| | | | until 12 apr | 6% |
| | | | rent 24.04 | 3% |
| | | | ##21 | 1% |
| T2 & T6 | mobile | 52% | billpay | 20% |
| | phone | 8% | mobile bpay | 10% |
| | postpaid | 2% | mobile bill payment | 4% |
| | | | vodafone | 2% |
| | | | vodafone 24.04 | 2% |
| T3 | charity | 70% | auscharity | 10% |
| | donation | 16% | helpcommunity | 4% |
| T4 | insurance | 50% | billpay | 15% |
| | premium | 20% | ing 12 | 15% |

Table 14 Tags assigned to evaluation tasks

According to Table 12, Tasks 1 and 5 have two system tags and six user tags. The systems tags account for 54% of the tags assigned to both tasks, while the user tags make up 46%

of the tags assigned to the tasks. The most frequently used system tag is "rent" while "rental" is the commonly used user tag. Tasks 2 and 6 have three system tags and five user tags. The systems tags are 62% and the user tags are 38%. The tag "mobile" is the most frequently used system tag and "billpay" being the most popular user tag. Task 3 has two systems tags that make up 70% of the tags assigned and two user tags that take up the rest of the 30%. "Charity" is the most used system tag and "auscharity" tag denoting the charity organisation's name is the preferred user tag. Likewise, Task 4 also has two systems tags and user tags that constitute 50% and 15% of the tags, respectively. The frequently used system tag is "insurance" and user tags are "billpay" and "ing 12".

Based on the tags assigned, it is obvious that systems tags have a higher frequency compared to user tags. This potentially means that the systems tags are appropriate for the tasks given. However they appear to be generic and conversely, user tags tend to be specific denoting the payee. Additionally, user tags also contain specific numeric values to indicate the month and/or year (e.g., "rent 24.04"), or a particular duration (e.g., "fortnight rent"). Nevertheless, generic tags such as "billpay" seem to be widely used, more frequently to annotate bill payment tasks.

In general, the system tags have a higher assignment percentages compared to user tags. A higher number of user tags are found for the first two tasks with a recurring scenario. Furthermore, these user tags are more frequently used compared to the user tags assigned for the one-time tasks.

## 7.6    SUMMARY

This chapter presented the results of the main study based on the data analysis design outlined in the earlier chapter. The analysis categories used include banking contexts, age groups, mobile banking experience, task types and task modes. The results can be summarised as the following. Firstly, the perceived usability represented by SUS scores and experience ratings indicate a significant result for the tag-based interface in both online and mobile contexts for participants below 40 years of age. Secondly, the actual usability (efficiency and effectiveness) represented by task completions times and rates indicate a non-significant result for the tag-based interface across all analysis categories. Thirdly, the results point out a set of common issues and errors, recognised as challenges pertinent to the tag-based interface, grouped based on frequency and severity. Lastly, the results of the tags assigned during the evaluation are presented to better understand the tagging behaviour of participants.

# Chapter 8. Discussion

This chapter provides an interpretation of the findings based on user observation and previous related work. Section 8.1 provides a discussion of the results with reference to the research questions and hypotheses outlined at the beginning of the thesis. Section 8.2 presents a range of challenges identified with the tag-based interface and recommendations of potential solutions that can address the challenges.

## 8.1    RESULTS

The results help address a key research question of this study: RQ2 (see Section 3.6 - Research Questions). RQ2 is focused on the effect of tag-based customisation on perceived and actual usability in online and mobile banking.

The results propose that tag-based customisation can improve perceived usability (satisfaction) of online and mobile banking. The study findings support this proposition for two age groups: 21-30 and 31-40; and for both experienced and inexperienced mobile banking users. The paired t-test analyses showed that the SUS scores and summative experience ratings are significantly higher for the tag-based interface over the conventional interface in both online and mobile contexts. This suggests that participants are more satisfied with the tag-based interface than the conventional interface. This outcome is even more apparent in the mobile context compared to the online context. One possible explanation is the ability to carry out tasks via simple tag selections, which in effect reduces the effort required of users on mobile devices. The favourable rating of user-friendliness (experience ratings) for tags compared to the conventional design may result from participants finding it easier and simpler to interact via their own tags. However, the notion that tag-based customisation can improve perceived usability of online and mobile banking is not supported for the age group 41-50. Given that only 7% of the participants are from this age group, it is not known whether the finding is reflective of the age group. Nonetheless, previous studies as noted by Hanson (2010) show that this may be the likely case as older users generally are disinterested in new technology and are not inclined to adopt technology for the sake of being current. Instead, the technology in question must be perceived as useful or worthwhile and address a particular need or interest. According to Campos and Nunes (2007), perceived usefulness and usability often collide, where useful tools are not usable and usable tools are not sufficiently useful. The overall perceived usability results suggest that the latter is

most likely the case simply because older participants did not see the value or significance of tags for banking purposes and the learning cost associated with it.

Interestingly, participants with no prior experience in mobile banking were more satisfied with the tag-based interface compared to mobile-experienced participants. Alternatively, with the conventional interface, a difference of about 11% is observed as an effect of past mobile banking experiences, which is consistent with the findings reported by Sauro (2011). The high scores and ratings observed among inexperienced mobile banking participants suggest that there is a potential for the tag-based interface to positively affect the adoption and acceptance of mobile banking. According to Kargin et al. (2009), perceived usability or user satisfaction is a key determinant of mobile services adoption and acceptance. This is imperative given that the global customer base of mobile banking is expected to grow rapidly and reach close to one billion users by 2015[29]. This figure further highlights the significance of mobile banking and the need for a usable mobile interface.

The results however do not support the proposition that tag-customisation can improve actual usability (efficiency and effectiveness) of online and mobile banking.

The difference in efficiency, measured through task completion times, is not significant in either context. Likewise, the task completions times were also not significant for various analysis categories including individual tasks, mobile banking experience, age groups, task types and task modes. One possible explanation is participants' lack of experience with the tag-based interface, which may have led to slower task completion times. Conversely, participants' past experience with the conventional interface is likely to have positively affected the task completion times on the conventional interface.  In general, the task completion times show that the participants from the younger age group (21-30) performed equally well on both interfaces in both contexts. Likewise, the middle (31-40) and older (41-50) age groups have close and comparable completion times in the online context. However, participants from both of these age groups spent more time with the tag-based interface in the mobile context. This finding is closely associated with participants' mobile banking experience since inexperienced users are largely from the middle and older age groups.

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[29] Global Industry Analysts, http://www.prweb.com/releases/2010/02/prweb3553494.htm

The results show that there are marginal differences in effectiveness, measured by task completion rates and user errors, between the two interfaces. Participants managed to complete all evaluation tasks on both interfaces in the online and mobile contexts. All participants had prior experience in conducting transactions via online banking that enabled them to carry out the given evaluation tasks without much difficulty. This is useful to discover participants' perception on usefulness and ease-of-use of tag-based customisation especially for everyday banking use. Introducing more intricate tasks may however help to better understand effectiveness of both interfaces, but this may also impede the relevance and purpose from an average user's point of view. In terms of accuracy, participants appear to make more mistakes with the tag-based interface particularly with the introduction of a new kind of activity. The first task involving a new banking activity and the fifth task involving a past banking activity record the most number of errors (within the medium and high ranges), and these errors recede for subsequent tasks of a similar nature. This pattern suggests lack of familiarity with the interface as the likely issue. The errors are especially obvious in the mobile context and in general participants made more errors in the mobile context compared to the online context. Such a result may be broadly attributed to the lack of mobile banking experience among the participants and also specifically to the way in which tags are used to deliver customisation that may require certain level of understanding albeit being easy to conduct (e.g., clicking a tag from the tag cloud auto fills a bill payment form).

Although, the actual user performance indicated by task completion times is not improved in both contexts, participants perceived the tag-based interface as one that can improve their performance and appear to be more satisfied and inclined to use the tag-based interface than the conventional interface. The most likely reason for the poor user performance on the tag-based interface is lack of experience with the new tag-based interaction style. Also, in the mobile context, this issue may have been further exacerbated by a smaller display. Nevertheless, longer task completion times are anticipated for this study given that a learning curve/cost is associated with the tag-based interface.

The results of the study shed light on minimal information on screen (tag-based) versus detailed information on screen (conventional). The results suggest that participants from the younger (21-30) and middle (31-40) age groups prefer minimal information on screen by default and being presented with detailed information on demand. This may be strongly tied to the security and privacy concerns of banking users especially those related to mobile banking (Wessels, et al., 2010). The older group (41-50), however, appear to prefer detailed information on screen. One possible explanation is that users actually find it easier for decision-making.

Nonetheless, that preference which is observed with the older group may simply be a matter of acclimatisation.

In addition, based on user observation, the notion of providing tag suggestions as a way to encourage the user to tag and re-use tags already present in the system as suggested by Weinberger et al. (2008) is useful especially in the mobile context where it is cumbersome to tag. Participants obviously preferred to select suggested tags that were appropriate rather than typing their own. This is evident in the results where a high usage of system tags over user tags is found (see Table 10). However, when they did enter their own tags, they expected them to be shown on the top of the list of suggested tags.

Overall, the study highlights the usability of the tag-based customised interactions where empirical findings suggest that the tag-based interface can improve perceived usability in both online and mobile banking. This outcome confirms an earlier study (Rahim, et al., 2009) that proposed customisation as a key determinant of user satisfaction or perceived usability in banking context. The findings also suggest that the tag-based interface is highly usable even though participants had no past experience with it. According to McLellan et al. (2012), more experience users have with a product, the higher, more favourable, their SUS scores. Therefore, they recommend that user experience professionals need to assess participants' experience with a product before administering SUS. The findings however do not support this view and rather the opposite is found to be true. Despite the lack of experience, participants scored/rated the tag-based interface higher compared to the conventional interface. Therefore, a tag-based interface appears to be both suitable and practical for banking purposes where a high acceptance is likely among online and mobile banking users, especially those in the younger and middle age groups.

Even though only perceived usability is positively affected by tag-based custom interactions in both online and mobile contexts, nevertheless the outcome is important as perceived usability is often more influential than the actual usability of an interface (Phillips, et al., 2009). For example, Tractinsky, Katz & Ikar (2000) studied ATM interfaces and found that users judged how usable the interfaces were based on their aesthetic appeal, regardless of actual usability. Brady and Phillips (2003) found that websites with consistent balance and colour schemes were rated as more usable by participants than websites with uneven and poor colour schemes. Furthermore, marginal differences in task completion times are not likely to have a strong impact on users and these may go unnoticed with a product or system perceived as usable (Hassenzahl, 2004). Though, this may not be the case if users experience low levels of effectiveness and as a result are unable to complete a task successfully (Hassenzahl, 2004).

Similar to the above mentioned examples, the usability findings of the tag-based interface lends further support to the argument that perceived usability is potentially more significant than actual usability and both may not necessarily correlate. This observation is especially apparent in the mobile banking context where participants were slower with the tag-based interface, yet they perceived the interface as one that is more usable compared to the conventional interface.

There is an important question as to whether long-term term use of a tag-based interface would have any significant effect on usability particularly satisfaction, which is significantly improved compared to the conventional interface. To predict this, the Expectation Disconfirmation Theory (EDT) is used (Oliver, 1980). The theory posits that expectations, coupled with perceived performance, lead to satisfaction. This effect is mediated via positive or negative disconfirmation between expectations and performance. If a technology exceeds expectations (positive disconfirmation) satisfaction is positively affected. If a technology falls short of expectations (negative disconfirmation) then satisfaction is negatively affected. A recent study on EDT shows performance as a key determinant of satisfaction that influences continuance of use of technology (Lankton et al., 2012).

The SUS instrument provides an indicator of perceived performance. The difference found in terms of the SUS scores and experience ratings in both online and mobile contexts highlight an increased level of satisfaction among participants, especially from the young- and middle- age groups. This according to the EDT is because the expectations of participants are outperformed or in other words a low level of negative disconfirmation is present, which can be attributed to a positive performance. Given participant's prior experience with the conventional interface, primarily in the online context, he/she would have a set of expectations for the tag-based interface. The user's perceived performance indicated through the SUS shows that the expectations are positively disconfirmed, leading to satisfaction. In the mobile context, however, users without prior mobile banking experience may have formed certain expectations based on the use of the online counterpart or other mobile applications.

Based on the EDT, a tag-based interface is likely to have a positive effect on perceived usability (satisfaction) in the long-term as long as the performance is not negatively affected. The expectations of users may be negatively disconfirmed due to challenges related to the customisation offered (see Section 8.2 Challenges and Recommendations), leading to dissatisfaction. For example, if the expectation to speedily conduct a past transaction via a mobile tag cloud is not met for some reason (e.g., the presence of large amounts of tags making it cumbersome to locate a tag) will invariably lead to negative disconfirmation that in turn will see

the user dissatisfied with the system. As such, it is important to ensure the challenges are addressed so the performance of the tag-based interface is not lowered or compromised.

## 8.2    CHALLENGES AND RECOMMENDATIONS

In this section the challenges identified with the tag-based interface are presented, and recommendations for meeting the challenges are provided. This section addresses Research Question 3 (see Section 4.1 - Research Questions). The challenges identified are not based on the quantitative data described above; they are based on qualitative observations made during task performance and on comments from participants during the debriefing. There are five issues: minimal information on the tag-based screen, tag clouds for mobile, idiosyncratic and ambiguous tags, tagging behaviour due to use of the conventional interface, and navigation through a large number of tags. Potential solutions for these challenges are drawn based on practical solutions available online and past work related to tags.

The first issue is the limitation around the level of information displayed on tag-based screens. The conventional interface provides all relevant information by default to a banking user for decision making. Alternatively, the tag-based interface only displays tags on screen, placing an increased level of responsibility on users to recall or recognize a tag with regards to a resource such as bank account or biller. Therefore, it is important to enable users to retrieve relevant information associated with a tag effortlessly and unobtrusively when required. This ensures users are confident and comfortable with the interface as locus of control (Shneiderman, et al., 2004) remains with them.

This issue can be remedied through dynamic tooltip popups (i.e., jQuery tooltip[30] - see Figure 51). Dynamic tooltip popups allow information to be displayed on demand in an unobtrusive fashion. The browser events "hover" and "tap" can be used to trigger the tooltip in online and mobile contexts, respectively. This places a reduced level of effort to view detailed information associated with a tag. From the results, it is obvious that the majority of users prefer information on demand, especially in the mobile context. In addition, visual cues such as font and background colour can be used to deliver subtle messages to users. For example, the colour green can indicate a healthy account balance and red for an unhealthy account balance. Likewise, font

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[30] jQuery Tooltip, http://jquerytools.org/demos/tooltip/index.html

colours can help indicate transaction status: green for success, orange for pending, and red for failure.
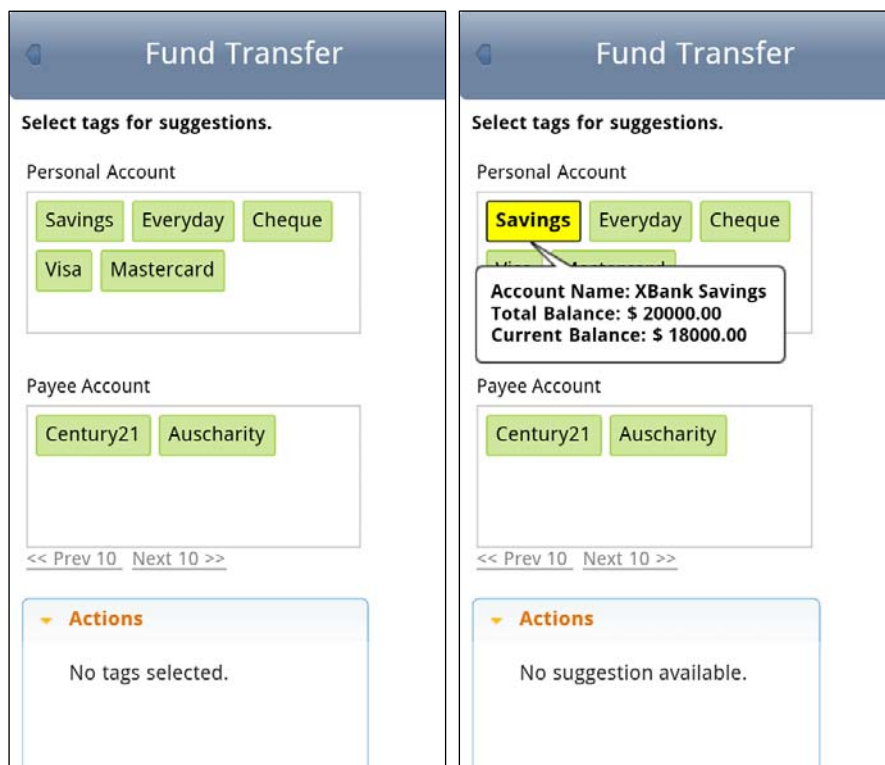


Figure 51 Dynamic tooltip popup

The second issue is the difficulty in carrying out past or recurring transactions via tag clouds. The issue is particularly evident in the mobile context (see Table 8) where an obvious space constraint exists due to smaller screen sizes. A higher completion time is observed with the tag-based interface for recurring tasks (see Figure 50) in the mobile context, which is about 8 seconds slower compared to the conventional interface. Conversely, in the online context, the tag-based interface is faster by 4.4s over the conventional interface. Though, both the differences are not significant, the results suggest that tag clouds may be less suitable for use in mobile devices.

According to study by Rivadeneira (2007), large font sizes used in tag clouds help people to recognise and recall tags better. For this purpose, the mobile tag clouds were designed to use large font sizes with a minimum of 18pt (see Figure 52). The difficulty observed, conversely, may be a user-experience related issue. Slower completion times appear to be closely related to mobile banking experience. Figure 48 shows that participants without experience spent about 10s more on the tag-based interface compared to participants with experience. Figure 46 supports this view where a small improvement of 1.3s is seen between two successive recurring tasks 5 and 6. Additionally, the familiarity with tags and tag clouds, particularly in the mobile banking contest is potentially another contributing factor to the outcome.
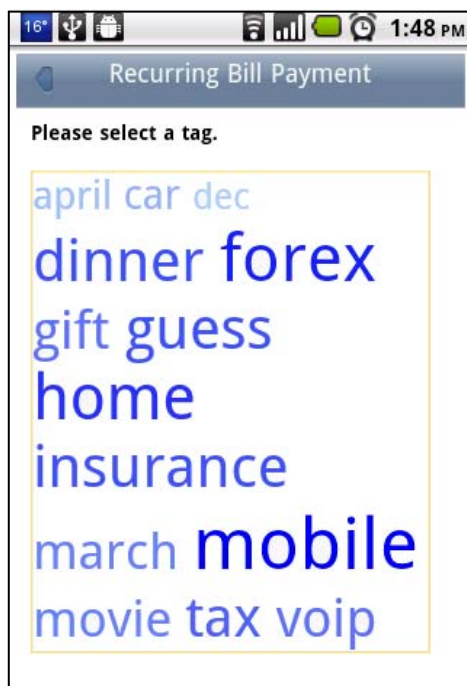
Figure 52 Mobile tag cloud

The third issue is related to assignment of tags that lack meaning, particularly those that are idiosyncratic and ambiguous. The use of idiosyncratic tags, which at first may appear to users as easy and very personal, can impede the usability of the interface especially in the presence of a large number of tags. Users generally struggle to recall or contextualize tags assigned to transactions that are not meaningful enough like "##21" assigned to a fund transfer on the 21$^{st}$ of the calendar month, for example. Moreover, idiosyncratic tags need to be excluded from cross-user tag suggestions that otherwise could distort the quality of suggestions and users' perceived usefulness. Conversely, ambiguous tags can stem from overly generic or synonymous keywords used to describe or categorize a resource. For example, a mobile bill payment tagged as "bill pay" or "payment" does not offer much detail about the transaction nor context for future recall.

Suggesting tags, and educating and training users on tagging best practices may alleviate this third issue. Firstly, through the use of tag suggestions users may be persuaded into choosing an existing tag instead of entering their own. Also, to increase the chances of users selecting a suggested tag, the tag suggestion popup can be displayed "onfocus" of form input box rather than "onkeystroke". In other words, the tags suggestion list is shown even before the user starts typing and tags are filtered as the user types. Secondly, a more user-centric approach is education and training on tagging best practices. Since tagging is a user-based activity, the knowledge of tagging prior to assignment of tags is valuable. Lee et al. (2009) support this view in a study that showed low familiarity with tagging among users entailed low quality and less effective tags. The

study also shows that users with prior knowledge of tagging tag effectively, consequently reducing or eliminating any issues that otherwise may be prevalent. One simple means of educating users is by explaining the benefits of assigning meaningful tags to banking resources. This could be done through a multimedia presentation illustrating different examples using simple day-to-day banking scenarios. Furthermore, other interactive means such as online games (e.g., tagr[31]) can also be employed to educate and train users on tagging best practices in a fun and engaging manner.

The fourth issue is concerned with the tagging behaviour of users, largely influenced by the way in which the conventional interface functions. Instead of inserting discrete and meaningful keywords as tags, users provide a one-line description that is generally lengthy and specific. For example, a fortnight rent payment in the month of April is described as "until apr 12" or "rent 24.04" (see Table 9). These descriptions, despite being useful references, do not permit reuse or simple categorization of transactions.

This issue can be easily addressed by using multiple tags. In the example above, tags such as "rent" and "april" can help to categorize and simplify the process of tracking and reconciliation. Also, in the following instance, the primary tag "rent" can be retained and the secondary tag "april" can be changed to "may," for example. A more advanced example for users who wish to keep a detailed account of their transactions would involve three tags where the first describes the activity ("rent"), the second the month ("april") and the third the exact date of the activity ("24.04.12"). As a result, tags can be re-used for similar transactions with the option of adding more contexts through addition or replacement of tags.

The fifth and final issue is the challenge of navigating through large numbers of tags (>100). This is likely to become a problem in the long-term, exacerbated by random and unorganized assignment of tags. Also, this issue is a potential challenge for users who use online banking more extensively than others and have a multitude of financial needs. The issue itself is likely to have a more significant impact in the mobile context than online given the display constraints due to smaller screen sizes. Nevertheless, regardless of the banking context, users are likely to find it cumbersome to navigate through their tags for each transaction they conduct.

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[31] http://tagr.kewlbox.com/

Therefore, a simple and convenient way to discriminate and select tags is essential and paramount.

This issue can be addressed through the addition of several design features. First, a search feature that allows users to quickly lookup tags based on tag names and related transactional details such as date or amount. That feature can be made more intuitive by filtering tags as users type. Furthermore, tags can be sorted based on usage in both online and mobile contexts. As a result, the most commonly used tags are shown first by default. Second, the ability to edit past tags need to be incorporated to enable users to reorganize and manage their tags. This is an integral part of the learning process to enable users to tag effectively. Fortunately, personal financial management (PFM) tools currently provide a wide range of tag management features that encompass the aforementioned features as well. Thus, the integration of such a tool with online/mobile banking is both useful and prevents reinventing the wheel. Table 13 lists some of the key management features offered by PFM tools such as Mint, ANZ-MoneyManager and MoneyStrands that are meant to simplify tagging.

| Feature | Description |
| --- | --- |
| 1. Sticky/Auto tags | Automatically assign tag to transactions from the same merchant or service provider. For example, the tag "mobile" for the telecom company, Vodafone. |
| 2. Categories and sub-categories | Associate tags to a particular category or sub-category, for a detailed and structured organisation of resources. For example, the tag "Vegetables" under the category of "Shopping" and sub-category of "Groceries". |
| 3. Edit | Edit tags individually (a single resource) or globally (applies to all resources) and/or reassign tags to new resources. |
| 4. Quick search | Search tagged resources based on tag names, amount or date. |
| 5. Self-tagging | Assign tags as self-description for financial analysis and comparison. For example, the tags "professional" and "21-30" to describe a young professional |

Table 15 Tag management features

### 8.3    SUMMARY

This chapter presented a discussion on the results of the study. An interpretation of the results is given based on insights gained via user observation and debriefing with participants. To help explain some of the findings, previous related work is referenced. Then, the challenges found with the tag-based interface are elaborated with examples and potential solutions are recommended that can potentially address the challenges. The solutions are drawn from the study and also from relevant literature.

# Chapter 9. Customisation Model

This chapter presents a tag-based customisation model. Section 9.1 provides details on the tag-based customisation model with examples from online and mobile banking. Section 9.2 attempts to highlight the usefulness of the model by applying it to two other popular E-commerce websites. This also illustrates the potential application of tag-based customisation in other non-banking contexts.

## 9.1    TAG-BASED CUSTOMISATION
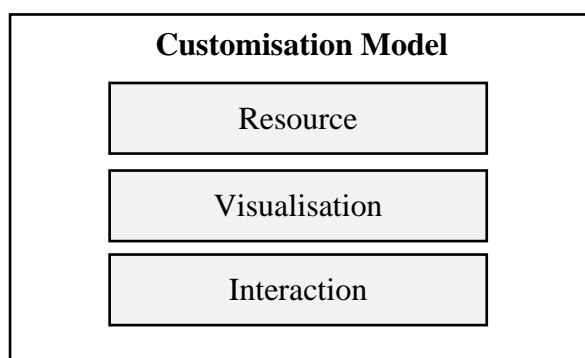


Figure 53 Tag-based customisation model

The model shown in Figure 53 consists of three concepts: resource, visualisation and interaction. These concepts are inter-related (see Figure 54) and are useful to facilitate tag-based customisation in the online and mobile contexts.
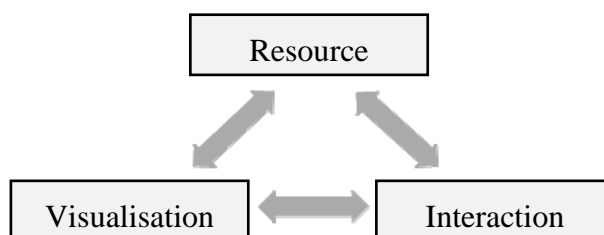


Figure 54 Model relationship

Tag-based customisation encompasses three inter-related concepts: resource, visualisation and interaction. *Resource* denotes the range of taggable elements found on a website such as online or mobile banking (see Section 9.1.1). *Visualisation* refers to the various techniques and properties to render and display a tag-based interface (see Section 9.1.2). *Interaction* represents the different types of customisation possible through tags (see Section 9.1.3).

### 9.1.1    Resource
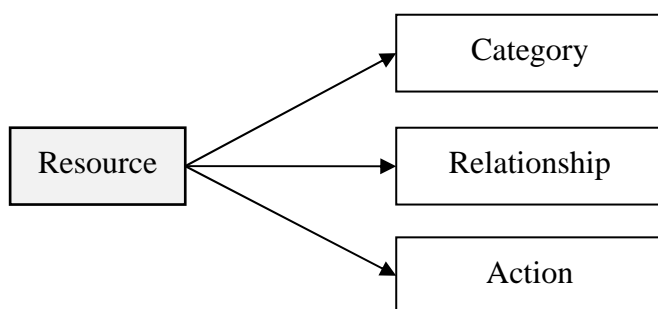


Figure 55 Resource model

Taggable resources in the tag-based customisation model encompass three key criteria: category, relationship and action.

The resource *category* represents the various types of taggable resources found in a Web domain such as video, photo and transaction. These resources can be further divided into smaller resources for a finer level of tagging. For example, a transaction may encompass several other resources including bank account and biller. Three simple criteria are proposed to identify the range of taggable resources in a website (see Table 14).

| Criteria | Optional |
|---|---|
| Is the resource central to a website feature/activity? | No |
| Is the resource a reference to a website feature/activity? | Yes |
| Is the resource static or semi-static by nature? | No |

Table 16 Analysis criteria

The resource *relationship* is the association between two or more taggable resources. This attribute is useful to map out the link between resources and website features. Generally, every website feature is based on a set of resources. For instance, bill payment in online banking encompasses two resources: bank account and biller. Thus, both these resources have a relationship, useful to carry out a bill payment.

The resource *action* is the possible actions between taggable resources based on their relationships. Two or more related resources can be used to perform a set of actions. For example, possible actions for bank account and biller include bill payment, schedule bill payment and view bill payment history. The different actions enable access to website features in a customised manner with the relevant resources pre-selected.

There are five types of key resources in online and mobile banking namely bank account, biller, reference, message and application (Ravendran et al., 2011). These resources were identified through examination of the online and mobile banking websites of two leading banks in Australia: Commonwealth Bank[32] and Suncorp Bank[33]. The examination specifically focused on personal banking as it appeals to a wider spread of people. Table 13 lists and briefly describes these resources.

| Resource | Type | Description |
|---|---|---|
| Account | Personal | User owned accounts (e.g., everyday, savings, cheque, credit card, business, etc) |
| | Payee | Linked (personal) or Other (e.g., internal, external and overseas account) |
| Biller | All | Registered and unregistered billers |
| Reference | Personal | Personal description of a transaction. Transaction types include offline such as EFTPOS, direct debit, etc; and online such as bill pay, fund transfer, shopping, etc |
| | Payee | Description of transaction for recipient's reference |
| Message | All | Personal communication between user and bank |
| Application | All | All types of financial products such as account, credit card, loans, etc |

Table 17 Taggable resources

Based on the resources listed in Table 15, the relationship and action attributes have been determined (see Table 16). The key resource, account, has relationships with three resources: one self-related and two external-related. Some of the actions possible with two or more accounts include funds transfer, history and scheduled transfer. While actions possible with one or more biller include bill payment, view history and schedule payment, and with one or more application include apply, cancel and suspend. No relationship and action is available for two resources: reference and message.

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[32] Commonwealth Bank, (http://commbank.com.au)

[33] Suncorp Bank (http://www.suncorp.com.au)

| Resource | Relationship | Action |
|---|---|---|
| Account<br><br>Biller | Account-to-Account | Funds transfer, View history and Schedule transfer |
| | Account-to-Biller | Bill payment, View history and Schedule payment* |
| | Account-to-Application | Apply for product/service, Cancel application and Suspend application** |
| | Biller-to-Account | Same as * |
| Reference | None | - |
| Message | None | - |
| Application | Application-to-Account | Same as ** |

Table 18 Resource relationship and action

A filter mechanism is needed for actions based on resource properties which then determine the possible actions, for instance, the action of transferring funds from a Savings account to Visa credit card account is valid but not the other way around as credit card accounts are only meant for online and offline purchases. For this purpose, a technique is proposed that uses pre-defined rules associated with resources for interaction (Ravendran, et al., 2011). This allows for selective action relationship based on restrictions and nature of a resource.

### 9.1.2   Visualisation
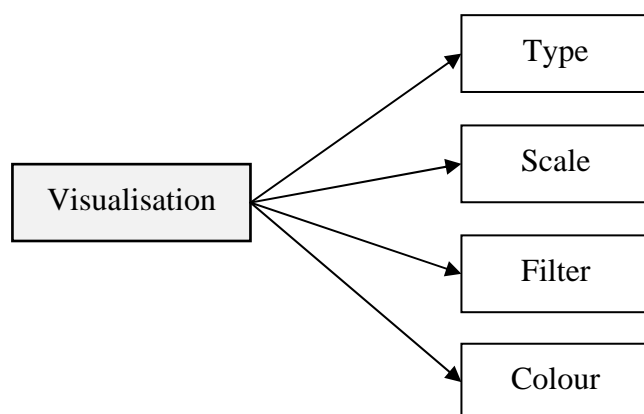


Figure 56 Visualisation model

Tags can be visually represented in both individual and aggregated forms. Tags displayed as separate clickable elements on the website interface is particularly useful to represent unique and limited number of banking resources such as bank accounts and billers. This form of visualisation is straightforward and enables a specific type of customisation (see Figures 59 & 60). Alternatively, representation of tags in aggregated forms is less straightforward and is more suited to represent large number of resources such as transaction references. A popular technique for this purpose is tag clouds. Tag clouds provide effective representation of indexed information (Tang, et al., 2008) and serve as means of visual information retrieval (Hassan-Montero, et al., 2006), enabling a specific type of customisation (see Figure 58). Visually weighted tags based on frequency of use are a powerful way for users to comprehend their financial information. Such an interface element can also help users to quickly recognize and monitor financial expenses. Additionally, tag clouds facilitate website navigation (Kaser, et al., 2007), easing access to common banking activities and eliminating the need for menu-based navigation.

Tag-based visualisation encompasses four key elements: type, scale, filter and colour. Firstly, the visualisation type can be either individual or aggregated. Tag aggregation via tag clouds can vary in type as well, from a list to sphere comprising of different properties (e.g., height, font size, etc). Secondly, the scale used to determine the weight of tags can also be significantly different. Due to variable screen sizes, a higher scale is more appropriate for mobile devices with bigger screens and vice-versa. Thirdly, multiple filters such as amount, date or account can be applied to narrow down tags displayed. This is particularly useful when large numbers of tags exist. Lastly, the colour used to represent tags can be useful to communicate subtle and latent messages to users, for example status of transactions (e.g., green for successful, orange for pending and red for declined) or account balances (e.g., green for a healthy balance

and red for a low balance). However, to ensure accessibility particularly for the colour blind, colour schemes need to be accompanied with appropriate icons or alternate texts.

### 9.1.3   Interaction
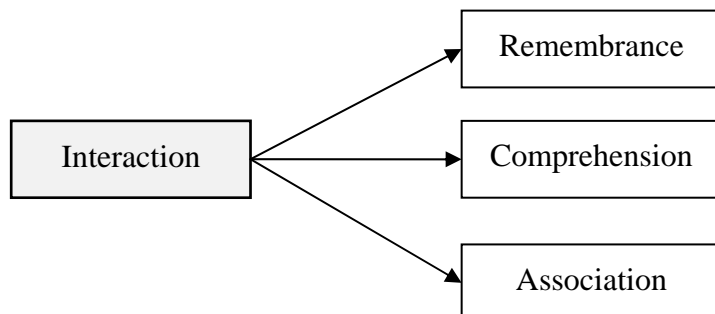


Figure 57 Interaction model

The interaction types are based on the customisation model founded on human-to-human interaction proposed by Fung (2008). Interaction customisation encompasses three types:

- Remembrance-based

- Comprehension-based

- Association-based

The following sections provide a brief definition of each interaction type and discuss the application of tags to facilitate these interactions in online and mobile banking contexts.

### a.   Remembrance-based

The remembrance-based customisation is defined as customisation through simple remembering of user's information based on the recurrence rate of a particular action on a website (Fung, 2008).

This customisation can be fulfilled through tags assigned to resources that are presented as tag clouds. This provides a visual retrieval interface that can simplify and ease the execution of past or recurring transactions. Simply by clicking on a tag, related information about a transaction that the tag is associated with can be retrieved and displayed. If a selected tag is associated with two or more tags then the tag cloud can be filtered to show tags that are co-occurring with the selected tag. This removes the need to navigate to a different page or perform a manual search query. This also means to carry out a past or recurring transaction, users will only need to update necessary information such as amount (if different) and possibly retain other details.

Below is an example of remembrance-based customisation in the online (left) and mobile (right) banking contexts.

**Note**: The pointer icon indicates a click action in the online context and the hand icon indicates a tap action in the mobile contexts.

*Scenario: Recurring monthly mobile bill payment. User selects "mobile" (1) tag from tag cloud. As a result, the form is auto-completed and relevant tags are pre-selected (tick).*

Fig...

## b. Comprehension-based

Comprehension-based customisation is defined as customisation through recognition of user's behaviours to provide assistance towards fulfilling the users' needs (Fung, 2008).

This customisation can be fulfilled by inferring possible banking actions (i.e., fund transfer) based on tags selected by a user. Such inference is possible for tags with certain types of relations (e.g., account to account, account to biller). Using these relations and simple pre-defined rules (e.g., transfer from Savings account to Visa account is valid but not the other way around) possible actions can be populated. The actions may also constitute different types of services or features offered by the bank for a particular need, which otherwise may not be known to the user. By providing users with relevant options, banks may be able to provide suggestions to users based on their personal banking usage. For example, if a user performs fund transfers to a

selected payee two months in a row, then a new option suggesting that the user schedule a monthly transfer may be provided.

Below is an example of comprehension-based customisation in the online (left) and mobile (right) banking contexts.

*Scenario: New fund transfer from Everyday account to John's account. User selects "Everyday" (1) and then "John" (2) tags. The possible actions are populated as 1) 'Transfer from Everyday to John' and 2) 'View transaction history of Everyday and John'*
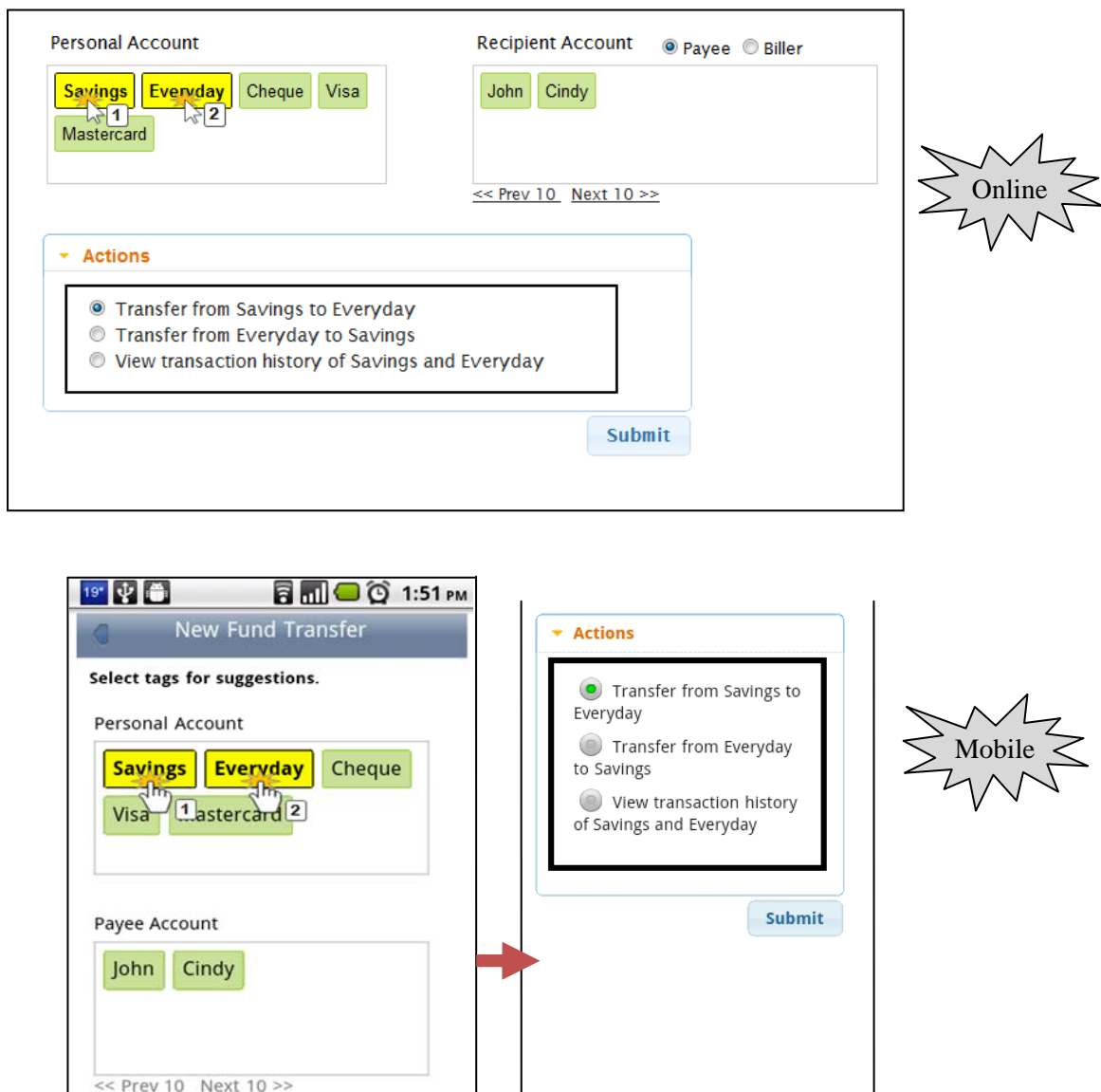


Figure 59 New fund transfer

### c. Association-based

The association-based customisation is defined as customisation through association of users' behaviours with other individuals who share similar interests or needs (Fung, 2008).

This customisation can be fulfilled by recommending tags to users (dropdown as focus is set on field and filter as user types). Tags can be associated and recommended to users based on certain criteria such as biller name or type. For example, when users select the biller Vodafone, a mobile service provider, tags associated with this specific biller can be recommended (i.e., "phone", "mobile", etc). Tags associated with a particular resource can be either defined by users (folksonomy) or system (taxonomy), or both combined (automanual folksonomies) (Smith, 2007). The relevance and appeal of recommended tags may be further improved by making sense out of the underlying meanings of tags via semantic analysis (Durao, et al., 2009; Qi Xin et al., 2010). This in turn could assist in forming more relevant associations between like-minded individuals within a community of users through discovery of semantic relationship between tags. As a result, recommendations that potentially deliver greater value is plausible, for example a set of related services based user's banking usage (Ravendran, et al., 2011).

Below is an example of association-based customisation in the online (left) and mobile (right) banking contexts.

*Scenario: Tag recommendation for multiple bill payment (mobile and money transfer). User selects "Vodafone" (1) and then "OzForex" (2) biller tags, and enters a description (3). As a result, a set of related tags are shown that are used in the context of the selected billers.*

Mobile
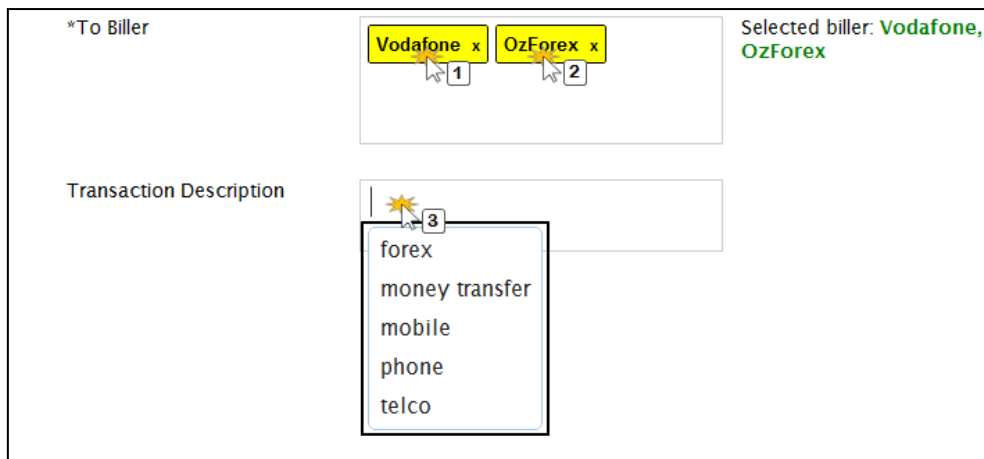
Figure 60 Tag recommendation

## 9.2     GENERALISATION

This section aims to illustrate the application of the tag-based customisation model in two other E-commerce domains/websites that are primarily product or service focused. Online retail and travel booking websites are chosen as case studies because they provide an interesting comparison in terms of focus (product / service), frequency of use (frequent / infrequent) and resources count (high / low).

The structure of the study is as follows. Firstly, the website (case) chosen for the study is described. Secondly, the range of taggable resources identified in the website is outlined. Then, a discussion of the possible tag-based visualisation for the website is provided. Finally, the different types of customised interaction via tags assigned to resources identified earlier are presented.

### 9.2.1   Online Retail

Online retail shopping is an easy and convenient way to buy products or services over the Web. From the wide range of stores available online, online supermarkets allow users to order and pay for a wide variety of products through the Internet. The purchased items can then be delivered to the user's door steps for a small delivery fee or alternatively picked up at the nearest store. One of the leading Australian online supermarkets is Coles[34] with over 700 stores Australia

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[34] Coles, http://www.coles.com.au

wide. Coles's online shopping website is examined and the sections below apply the tag-based customisation model to this context.
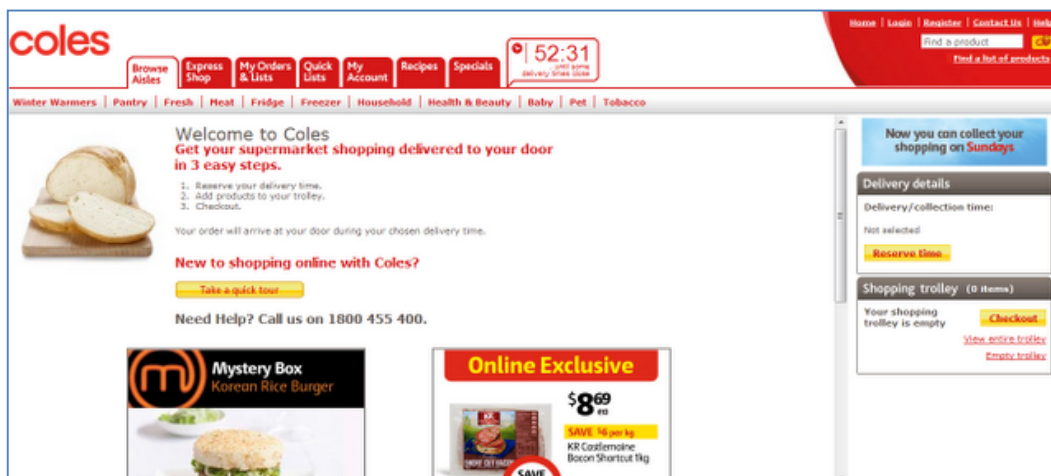


Figure 61 Coles website

### a.   Resources

There are five key taggable resources identified from Coles's online shopping website. The resources are shopping list, product, address, payment info and purchase. The table below describes each resource.

| Resource | Type | Description |
| --- | --- | --- |
| Shopping list | All | List of items that can be divided into categories such as groceries, clothing, household items, etc |
| Product | All | All items available in Coles online supermarket |
| Address | Shipping | Shipping address for an order |
| | Billing | Billing address for an order |
| Payment info | All | Payment method and information for an order |
| Purchase | All | Description about a purchased order |

Table 19 Taggable resources (Coles)

For the sake of simplicity and ease of design, products are assumed to be always part of one or more shopping lists. A default editable shopping list called 'MyList', for example can be used in the event the user does not create his or her own list. The following table depicts the relationship and action for the resources shown in Table 17.

| Resource | Relationship | Action |
|----------|-------------|--------|
| Shopping list (list) | List-to-List | Combine |
| | List-to-Product | Add and Delete* |
| | List-to-Address | Ship to or Bill to** |
| | List-to-Payment | Pay by*** |
| Product | Product-to-List | Same as * |
| Address | Address-to-List | Same as ** |
| Payment info (payment) | Payment-to-List | Same as *** |
| Purchase | None | - |

Table 20 Resource relationship and action

Table 18 shows that the key resource is shopping list with four relationships: self, product, address and payment. The relationships give the ability to perform several actions: combine more than one list for an order, add and delete products to lists, ship and/or bill to an address, and pay by a certain method or card. The rest of the resources have only a single relationship except for reference, which has none. All resources have single tag multiplicity except for product and purchase, which are likely to be useful for visualisation and search.

**b. Visualisation**

One of the possible visualisations in the online shopping context is a tag-cloud of products purchased, sorted by either item frequency or value. This provides an overview of shopping expenses and items purchased over a period of time. Alternatively, a more useful visualisation in terms of customisation is a tag-cloud generated based on user's tags for purchases. By clicking on a purchase tag, a user can quickly and effortlessly make a similar order. Conversely, the display of individual tags such as shopping list, address and payment info enable users to carry out a new purchase with much ease, just by selecting tags. Additionally, font or background colour can be used to display the status of an order or purchase by highlighting the reference tags with different colours (i.e., green for delivered, orange for in process and red for error or failed).

### c.  Customisation

Remembrance-based customisation is suitable to manage recurring shopping needs of users such as groceries. By tagging a shopping order (purchase), users can easily re-order the list of items by selecting the appropriate reference tags. Users may need to provide their payment information such as credit card details if the information is not already available or stored at the server. Otherwise, for payment via online banking such as BPAY[35], users can be automatically redirected to their online banking website. To further improve usability, users could schedule orders based on a stipulated period of time such as weekly, fortnightly or monthly.

Comprehension-based customisation can ease the process of conducting a new shopping order or purchase. By simply selecting the shopping list tags along with the address and payment tags, users can quickly carry out their shopping needs. The absence of a certain type of tag can be used as an indication for user input. For example, if shipping address is not part of the selected tags, a popup can be shown requesting user input on whether the order will be shipped to a new address or picked up by the user. A more advanced case involving an order that needs to be shipped to two different addresses can be easily achieved by selecting two address tags together with the shopping list and payment tag, for example.

Association-based customisation is useful to provide tag and product recommendation. Based on products ordered, suggestions can be offered for user's shopping list tag. Simple association of users through similar product usage can achieve this. Likewise, tags can be recommended for products, allowing users to assign their own keywords to a range of products available in the online store. This act of assigning personal tags to a product may be seen as user's expression of interest on a specific product. Thus, it may be used alongside product usage information to deliver tailored ads or promotions that target individual users.

### 9.2.2  Travel Booking

Travel websites afford a convenient way to search and book flights over the Internet. At present, many websites provide such services in Australia enabling users to search through many different airlines such as including Webjet[36] and FlightCentre[37]. However, these websites do not include budget airlines as part of their searches which leave no choice for users but to directly

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[35] BPAY, http://www.bpay.com.au/

[36] Webjet, http://www.webjet.com.au

[37] Flightcentre, http://www.flightcentre.com.au

visit the budget airline's website to search and book flights. One such service is AirAsia[38], a leading global low-cost budget carrier recognized as the best in the world for three consecutive years by Skytrax[39]. AirAsia operates at key locations in Australia and offers an attractive alternative for budget travel providing services such as accommodation, tours, car rentals and mobile telecommunications.



Figure 62 AirAsia website

### a. Resources

There are four key taggable resources identified from AirAsia's online travel website. The resources are destination, preference, payment info and booking. The table below describes each resource.

| Resource | Type | Description |
|----------|------|-------------|
| Destination | All | Travel destinations offered by the airline |
| Preference | All | Travel preferences or options |
| Payment info | All | Payment method and information to purchase a ticket |
| Booking | All | Ticket reference or description |

Table 21 Taggable resources (AirAsia)

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[38] AirAsia, http://www.airasia.com.au

[39] Skytrax, http://www.airlinequality.com/

Preference is listed as a separately taggable resource since travel preferences with AirAsia, unlike other travel websites, require user's input on a wide range of options offered by the airline for a particular route. These options include seat pre-selection, meal pre-booking, travel insurance, airport-to-city transfer service and baggage limit. Thus, the use of tags to remember user preferences can simplify the booking process. The following table depicts the relationship and action for the resources shown in Table 19.

| Resource | Relationship | Action |
|---|---|---|
| Destination | Destination-to-Destination | Search |
|  | Destination-to-Preference | Apply* |
|  | Destination-to-Payment | Pay by** |
| Preference | Preference-to-Destination | Same as * |
| Payment info (payment) | Payment-to-Destination | Same as ** |

Table 22 Resource relationship and action

Table 20 shows that destination is a key resource with three relationships: self, preference, and payment. The relationships allow flight search for multiple destinations, application or use of previous travel preferences and payment via a certain method or card. The rest of the resources have only a single relationship except for booking which has none.

## b.  Visualisation

A tag-based visualisation in the online flight booking context can help visualize destinations travelled, sorted by either destination frequency or ticket value. This also provides an overview of travel expenses over a period of time. Furthermore, a more useful visualisation for customisation is a tag-cloud based on user's references for previous travels. By clicking on a reference tag of a past travel, a user can quickly and easily request for a quote and subsequently, book the ticket with the same information. Alternatively, the display of individual tags like destination, preference and payment info allow users to book a new travel with much ease, just via tag selection. Also, font or background colour can be used to display the status of a ticket or payment by highlighting the booking tags with different colours (i.e., green for booked, orange for in process and red for cancelled).

## c.  Customisation

Remembrance-based customisation is useful to fulfil user's recurring travel needs such as a visit to user's home country. By tagging a travel booking, users can simply create a similar

travel booking at a later date by clicking on the appropriate reference tags. However, users may need to provide their payment information such as credit card details if the information is not already available or stored at the server. Otherwise, for payment via online banking such as BPAY, users can be automatically redirected to their preferred online banking website. Remembering such preferences simplify the interaction especially for returning users.

Comprehension-based customisation can help simplify the process of booking a new travel to a single or multiple destinations. The ability to tag destinations allow users to simply select tags and be offered travel information as suggestions based on different criteria like price, duration, number of transits, etc. For example, if a user tagged two destinations as "home" and "parent" denoting user's country of residence and parent's, then the selection of these tags can be seen as an expression of user's intent to travel between the two countries. Consequently, a set of suggestions based on lowest fare, shortest travel time and fewest transits, for example, can be provided. Furthermore, selection of preference and payment tags along with destinations tags is useful to complete the booking process without additional user input. The absence of these tags is an indication for user input, particularly useful in circumstances where new information will be provided (e.g., payment via a new credit card).

Association-based customisation can assist users in the form of tag recommendation. By associating travel destinations of users, a set of tags can be suggested for destination and reference resources. Apart from this, by considering tagged destinations as highly personal and relevant to users, for example travel destinations, accommodation and other services can be recommended. This could be achieved by taking into account other users who have tagged similar or even comparable destinations and potentially matching their travel patterns (i.e., travel frequency). Furthermore, this may also help the airlines to tailor ads or promotions that target individual users. The use of semantic analysis to identify meaning of tags and associate users based tag similarity is also plausible. Travel enthusiasts may find travel recommendations interesting and reasonable with a budget airline such as AirAsia especially if the recommendations involve promotions or sales.

### 9.2.3   Discussion

The two case studies presented in this section are aimed to illustrate the application of the tag-based customisation model to E-commerce websites other than online and mobile banking. The ability to tag resources can afford customised interactions that simplify and ease the use of the websites, which, in turn, enable users to achieve their online shopping and travel booking needs with less effort and time. Tag-based visualisations can help to quickly understand

the status of purchases and bookings, and to provide an overview of user's past purchases and bookings.

Tag-based customisation offers both websites an opportunity to better fulfil the needs of users through customisation. Users are likely to experience greater levels of satisfaction in these contexts, similar to online banking. As a result of this, there may be increased use of online shopping and travel booking, especially in the mobile context. For online retail, users may find it easier and more comfortable to carry out purchases from their mobile devices. Likewise, for online travel booking, users could quickly check for flights to their favourite destinations from their mobile devices, and, consequently, book flights with minimal effort via tags.

Through the case studies, the application of the tag-based customisation model is illustrated, which is potentially also relevant to a wider range of E-commerce websites. Two popular E-commerce websites that are presently non-tag based are selected to highlight the prospective benefits and advantages of customisation. These websites stand to gain the most through the application of tags compared to websites that are already tag-based. Overall, this exercise highlights that the proposed model encompasses the necessary fundamentals to aid the design and implementation of the proposed tag-based customisation.

## 9.3    SUMMARY

This chapter presented a tag-based customisation model derived from the work presented. The model is aimed for E-commerce websites and is illustrated based on examples from online and mobile banking. To illustrate the usefulness of the model, it is applied to two other E-commerce websites in the retail and travel industries. The way this is done is by first identifying potential taggable resources on the website and establishing the relationships between the resources. Subsequently, the type of visualisation suitable in the context of the website is outlined. Finally, each of the customisation types are discussed with regards to the nature and purpose of the website.

# Chapter 10. Conclusion

This thesis explored a tag-based customisation, a need generated from research with a focus on practice. This proposed approach extends the existing model of tagging seen in the literature. This approach enables existing E-commerce websites, which are either tag, or non tag-based to leverage tags to deliver customised interactions to users. For the purpose of this thesis, online and mobile banking is chosen as the study domain where customisation is not well understood. From the literature review, a pertinent interaction customisation model based on the levels-of-processing framework (cognition model) is adapted to the context of this study. The tag-based customisation approach is examined to understand the impact on usability constructs name efficiency, effectiveness and satisfaction. Based on a set of taggable resources in the online and mobile contexts identified via a preliminary study, a software-based prototype is developed. This prototype supports both online and mobile contexts. The prototype is subsequently evaluated via a comparative usability study. The study compared the tag-based interaction with the present conventional interaction for a set of banking tasks encompassing two key banking activities: fund transfer and bill payment. An iterative model is used for the evaluation and a total of three iterations are conducted with one internal and two external tests (pilot and main studies).

The results propose that tag-based customisation can improve perceived usability in both online and mobile contexts. This outcome is especially apparent in the mobile context, among inexperienced mobile banking users. However, no improvements are observed with the actual usability in both online and mobile contexts. The findings from the pilot study and the main study are consistent in that they show that a tag-based interface supporting tag-based customisation improves satisfaction over a conventional interface. Despite a high number of user errors and lack of experience with tagging/tags mainly in the financial context, users still appear to be satisfied with and are inclined to use the tag-based interface. Therefore, there is a potential for tag-based customisation to positively affect the adoption and acceptance of mobile banking. The findings also suggest that tag-based customisation is more suitable for young- and middle- age users who are between 21 to 40 years old. Aside from effects on usability, this thesis outlines a range of challenges that may impede the use of a tag-based interface. Consequently, a set of potential solutions is outlined to address these challenges based on the prototype and previous work.

The contribution of this thesis is the demonstration of the concept of tag-based customisation in the Internet banking domain, which may also be applied across other E-commerce domains; and its impact on usability. A tag-based customisation model is proposed with the aim of facilitating the use of tags for customisation. The model encompasses three key elements (resources, visualisation and interactions), which are essential to deliver tag-based customisation in E-commerce websites. This includes websites that are currently tag-based and those that are not. The model is elaborated with reference to the chosen study domain in both online and mobile contexts. To further illustrate the application of the model, two other E-commerce sites are studied (retail and travel). These websites provide an interesting comparison in terms of scope, frequency of use and resources. By analysing both the websites, a set of taggable resources is identified and the possible customisation types are discussed.

## 10.1   IMPLICATIONS

The work presented has several implications for both research (academic) and practice.

### 10.1.1  Research

A tag-based customisation approach contributes to the existing body of literature by outlining the knowledge and understanding pertinent to the use of user-defined tags to facilitate customisation of E-commerce websites. Through this approach, the usability of E-commerce websites specifically perceived usability (satisfaction), as seen with online and mobile banking, may be positively affected.  For illustration purposes, a conceptual model is presented that extends the present understanding and use of tagging systems in the personal information management context to facilitate customisation.

The results presented contribute to the existing body of knowledge by highlighting that customisation can improve perceived usability of both online and mobile banking; and is found to be most appealing to inexperienced users thus having the potential to positively affect adoption and acceptance of mobile banking. Furthermore, the results reaffirm a finding from the literature that customisation is a key determinant of user satisfaction in the banking context. Also, the results lend support to the argument that perceived usability is potentially more influential than actual usability, and is not directly related to each other. This is given that the results indicate higher levels of perceived usability (satisfaction) despite lower levels of actual usability (efficiency & effectiveness).

### 10.1.2  Practice

The main contribution of this thesis to practice is a tag-based customisation model. This model contributes to practice by providing a guideline for the implementation of customisation in E-commerce websites. The model in its present form targets Website Designers and E-commerce providers to improve perceived usability. The model affords simple and easy to use tag-based customisation, especially suited to the mobile context. The approach has the potential to improve perceived usability and in turn positively influence adoption and acceptance of E-commerce in the mobile context (M-commerce), as seen with mobile banking. This is significant as M-commerce is gaining acceptance as a convenient channel with increased mobility to carry out Internet transactions or activities.

Apart from the customisation model, another important contribution to practice is the design and implementation of a tag-based prototype that demonstrates the different customisation types in the online and mobile contexts, and the challenges in each of the contexts. Banking providers and other institutions alike may find the recommendations presented valuable towards a commercial design and implementation.

### 10.2  LIMITATIONS

There are a few limitations to the findings reported. Firstly, to measure the usability of the proposed tag-based customisation approach, only a single design of the interface was considered. The design however was developed based on well-accepted UI design guidelines and improved iteratively (prototyping) based on user feedback.

Secondly, the study only considered first-time users. The experience of participants with tags and the prototype was not accounted for. The study participants evaluated the prototype based on a single session of testing, although scenarios simulating repeated use-case (e.g., monthly bill payment) were included with the intention of providing the participants with some form of perception of extended use.

Thirdly, the participants of the study only used a single language (English). Thus, some of the findings may be specific to the English language. Nevertheless, despite the use of only one language, generic issues applicable to any other language are found such as the use of numeric values and special characters as tag names.

Finally, for the conventional interface, the study only considered customisation found in the surveyed banking websites. The study did not take attempt to include other forms of customisation found in previous studies.

## 10.3   FUTURE WORK

Firstly, the study reported can be conducted with a larger number of participants. Such a study can provide a better understanding of the measured impact of tag-based customisation on usability and also help identify the less obvious usability issues. The use of a non-random sample that has an equal representation of participants from each age group may be useful to determine the effects on age groups with a higher degree of certainty. Additionally, a study with larger number of participants can help to ascertain the findings of the pilot and main studies.

Secondly, apart from the usability aspects defined by ISO 9241-11, examination of other aspects such as affective considerations (i.e., aesthetics) can help determine the extent to which other dimensions influence usability. According to Lindgaard and Dudek (2003), aesthetics can influence user's judgement on his or her satisfaction. Measuring the aesthetic appeal of a tag-based interface can help to better understand the impact on usability, particularly perceived usability. At present it is not clear to what extent aesthetics has influenced the study results presented. The visual representation of tags used to deliver the different customisation types may have positively influenced user's perception on usability. This may explain the improved usability scores and ratings observed with the tag-based interface in both online and mobile contexts.

Additionally, the influence of experience on the usability of a tag-based interface can be examined via a longitudinal study. It would be interesting to find out whether experience with tags or a tag-based interface enhances or diminishes usability. From the debriefing with participants, it appears that the lack of experience with tags or a tag-based interface is the key cause of discomfort or dissatisfaction among participants more than anything. Two participants who preferred the conventional interface mentioned the comments below when asked about their views on the tag-based interface.

"*I am not comfortable with the inconsistent size of words on the screen (referring to a tag cloud).*" - A participant who is above 40 years of age

"*I am very happy with the conventional interface and do not feel comfortable moving to a new interface.*" - A participant who is between 31 to 40 years of age

It is possible that with experience, the efficiency and effectiveness (AU) of users is improved. According to the literature, experience is closely linked to performance of users with systems. However, the same cannot be said about satisfaction (PU) as experience can easily change the perception of users regardless of how they felt during their initial use. Based on the Expectation Disconfirmation Theory (EDT), this is likely if the perceived performance is affected which in

turn impacts satisfaction. Thus, it seems important to address the challenges related to the tag-based interface that are likely to impede performance especially in the long run. A longitudinal study can help to examine the impact of the recommended solutions in addressing the challenges identified, particularly in the presence of a large number of tags.

Given that the findings suggest that the tag-based interface is more suited for young (21-30) and middle (31-40) age users, an investigation on ways which can make it more engaging and appealing to older users will be useful. This may have wider implications for usability, particularly designing customisation for older users. It is possible that the implementation carried out is more suitable for younger users and less suitable for older users. Conversely, it may be a matter of familiarity / experience with the interface in which case extra care needs to be taken with the interface to ensure the necessary assistance in the form of dialogs, wizards, tutorials, etc are provided to ease the transition between the conventional and tag-based interfaces.

Further investigation exploring the social aspect of tags can be carried out in the future, especially in the banking context. This thesis only focused on the personal side of tags for the purpose of facilitating customisation of online and mobile banking. Inclusion of social elements of tags can afford other types of recommendations such as products and services aggregation, which in turn can add more value to the customisation provided. By analysing the underlying meaning of tags, a set of relevant products or services may be recommended to banking users based on the sameness of semantics, for example (see Figure 24). However, much like any other form of semantic analysis, the quality and accuracy of the recommendations are largely dependent on the meaningfulness of tags (Cattuto et al., 2008; Qi Xin, et al., 2010). As such, it becomes important to ensure users assign meaningful tags to resources that can be made sense of across the network. The ability to interact and perform banking activities using tags via tag-based customisation may motivate users to do exactly this, gradually enabling more social aspects of tagging.

Lastly, future work can also involve undertaking of a similar study in other banking contexts specifically that of developed countries with large numbers of smart phone users such as Singapore and the US[40]. The high number of users and volumes of online activity makes customisation highly relevant and beneficial to these contexts. In addition, an investigation

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[40] Google, http://google-au.blogspot.com.au/2011/09/smartphones-at-dinner-table-smartphone.html

related to the application and impact of the tag-based customisation model in other domains (non-Ecommerce) especially those with a presence of tags such as online library and file sharing, is potentially useful. Such a study can help to assess and extend the model to a wider range of websites.

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# Appendices

# APPENDIX A – SUS

# Website Usability Scale

|  | Strongly disagree | W1 = Website 1 W2 = Website 2 | | Strongly agree |
|---|---|---|---|---|

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|

1. I think that I would like to
   use this website frequently

**W1**
**W2**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|

2. I found the website unnecessarily
   complex

**W1**
**W2**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|

3. I thought the website was easy
   to use

**W1**
**W2**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|

4. I think that I would need the
   support of a technical person to
   be able to use this website

**W1**
**W2**

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|

5. I found the various functions in
   this website were well integrated

**W1**
**W2**

|     | 1 | 2 | 3 | 4 | 5 |
|-----|---|---|---|---|---|

6. I thought there was too much

   inconsistency in this website

**W1**

**W2**

|     | 1 | 2 | 3 | 4 | 5 |
|-----|---|---|---|---|---|

7. I would imagine that most people

   would learn to use this website

   very quickly

**W1**

**W2**

|     | 1 | 2 | 3 | 4 | 5 |
|-----|---|---|---|---|---|

8. I found the website very

   cumbersome to use

**W1**

**W2**

|     | 1 | 2 | 3 | 4 | 5 |
|-----|---|---|---|---|---|

9. I felt very confident using the

   website

**W1**

**W2**

|     | 1 | 2 | 3 | 4 | 5 |
|-----|---|---|---|---|---|

10. I needed to learn a lot of

    things before I could get going

    with this website

**W1**

**W2**

11. Overall, I would rate the user-friendliness of this website as:

| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
|---|---|---|---|---|---|---|---|
| **W1** | | | | | | | |
| **W2** | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |
| | Worst Imaginable | Awful | Poor | OK | Good | Excellent | Best Imaginable |

# APPENDIX B – DEBRIEFING QUESTIONS

# Debriefing Questions

1. Did you experience any difficulties with the SUS questionnaire?

2. What do you think of the interfaces based on your overall experience?

3. Which interface do you prefer?

4. Why do you prefer the interface?

5. What kind of design changes would you like to see with the interfaces?

6. Any difficulties you experienced with the interfaces?

7. Do you have any other comments?

# APPENDIX C – PRE-TEST QUESTIONNAIRE

# Pre-Test Questionnaire

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| **Section 1: General information** |
|---|

Age:

      [ ] 18-20                  [ ] 21-30                  [ ] 31-40

      [ ] 41-50                  [ ] 51-60                  [ ] Over 60

Sex:

      [ ] Male                  [ ] Female

Your profession:

      [ ] University student

      [ ] Industry professional

      [ ] Researcher

      [ ] Self-employed

      [ ] Other (please specify) _____

---

**Section 2: Computer experience**

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**Considering your computer usage over the past 12 months, please answer the following:**

What sort of computer do you usually use (tick all that apply)?

> [ ] IBM/compatible PC (Windows)

> [ ] Macintosh

> [ ] Unix/Linux

> [ ] Other

Where do you usually use a computer (tick all that apply)?

> [ ] at work/uni/school

> [ ] at home

> [ ] other (please specify) _____

How many hours per week would you usually spend using a computer?

> [ ] less than 5

> [ ] 6-15

> [ ] 15-30

> [ ] more than 30

Please indicate the frequency of your use of the following desktop computer programs

> Word processors      [ ] daily [ ] weekly      [ ] monthly      [ ] rarely/never

> Spreadsheets         [ ] daily [ ] weekly      [ ] monthly      [ ] rarely/never

> Databases            [ ] daily [ ] weekly      [ ] monthly      [ ] rarely/never

> Graphic design tools [ ] daily [ ] weekly      [ ] monthly      [ ] rarely/never

> Web design tools     [ ] daily [ ] weekly      [ ] monthly      [ ] rarely/never

> Games                [ ] daily [ ] weekly      [ ] monthly      [ ] rarely/never

---

Please indicate whether you agree or disagree with the following statement:

|  | **Strongly disagree** |  |  | **Strongly agree** |
|---|---|---|---|---|

I enjoy using computers

| 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
|  |  |  |  |  |

---

**Section 3: Internet and web experience**

**Considering your Internet usage over the past 12 months, please answer the following:**

How many hours per week would you usually spend using the Internet?

[ ] none

[ ] less than 5

[ ] 6-15

[ ] 15-30

[ ] more than 30

Please indicate the frequency of your use of the following Internet services

Email            [ ] daily [ ] weekly      [ ] monthly      [ ] rarely/never

Web              [ ] daily [ ] weekly      [ ] monthly      [ ] rarely/never

Instant messaging      [ ] daily [ ] weekly      [ ] monthly      [ ] rarely/never

(e.g. MSN messenger, ICQ, AOL instant messaging)

Please indicate the frequency of your use of the web for the following kinds of activities:

Work/study          [ ] daily [ ] weekly      [ ] monthly      [ ] rarely/never

Entertainment        [ ] daily [ ] weekly      [ ] monthly      [ ] rarely/never

E-commerce          [ ] daily [ ] weekly      [ ] monthly      [ ] rarely/never

Which web browser do you **usually** use? (tick all that apply)

[ ] Chrome

[ ] Internet Explorer

[ ] Safari

[ ] Firefox (Mozilla)

[ ] Other (please specify) _____

Please indicate whether you agree or disagree with the following statement:

I enjoy using the Internet

| **Strongly disagree** | | | | **Strongly agree** |
|---|---|---|---|---|
| | | | | |
| 1 | 2 | 3 | 4 | 5 |
| | | | | |

**Section 4: Familiarity with and use of Online and Mobile Banking**

**Considering your use of online banking, please answer the following:**

How many active online banking account(s) do you have?

[ ] None

[ ] One

[ ] Two

[ ] More than two

How often do you access your online banking?

[ ] At least once per week

[ ] Two or three times each month

[ ] Monthly or less

[ ] Less than five times ever

[ ] Never

How often do you access your mobile banking?

[ ] At least once per week

[ ] Two or three times each month

[ ] Monthly or less

[ ] Less than five times ever

[ ] Never (Please answer next question)

Please provide you reason(s) for not using mobile banking, if any?

_____

What do you use your online banking mainly for?

[ ] Fund transfer

[ ] Bill payment

[ ] Credit card payment

[ ] Check balance

[ ] View transaction history

[ ] Others (please specify) _____

---

**Section 5: Familiarity with Tags/Tagging**

---

**Considering your use of tags or tagging experience, please answer the following:**

Have you tagged any Web resources (e.g., photo, video, people, etc) before?

     [ ] No

     [ ] Yes

If you answered Yes to the question above, then please name a few Websites where you tag resources.

     [ ] Facebook

     [ ] Youtube

     [ ] Flickr

     [ ] Others

_____

_____

Have you tagged financial data via personal financial management tools (e.g., Mint, ANZ-MoneyManager, etc)?

     [ ] No

     [ ] Yes

If you answered Yes to the question above, how often do you tag your financial data?

     [ ] Daily

     [ ] Weekly

     [ ] Fortnightly

     [ ] Monthly

     [ ] Seldom

# Thank you for participating in this research study.

---

# APPENDIX D – ONLINE BANKING SCREENSHOTS

# Online Banking Screenshots

## 1. Personal Account



R1: Personal Account

## 2. Payee Account



R2: Payee Account

## 3. Description



R4: Payee Description

R3: Personal Description

## 4. Biller



R5: Biller

## 5. Application



R6: Application

## 6. Messages



R7: Message

# APPENDIX E – MOBILE BANKING SCREENSHOTS

# Mobile Banking Screenshots

## 1. Personal Account



R1: Personal Account

## 2. Payee Account



R2: Payee Account

## 3. Description



R3: Personal Description

## 4. Biller



R5: Biller

## 5. Application



R6: Application

# APPENDIX F – CUSTOMISATION EXAMPLES

# Customisation Examples

**1. Remembrance-based**

Scenario_1.1:  Fund Transfer from X to Y for 2 times in months A & B

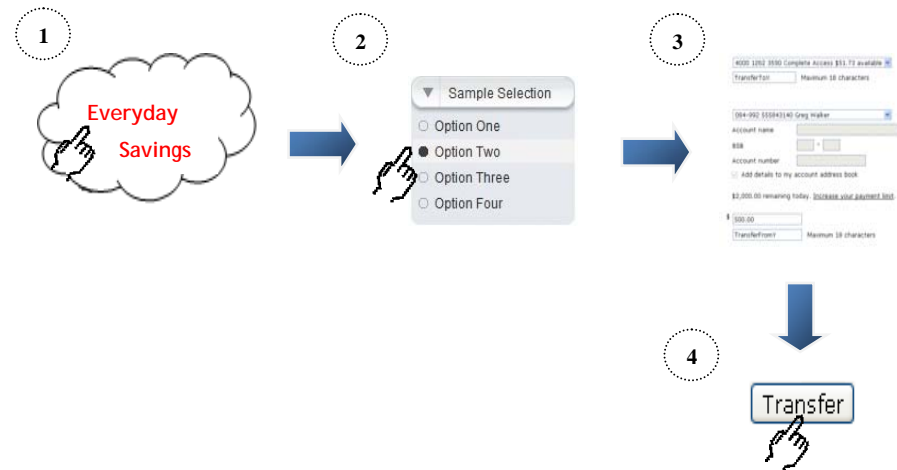| Scenario without Customization | Scenario with Customization |
|---|---|
| **Month A** ||
| STEP 1: Select **"Transfers"** from menu.<br><br>STEP 2: Select/Enter transaction details (personal account, payee account, amount, date, etc).<br><br>STEP 3: Transaction description (e.g., "*TransferToY*") and payee  description ("*TransferFromX*").<br><br>STEP 4: Submit transfer. | STEP 1: Select **"Transfers"** from menu.<br><br>STEP 2: Select/Enter transaction details (personal account, payee account, amount, date, etc).<br><br>STEP 3: Payee account tag (e.g., "*PayeeY*"), transaction description tag (e.g., "*TransferToY*") and payee description  tag ("*TransferFromX*").<br><br>STEP 4: Submit transfer. |
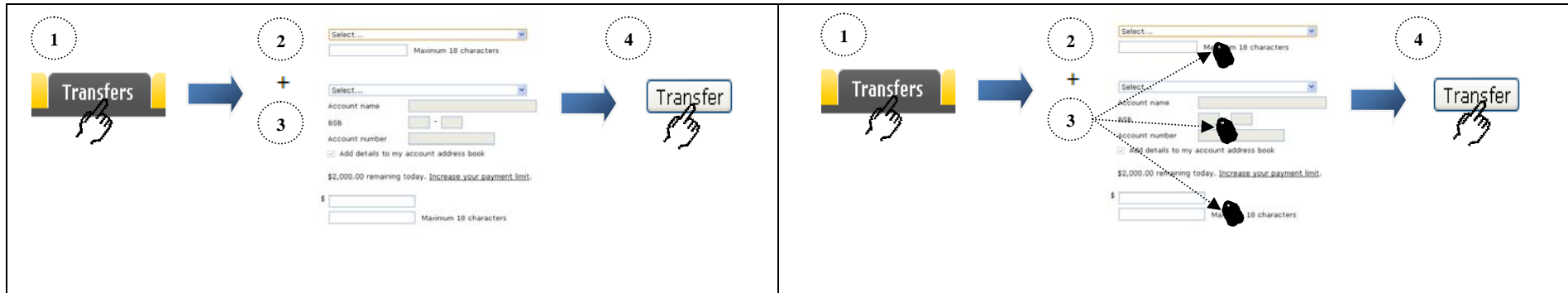
**Month B**

**Same as above.**
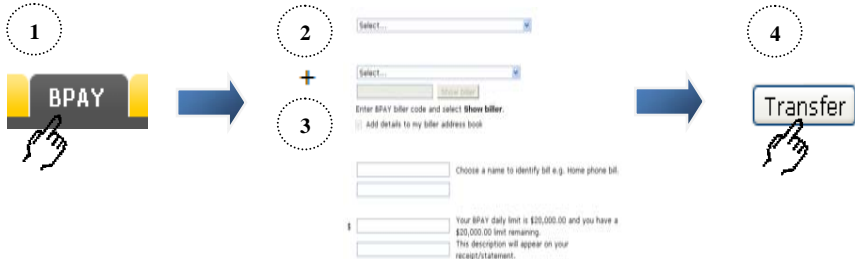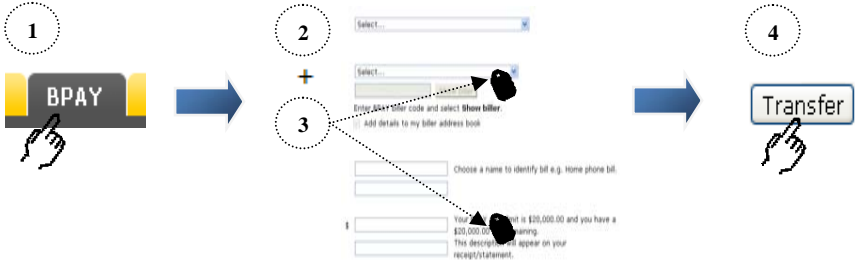
STEP 1: Select **"TransferToY"** from activity tag cloud.

STEP 2 (optional): Change transaction details (e.g., amount, date, etc) or tags.

STEP 3: Submit transfer.

Scenario_1.2:  BPay to Biller M for 2 times in months A & B

| Scenario without Customization | Scenario with Customization |
|---|---|
| **Month A** ||
| STEP 1: Select **"BPAY"** from menu.<br><br>STEP 2: Select/Enter transaction details (personal account, biller code, amount, date, etc).<br><br>STEP 3: Transaction description (e.g., "*BillM*").<br><br>STEP 4: Submit transfer. | STEP 1: Select **"BPAY"** from menu.<br><br>STEP 2: Select/Enter transaction details (personal account, biller code, amount, date, etc).<br><br>STEP 3: Biller tag (e.g., "Biller*M")* and transaction description tag (e.g., "*BillM*").<br><br>STEP 4: Submit transfer. |
| **Month B** ||
| Same as above. | STEP 1: Select **"*BillM*"** tag from activity tag cloud.<br><br>STEP 2 (optional): Change transaction details (e.g., amount, date, etc). |

| STEP 3: Submit payment. |
| --- |
|  |
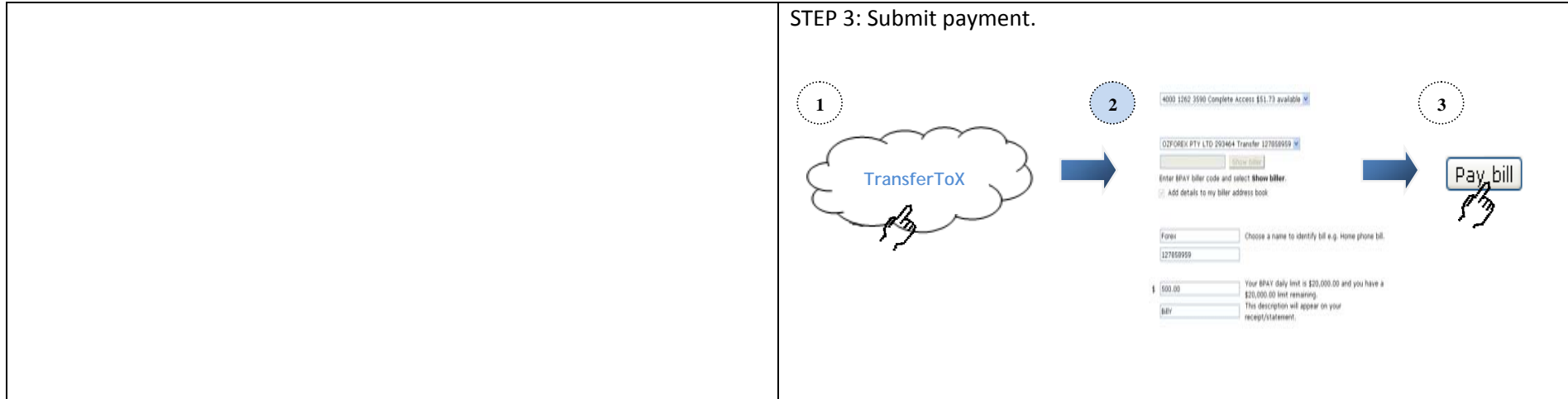
## 2. Comprehension-based

*Note:  Everyday account is tagged as "*Everyday*" and Savings account is tagged as "*Savings*".  Three different tag clouds are assumed: account, payee and activity.

Scenario_2.1:  3$^{rd}$ party fund transfer to a friend (Z) from everyday account.

*Note: Z is tagged as "*FriendZ*".

| Scenario without Customization | Scenario with Customization |
| --- | --- |
| STEP 1: Select **"Transfer"** from menu.<br><br>STEP 2: Select/Enter transaction details (personal account, payee account, amount, date, etc). | STEP 1: Select **"*Everyday*"**tag from account tag cloud and **"*FriendZ*"** tag from payee tag cloud.<br><br>STEP 2: Select action based on tag inference. |

| STEP 3: Transaction description (e.g., "*TransferToY*") and payee  description ("*TransferFromX*").<br><br>STEP 4: Submit transfer.<br><br><br>Diagram same as Scenario_1.1. | STEP 3: Enter amount, tags and specific date (optional).<br><br>STEP 4: Submit transfer.<br><br><br><br>Sample inference (Step 2):<br><br>**3<sup>rd</sup> party transfer from Everyday Account to FriendZ?**<br><br>**View transaction history of Everyday Account to FriendZ?** |
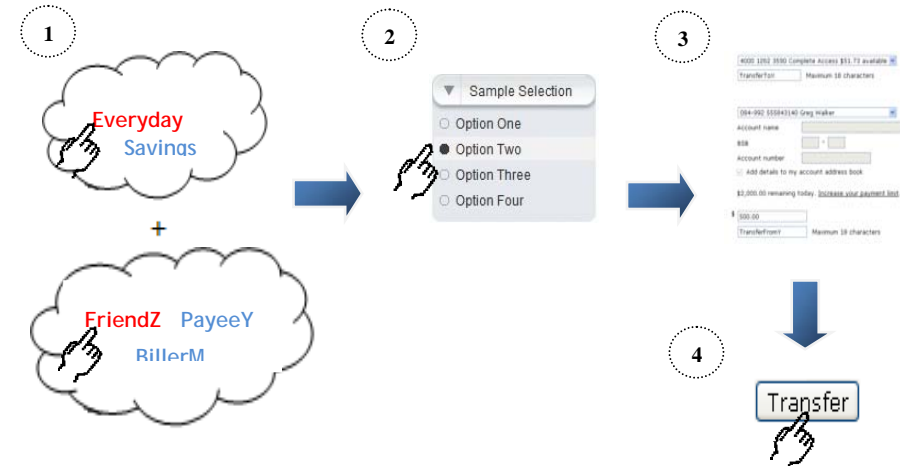
Scenario_2.2:  Internal fund transfer between everyday account and savings account.

| Scenario without Customization | Scenario with Customization |
|---|---|
| STEP 1: Select **"Transfer"** from menu. | STEP 1: Select **"*Everyday*"** and **"*Savings*"** tags from account tag cloud. |

| | |
|---|---|
| STEP 2: Select/Enter transaction details (personal account, payee account, amount, date, etc).<br><br>STEP 3: Transaction description (e.g., "*TransferToY*") and payee  description ("*TransferFromX*").<br><br>STEP 4: Submit transfer.<br><br><br>Diagram same as Scenario_1.1. | STEP 2: Select action based on tag inference.<br><br>STEP 3: Enter amount, tag and specific date (optional).<br><br>STEP 4: Submit transfer.<br><br><br><br>Sample inference (Step 2):<br><br>**Transfer from Everyday Account to Savings Account?**<br><br>**Transfer from Savings Account to Everyday Account?**<br><br>**View transaction history between Everyday Account and Savings Account?** |
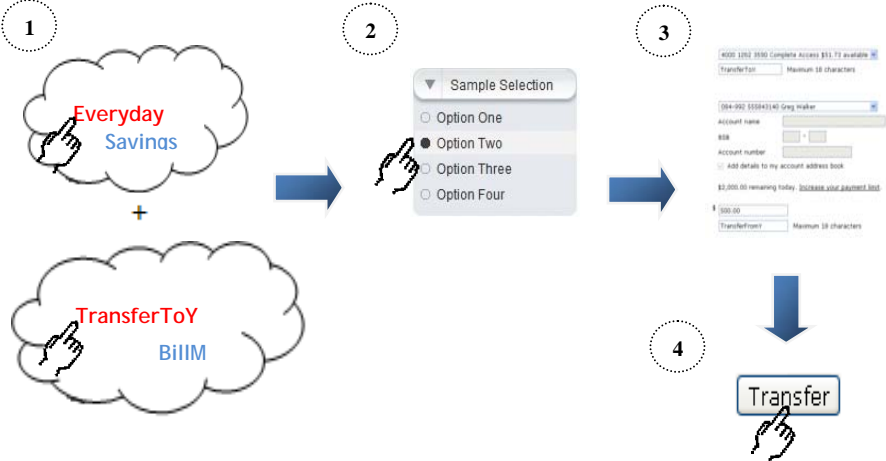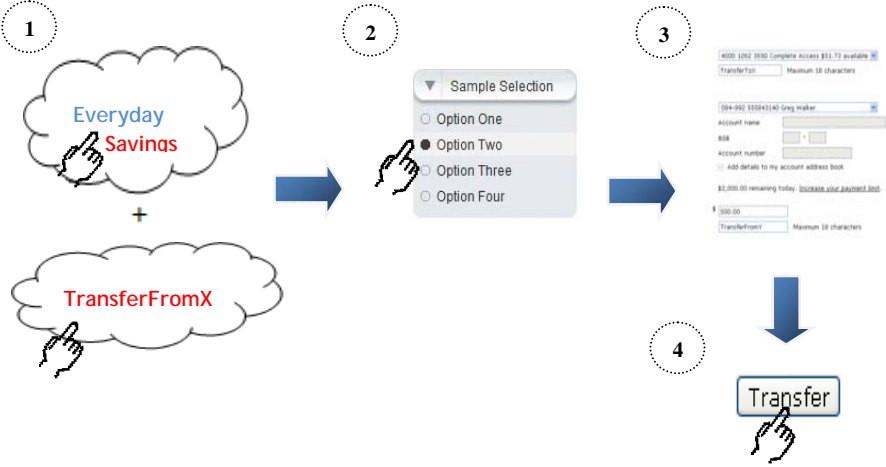
Scenario_2.3:  Fund transfer from X to Y from everyday account using transaction description tag from Scenario_1.1.

| Scenario without Customization | Scenario with Customization |
|---|---|
| STEP 1: Select **"Transfer"** from menu.<br><br>STEP 2: Select/Enter transaction details (personal account, payee account, amount, date, etc).<br><br>STEP 3: Transaction description (e.g., "*TransferToY*") and payee description ("*TransferFromX*").<br><br>STEP 4: Submit transfer.<br><br><br><br>Diagram same as Scenario_1.1. | STEP 1: Select **"*Everyday*"** tag from account tag cloud and **"*TransferToY*"** tag from activity tag cloud.<br><br>STEP 2: Select action based on tag inference.<br><br>STEP 3: Change amount and specific date (optional).<br><br>STEP 4: Submit transfer.<br><br><br><br>Sample inference (Step 2):<br><br>**Transfer from Everyday Account to Y?**<br><br>**View transaction history of Everyday Account to Y?** |

Scenario_2.4:  Fund transfer from Y to X from savings account using payee description tag from Scenario_1.1.

*Note: Savings account is tagged as "*Savings*".

| Scenario without Customization | Scenario with Customization |
|---|---|
| STEP 1: Select **"Transfer"** from menu.<br><br>STEP 2: Select/Enter transaction details (personal account, payee account, amount, date, etc).<br><br>STEP 3: Transaction description (e.g., "*TransferToX*") and payee  description ("*TransferFromY*").<br><br>STEP 4: Submit transfer.<br><br><br><br>Diagram same as Scenario_1.1. | STEP 1: Select **"*Savings*"** tag from account  tag cloud and **"*TransferFromX*"** tag from activity tag cloud.<br><br>STEP 2: Select action based on tag inference.<br><br>STEP 3: Enter amount, tags and specific date (optional).<br><br>STEP 4: Submit transfer.<br><br> |

| | Sample inference (Step 2): |
|---|---|
| | **Transfer from Savings Account to X?**<br><br>**View transaction history of Savings Account to X?** |

### 3. Association-based

Based on the resources tagged by a user (e.g., account or biller), tag suggestions can be provided. The suggested tags both from the users personal tags and tags assigned by other users who have similar needs or preferences.

Scenario_3.1:  User X does a new BPAY transaction – mobile bill payment to the biller "*Vodafone*".  As a result, a set of tags are recommended:

| |
|---|
| mobile<br>phone<br>postpaid |

Scenario_3.2:  User X does a recurring fund transfer – rent payment to the payee "*Century21*".  As a result, a set of tags are recommended, however the user's tag ("unit_rent") is listed on the top:

| |
|---|
| **unit_rent**<br>rent<br>house<br>lease |

Going by the assumption that users may be interested in discovering similar product or service providers to theirs and the popularity of such providers in terms of total number of users, the following aggregations may be valuable. The aggregations may be generated for a certain time frame (e.g., 2 weeks, 1 month, etc) and the significance factor of the tag cloud could be based on several criteria (e.g., total payee, average amount spent, most recent, etc).

Scenario_4.1: User X does three BPAY transactions – mobile, insurance and money transfer and tags the biller as "*Vodafone*", "*Allianz*" and "*Ozforex*", respectively.

| | | |
|---|---|---|
| Vodafone (100)<br><br>Telstra (200)   Optus (300)<br><br>3Mobile (500) | Allianz (400)<br><br>ING (200)   IAG (400)<br><br>Zurich (300) | OzForex (150)   UAE Exchange (300)<br><br>Western Union (800)<br><br>Travelex (100)   Moneygram(100) |

Scenario_4.2: User X does EFTPOS and direct debit transactions for three expenses in a month and tags them as "*Grocery*", "*Shopping*" and "*Gym*". Based on the transaction description, the payee or merchant could be identified and extracted to provide the following aggregation.

Sample description:

| Expense / Tag | Transaction Description | Payee or Merchant |
|---|---|---|
| Grocery | *COLES WEST END QLD AU* | Coles |
| Shopping | *TEMT UPPER MT GRAVA QLD* | Temt |
| Gym | *Direct Debit XXXXX Goodlife Holland GLHPXXXXXXX* | Goodlife |

| | | |
|---|---|---|
| Woolworths (700)<br><br>Coles (1000)<br><br>Foodworks (300)   ALDI (50) | Guess (200)   Temt (160)<br><br>Karen Millen (400)<br><br>Glassons (100)  Cue (90) Lolitta (80) | Goodlife (400)<br><br>Fitness First (800)<br><br>Jetts (100)   SNAP Fitness (100) |

# APPENDIX G – PROTOTYPE SCREENSHOTS

# Tag-based (Online)

1. Default page (Tab 1 – Accounts)

## XBank Online Banking Website

Logout

| Accounts | New Transaction | Past Transaction |

### Account Details

| Account | Account Number | Account Balance | Available Funds | Tag |
|---|---|---|---|---|
| XBank Savings | 428337859-234-9321 | $ 20000.00 | $ 18000.00 | savings |
| XBank Everyday | 123453244-344-2496 | $ 2000.00 | $ 1890.00 | everyday |
| XBank Cheque | 843945953-248-4994 | $ 5000.00 | $ 3992.00 | cheque |
| XBank Visa | 4323-2342-9473-2442 | $ 12000.00 | $ 9392.00 | visa |
| XBank MasterCard | 5342-2342-4543-2456 | $ 12000.00 | $ 11947.00 | mastercard |

Submit

2. Tab 2 – New transaction



3. Tab 3 – Past transaction (recurring)

# Tag-based (Mobile)

1. Main menu
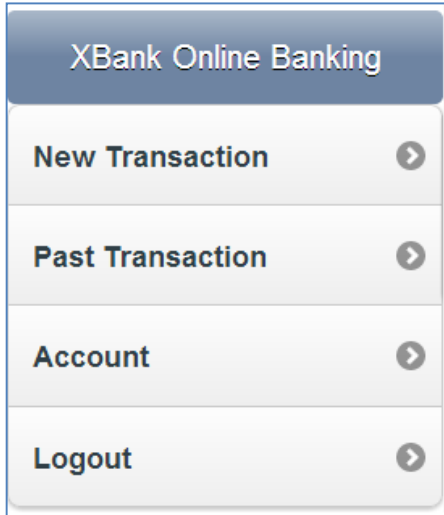


2. New transaction
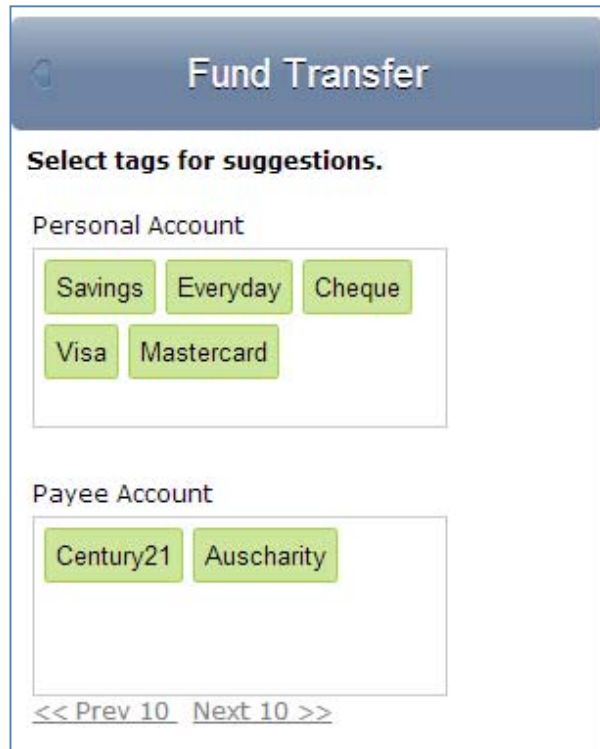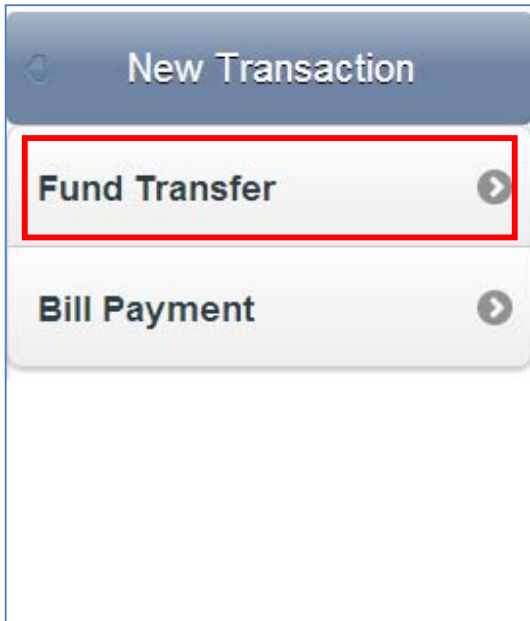
3.  Past transaction (recurring)
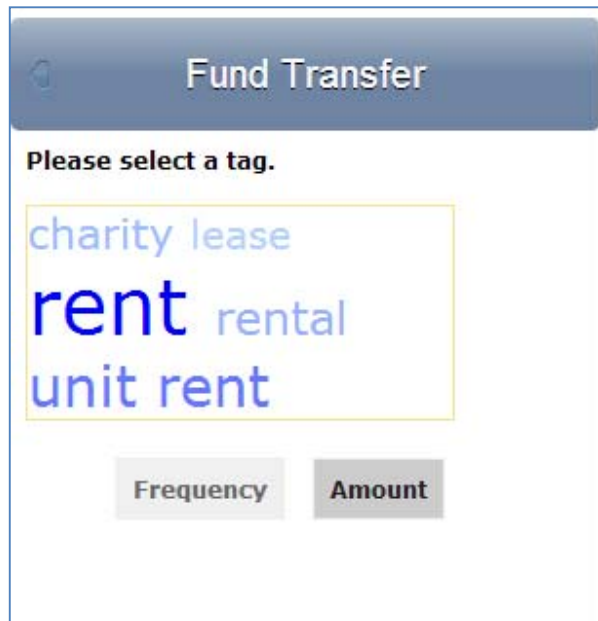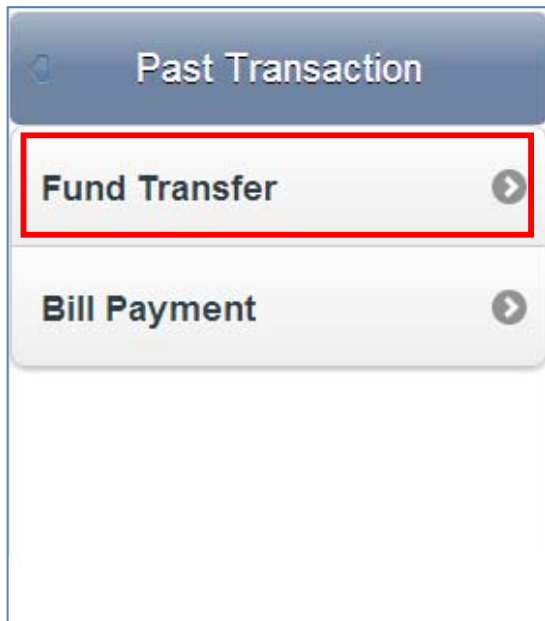
# Conventional (Online)

1. Default page (Tab 1 – Accounts)

**XBank Online Banking Website**

Logout

| Accounts | New Transaction | Past Transaction |

## Account Details

| Accounts | Account Number | Current Balance | Available Funds |
|---|---|---|---|
| XBank Savings | 428337859-234-9321 | $ 20000.00 | $ 18000.00 |
| XBank Everyday | 123453244-344-2496 | $ 2000.00 | $ 1890.00 |
| XBank Cheque | 843945953-248-4994 | $ 5000.00 | $ 3992.00 |
| XBank Visa | 4323-2342-9473-2442 | $ 12000.00 | $ 9392.00 |
| XBank MasterCard | 5342-2342-4543-2456 | $ 12000.00 | $ 11947.00 |

2. Tab 2 – New transaction



3. Tab 3 – Past transaction (recurring)
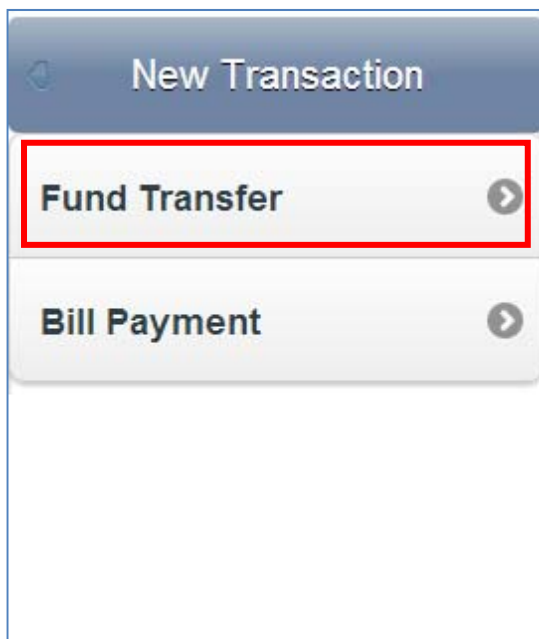
# Conventional (Mobile)

1. Main menu

   Same as Tag-based - Mobile (1).

2. New transaction

3. Past transaction (recurring)