

Investigating the Use and Adoption of Self-service Technology in China

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Abstract. Self-service technology use and adoption can be seen as an evolutionary process. From a conceptual perspective, evolution delivers the growing advantages of self-service. From a practical perspective, evolution is based on user perceptions and attitude toward adopting the technology. Based on the latter perspective of technology adoption, this paper presents an analysis of three empirical studies exploring self-service solutions for Chinese customers. These studies involve several user-centred research methodologies. The studies were carried out as a result of research collaboration between Sino-European Usability Centre (SEUC), Dalian Maritime University, China and Advanced Technology and Research (AT&R), NCR, U.K. The first study investigates the introduction of a basic automated teller machine (ATM) accommodating Chinese user requirement. Findings indicate that the relationship between individuals' pre-adoption and post-adoption perceptions of ATMs was a critical determinant of its continued use. The second study focussed on the functionality of ATMs in terms of using cash deposit solution. The study reports that the successful use of cash deposit was evaluated on the basis of users' understanding of deposit solution. The third study addressed biometric technology use for enhanced security on ATMs. Consistent with previous findings, user perceptions emerged as an important determinant of biometric technology adoption in the Chinese financial market. Based on user perceptions, these studies provide an understanding into the self-service future in China. Several user-centred design guidelines to adapt self-service technology to Chinese user requirements have emerged. Also, these studies offer valuable outcomes in terms of useful insights into the current Chinese banking culture. These insights provide Chinese financial institutions a basis to strategically introduce self-service technology on a broad scale.

1 Introduction

In the past decade, the evolution of self-service technology from a practical perspective has been greatly influenced by the focus of research on customer experience with the technology. Previous research also highlights the significance of user experience upon the potential diffusion of self-service technology in the Indian market (Angeli De et al. 2004). Therefore, it is important to analyse the evolution of

self-service technology from a user viewpoint in terms of various functionalities, convenience, security and efficiency the technology offers. In this study, the evolution of self-service will be analysed in the context of Chinese financial market. The Chinese market provides a platform to explore competitive opportunities for introducing self-service technology. Also, the fast growing Chinese economy has focused on the process of globalisation which has led to an increase in the practice of usability and user experience methods (Liu et al. 2005 and Wang 2003). Three user studies will be presented with a focus on various financial self-service technologies for Chinese customer.

The paper begins with a brief introduction to self-services solutions and their gradual growth in the financial market. The section also discusses the long-term close alliance between industry and academia at Advanced Technology and Research at NCR, U.K. and Sino-European Usability Centre at Dalian Maritime University, China, respectively. The alliance has provided a basis to design and carry out the three studies.

Section 3 reports on the first study which began with an in-depth analysis of Chinese individuals' requirements of using an ATM in terms of their perceptions. The study comprised two phases. The first phase carried out a preliminary investigation into user perceptions on the basis of focus groups and interviews with individuals with different levels of experience with ATMs. The second phase involved a comprehensive usability evaluation of an ATM. The usability evaluation began with experts to identify important areas of usability investigation. The expert evaluation was followed by regular users and non-users of ATMs, which provided useful insights into their preferences and concerns regarding the ATM use. The results of the research provided guidelines for the design of and interaction with ATMs. Positive user attitude toward using ATM technology evolved the process of introducing self-services in China. Since a strong preference for a richer functionality within ATM was expressed by users, the next user study analysed user requirements of cash deposit technology within ATMs in China, which is reported in Section 4.

The study on deposit technology was based on a questionnaire survey and usability evaluation of deposit technology to address user perceptions toward and difficulties with using the technology. The major findings from the study emerged in terms of users' perceived security, efficiency and ease of use of deposit technology use. With increased functionality, the security of self-service technologies becomes more critical. Therefore, the security issue was addressed in the third study which is discussed in Section 5.

In order to analyse user perceptions of ATM security, a two-phase project on biometric technology use for identity authentication within ATMs was conducted. In the first phase, usability methodologies such as interviews and survey were used in China to determine initial user perceptions of fingerprint technology use. In the second phase, an in-depth experimental study was conducted to investigate issues related to the actual use of fingerprint technology. The results of the second phase analysed user preferences for various fingerprint sensors, which further help understand how users measured efficiency, interactivity and feedback from sensors. The study concludes with a discussion of the findings of the three studies.

2 Background

In the financial sector, self-service technology was introduced in the form of an automated teller machine (ATM). The strength of ATMs was in dispensing cash and offering basic banking functions. With the advancement of online technology and self-service solutions in sectors such as retail, a need to enhance ATM capability has been felt. Therefore, enhancing the functionality of ATMs has promised financial instituted business value in terms of its operational efficiency and low cost maintenance and reliability. It is also important to note that the success of self-service technology has been assessed in terms of convenience, consistency, effectiveness and control from a user's viewpoint. Therefore, kiosks are deployed for banking, airport check-in retail store check-out and at cinemas and railway stations. Self-service technology is provided via the web, phone and kiosks. Individuals have been able to perform transactions by avoiding queues, during non-working hours and even at home online at their own convenience. Hence the user-centred self-service technology has contributed immensely to its widespread use. The introduction and deployment of self-service solutions has attracted many emerging markets in the past decade.

The success of self-service technology is of key interest for financial institutions in China which is potentially the largest future market in the world for the self-service technology. The collaboration between AT&R, NCR and SEUC, Dalian Maritime University has set forth several successful projects aiming to investigate self-service technology such as automated teller machines (ATMs), cash deposit solutions and biometric technology use for identity authentication. The aim of these projects has been to evolve the self-service technology in China by exploring the requirements and the usability of the technology in terms of customers' perceptions and experience. The collaborative work between SEUC and AT&R has involved several researcher visits for each study between the two centres. These visits have placed an emphasis on defining the scope and design of longitudinal studies and the provision of materials and supervision. The projects also involved secondments of SEUC students at AT&R to obtain first hand knowledge and experience with technology and interaction with researchers in AT&R. Continuous progress of all projects has been maintained through regular conference calls between SEUC and AT&R on a weekly basis. The success of these projects has provided academia a valuable opportunity to real-world exposure of user problems associated with self-service technology. These studies have put together a compendium of ideas to further explore avenues of collaboration between SEUC and AT&R.

One of the major factors contributing toward the success of the self-service technology is its design based on Chinese users' perceptions. The importance of user-centred technology design in general and self-service in particular has been realised in China for over a decade. However, it is still relatively a new discipline and has been practised in industries such as Microsoft, IBM, Nokia, etc., and some large scale local companies, such as Lenovo and Huawei (Wang 2003). However, user-centred design provides a strong foundation to identify and analyse critical user perceptions that determine the acceptance of technology. In the next section, the first study investigating the use of a customised ATM is analysed on the basis of Chinese user perceptions.

3 Self-service Technology – Automated Teller Machines

China has been seen as one of the biggest markets for the adoption of automated self-service solutions in the financial market. In order to obtain an understanding of how Chinese individuals perceived self-service technology, a study was initiated with a focus on the use of an ATM. The ATM was customised to Chinese users' requirements. The main aim of the study was to analyse user perceptions and attitude towards and any difficulties when using the customised ATM. The study included two main phases starting with a preliminary investigation based on focus group sessions and interviews, which then led to the usability evaluation of the ATM.

3.1 Phase I – Preliminary Investigation

Preliminary investigation began with eight focus groups with eight participants in each session both in Dalian and Shanghai. Participants were grouped on the basis of their experience/no-experience and higher/lower income. Several factors ranging from user expectations for the design of ATMs to the perceived use emerged as a result of focus groups sessions. These factors provided a basis to conduct interview with 100 Chinese individuals. 50% females and 50% males participated in the interview. Their age ranged between 18 and 54.

Individuals were divided into two groups. In one group, 60 individuals were approached when they finished using an ATM and were asked to participate in an interview. The participation was voluntary. In the other group, 40 users were asked to take part in the interview who had not used an ATM before the interview. Consistent findings emerged from data analysis of both user groups. Findings showed that a general positive perception of ATMs was expressed by users for its convenient use. Several preferences for the design of ATMs also emerged in the analysis of interview data. Certain concerns regarding the security were highlighted and users showed their interest in more financial operations to be automated in ATMs such as paying bills. The findings of the preliminary investigation provided an initial understanding of user perceptions of ATM use in general. To further address the actual use and user preferences of ATMs, a usability evaluation of a customised ATM was carried out in the next phase.

3.2 Phase II – Usability Evaluation

The phase began with the evaluation of an ATM by three usability experts from Dalian Maritime University. The purpose of conducting a heuristic usability evaluation with experts was to identify important factors to shape the usability evaluation with regular users of ATMs. Based on interview findings in Phase I and experts' feedback on ATM use, the evaluation of ATM was carried out with 30 Chinese individuals of whom 20 had experience and 10 had no experience of using ATMs. Users were asked to perform several typical tasks with the ATM.

Several physical features of the ATM design along with the information presented were evaluated. Despite the level of experience with ATMs, users generally presented a positive attitude toward the physical design of the ATM. Most features were perceived to be unambiguous and easy to use. These findings indicated that users

generally had a positive attitude toward features which gave them a sense of control. However, certain factors highlighting users' concerns with understanding the processing of transactions emerged. For example, the presentation of a screen saver (a welcome screen) during the inactivity of ATM was seen as confusing. Users also found decimal entry ambiguous during fund transfer. However, strong preferences for choosing a language for interaction were expressed. The aspects of ATM use which were reported to be confusing were used to modify the design. The comprehensive usability evaluation provided several useful design guidelines based on user perceptions and preferences of ATM use.

As identified in the study, users expressed a strong preference for more financial operations such as cash/cheque deposit to be incorporated within ATMs to enhance its functionality. In order to take this into account, a second follow-up user study was designed and conducted with Chinese users in Dalian. The study focussed on user perceptions and evaluation of the use of automated cash/cheque deposit technology within ATMs. The design of the study along with its major findings in terms of user perceptions toward accepting the technology is discussed in detail in the next section.

4 Operations – Cash Deposit

The success of cash withdrawal at ATMs has increased the demand for cash/cheque deposit automation within ATMs over the years. Therefore, automation of cash/cheque deposit solutions is on the rise in the financial sector. The acceptance of deposit technology not only depends on its technical proficiency but also on user perceptions and attitude towards its use. User perceptions in the evaluation of deposit technology acceptance become important due to a number of security and usability issues such as bank notes quality and validity, verification of deposits and the ease of use of the technology. In order to look into user perceptions and concerns regarding the use of deposit technology in China, a study was carried out in two major phases. The first phase involved a survey of Chinese individuals in Dalian, which provided a basis to address the emerging issues in the evaluation of actual use of deposit technology.

4.1 Phase I – Survey Enquiry

The survey began with a questionnaire design, which involved interviews with seven staff members from five different banks and discussion sessions with individual with and without deposit technology experience. 78 individuals participated in the survey. Data from 66 responses (59 males and 41 females) was found to be complete. Data analysis showed that security and ease of use were seen as most important factors associated with the use of deposit technology by both user groups (users with and without deposit technology experience). Overall users showed a positive attitude toward using deposit technology based on their perceived security and ease of use of the technology.

The preliminary survey investigation of common user perceptions of self-deposit technology led to the design and evaluation of the usability of a cash deposit prototype. The usability evaluation was based on the walkthrough method with both experts and regular users of financial services.

4.2 Phase II – Usability Evaluation

The evaluation of a deposit technology prototype began with four academic experts in the usability domain. The usability evaluation involved a screen flow of the prototype for interaction highlighting several issues. The usability issues were categorised under design aesthetic, user behaviour and information processing. The design aesthetic analysed user expectations from the interaction in terms of its presentation. Several factors such as screen layout, colour and font indicated how the interaction was perceived by users. User behaviour indicated how the use of cash technology was assessed in terms of its functionality. Information processing provided insights into user understanding of cash depositing function. Based on the data analysis, several suggestions were made which were incorporated in the prototype design. The prototype was then tested by regular users of financial services.

Eight individuals volunteered for an in-depth usability evaluation. The individuals were divided equally into two groups based on their experience and no experience with deposit technology. The experienced user group evaluated the original prototype and the no-experience group evaluated the revised version of the prototype.

As a result of evaluation, several issues related to the screen and message presentation emerged. The analysis of data showed that prototype was evaluated with a focus on the processing of information to ensure successful completion of cash deposit. Another important finding was the positive effect the design aesthetics had on the actual use of deposit technology.

The findings of the survey indicated a positive user preference for the automation of cash/cheque deposit operation for better security and ease of use measures. The usability evaluation study, however, indicated several factors determining the security and ease of use of deposit technology. The study produced design implications based on the significant insights into user perceptions and preferences of self-service deposit technology. To further explore user perceptions of ATM security, a study was carried out involving the use of biometric technology.

5 Enhanced Security – Biometrics

With an increasing demand of better security features on ATMs and maturing of technology, biometrics are seen as a reliable and robust way of improving the security of ATMs. The prevalence of biometric technology has promised better security and reliability in the self-service solutions. The biometric technology has also allowed financial institutions to expand their customer base in emerging markets such as China. However, introducing biometric technology in Chinese market faces several challenges such as understanding user perceptions and attitude toward using biometrics. In order to investigate user perceptions and concerns toward using biometric technology, a preliminary study was conducted in Dalian, China.

The study was comprised of two major stages, namely survey enquiry into Chinese individuals' general awareness and perception of biometric technology and testing of fingerprint and palm-vein sensors with Chinese individuals in Dalian.

5.1 Phase I – Survey Enquiry

In the first phase, the questionnaire was designed on the basis of several interviews conducted with nine usability experts both in industry and academia. The questionnaire was distributed to individuals both with and without experiences of biometric technology use. 152 complete responses were received out of which 118 participants had no experience with biometric technology and 34 reported to have some degree of experience with biometric technology. Out of 118 participants without any experience with biometric technology, 60 were female and 58 were male participants. In the group of 34 participants with biometric technology experience, 11 were females and were 23 males. The data analysis showed that more than half of participants with no biometric technology experience perceived it to be easy to use.

Participants with no experience with biometric technology perceived security as the most important feature of the technology. However, participants with experience with biometric technology expressed their preference for biometric technology for its convenient use. Findings indicated that participants' level of experience had a positive impact on their attitude toward biometric technology use. However, it was important to note that overall all participants showed a positive attitude toward using biometrics.

Phase I led to the design of a preliminary study investigating user perceptions and attitude based on biometric technology use. A pilot study was conducted with 40 UK participants in order to prepare the materials for conducting the actual study in Dalian with Chinese individuals.

5.2 Phase II – Sensor Testing

Three fingerprint sensors and one palm-vein sensor were used in the study with 46 female and 40 male Chinese individuals. Their age ranged between 16 and 65. Participants filled in a questionnaire before and after the use of sensors. The questionnaire looked into their perceived advantages and concerns related to biometric sensors use. The use of the sensors involved enrolling as a new bank customer and logging in with the new biometric identity.

The data from pre-test questionnaires showed that users perceived efficient use of biometric sensors as the most important feature provided by them. However, post-test questionnaire data indicated a change in user perceptions in terms of perceiving ease of use of biometric sensors as the most important feature.

The findings of the study highlighted a positive attitude of Chinese individuals toward using the biometrics technology. In the light of findings, it can be argued that there was no significant change in user attitude before and after using the biometric technology. The understanding of Chinese user perceptions and attitude toward using biometric technology set a basis for the design of a better training method for enrolment and interaction for the actual use of fingerprint technology.

6 Discussion

The research into exploring the acceptance of self-service financial technology in China can be seen as an evolutionary process. The process began with investigating

how a customised ATM was perceived and use by Chinese individuals. The study highlighted a positive attitude of Chinese individuals toward using the technology, which evolved as a strong preference for additional function of cash/cheque deposit within ATMs. In order to address user preference and analyse the use of emerging technology of cash deposit automation, second study was conducted in Dalian. The study showed that users preferred the deposit technology over the teller service for convenience and efficiency. User perceptions toward using deposit technology were then tested in a usability study of the technology. The usability evaluation indicated that users welcomed the technology and expressed willingness toward using the technology. However, due to sensitive nature of deposit technology, users expressed their expectations from the technology in terms of better security measures. This issue provided a basis to carry out the third study looking into the use of biometric technology use for identity verification on ATMs. Despite the awareness and level of experience with biometric technology, users showed an interest in the use of biometric technology. The actual use evaluation of biometric technology revealed certain issues the users had with the technology use. However, consistent with previous studies findings, positive user perceptions toward the introduction and use of biometric technology within ATMs emerged.

The findings of the three studies show consistent positive user perceptions toward using financial self-service. Use perceptions play a critical role in determining user attitude, which form user intention that determines diffusion of technology (Davis 1989). Several key factors that contribute toward user positive perceptions such as availability, efficiency and effectiveness of technology according to the requirements of Chinese individuals were highlighted. An in-depth understanding of Chinese user expectations and concerns will ensure the successful deployment and use of technology.

The importance of these studies can be seen in terms of several design guidelines that have emerged on the basis of users' opinions, expectations and requirements from the self-service technology. These findings will enhance the promotion of traditional self-service technology accommodating specific requirements of Chinese users.

The findings of these studies also offer a glimpse into the future of Chinese banking. The advancement of modern technology particularly in the emerging markets is breaking new ground in the area of financial services. The self-service concept developed specifically for the Chinese customers as a result of the collaboration between SEUC, China and AT&R, NCR help Chinese banks break into the highly competitive financial sector. With a consistent positive attitude of Chinese customers toward self-service technology, it can be argued that the technology will spread in this country faster than anywhere else.

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