Adaptation of NFC mobile credit card (NFC-MCC): technological evolution in M-payment system (mobile payment)

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Abstract

Near Field Communication (NFC), as an emerging and promising technology is an integration of Radio Frequency Identification (RFID) technology with mobile devices. This study adopts the Technology Acceptance Model (TAM) since it has the ability to predict different Information Technology (IT) utilization. TAM consists of five constructs which are perceived ease of use (PEOU), perceived usefulness (PU), and attitude towards using (ATU), behavioral intention to use (BI), and the actual system use (AU). The TAM model was retained with the introduction of eight new constructs, i.e., social influence (SI), personal innovativeness in information technology (PIIT), perceived financial cost (PFC). Environmental concern (EC), Perceived Marketplace Influence (PMI), Time Risk (TR), Trust and Perceived Risk (PR). The main objective of the study is to identify the adoption of Mobile Credit Card in Bangladesh. The other objective is to understand the factors which influence the adoption of Mobile Credit Card. The findings shed lights not only in terms of the theoretical contributions it makes but also provides valuable information not only for mobile phone manufacturers but also bank decision makers, merchants, software developers, governments, and practitioners when formulating their communication and business strategies related to NFC Mobile Credit Card adoption.

Keywords: Bangladesh; Near Field Communication; Perceived usefulness; Perceived ease of use; Perceived financial cost; Environmental concern; Perceived Marketplace Influence; Social Influence; Personal Innovativeness in Information Technology; Time Risk; Trust and Perceived Risk;

1.0 Preamble

Technological adaptation is growing faster with the advancement in the short-range wireless technologies such as Near Field Communication (NFC), Bluetooth, Infrared Data Association (IrDA) and Radio Frequency Identification (RFID). As such, Google, ISIS, and Visa have announced wallets that are using Near-Field Communication (NFC) technology. The increasing pressure will face by the financial sector where the main issue will be the increasing number of credit card users. The technological advancement will help to fulfill the national and international regulatory requirements.

NFC technology includes **a.** the technology is compatible with existing RFID structures, existing RFID tags, and contactless smart cards; **b.** it is easy to use and familiar to

people because users don't need to have any knowledge about the technology. All a user has to do is to start communication by bringing two devices together; **c.** the transmission range is so short that, when the user separates two devices, the communication is cut. This brings inherent security. If there isn't any other device close, there is no other communication.

In the past, shopping has often been associated with either cash or credit card payment. As mobile phone technology becomes more sophisticated, new forms of payment have since emerged within the mobile payment theme. Generally, mobile payment (MP) refers to the "payments for goods, services, and bills with a mobile device such as mobile phone, smartphone, or personal digital assistant by taking advantage of wireless and other communication technologies" (Dahlberg et al., 2008, p. 165). Regardless of the definition, MP is viewed as an alternative to the old-fashioned credit card. As mobile commerce continues to gain popularity, MP will eventually play an important role to facilitate transactions between consumers and merchants (Ondrus and Pigneur, 2006).

This study adopts the Technology Acceptance Model (TAM) since it has the ability to predict different Information Technology (IT) utilization. As the model only takes into consideration two constructs, the overall prediction is not considered to be complete. Taking the cue, this study incorporates two additional psychological variables, namely personal innovativeness in information technology (PIIT) and social influence (SI). The variables were included since consumers' paying habits are grounded from the person's characteristics as well as environmental influences. In addition, two other constructs on finance-related risks – perceived risk (PR) and perceived financial cost (PFC) were added to the model as well. This is in view of the fact that PR is among the major obstacles mentioned in most of the technology adoption studies, while the decision to adopt a particular technology is often linked to the perception of financial cost in acquiring and utilizing it. The arguments conclude that PR and PFC are the two major barriers in adopting financial-related MP services. Further, since most of the research papers related to IT adoption focused solely on the technology itself and do not consider other social factors, the moderating effect of gender is also added to the model. Taken together, it is believed that the integrated model can help to explain MCC's acceptance from the theoretical perspective, in which practical contributions can be derived at based on the study's results.

The next section reviews the literature relevant to the variables of interest. As a result, a research framework and a series of testable hypotheses are developed. The methodology is then described, followed by an analysis and interpretation of the data collected. The implications are discussed and recommendations are provided before the paper is concluded with possible future research directions.

Generally, mobile payment (MP) refers to the “payments for goods, services, and bills with a mobile device such as mobile

phone, smartphone or personal digital assistant by taking advantage of wireless and other communication technologies" (Dahlberg et al., 2008, p. 165). Increasing number of Mobile and Online Payments creates new opportunities, but it also creates new risks for financial services providers: strategic, but above all cross-level alliances between established internet players, telecommunication companies and for example - Credit Card companies along the value chain certainly have a promising objective: securing and building on their respective market positions. Those financial services providers who do not modernize their upstream and downstream value chains or subject them to the transformation process required for the digital network architecture could suffer painful losses over the medium term. Thus, pressure is growing on the traditional banking world.

Our study consists of the adaptation of new technology i.e. NFC Mobile Credit Card (NFC-MCC) and the future prospect of the Mobile Payment as an emerging country Bangladesh. The increasing number of mobile phone subscriber in Bangladesh i.e. 131.949 million (April 2016 by Bangladesh Telecommunication Regulatory Commission, (BTRC)). Daily average transaction of Mobile payment is increasing day by day i.e. 10.09% by March 2016 as compared to February 2016 (Mobile Financial Services (MFS) survey by Bangladesh Bank). As the establishment of the Banking Sector, digitalization in the Credit card system with the help of NFC will reduce the physical credit card. Eco-system in the Banking sector will create prospect by adapting of NFC Mobile Credit Card in Bangladesh which will develop the overall Banking System as a digitalized form.

Hence, this study will serve to narrow the research gap by examining the determinants of mobile credit card adoption using a trust-based Technology Acceptance Model (TAM). It will also investigate the moderator effects of income, education, gender and experience while investigating the causal relationships of these determinants. Therefore, the research questions for this study are:

What are the determinants of mobile credit card adoptions?

Do income, education, gender, and experience moderate the causal relationships between these determinants?

Thus, a scenario analysis focusing on the future development of payments and other financial services and the implications for the financial industry needs to reach out beyond the mobile payments segments – in contrast to many analyses currently in progress.

2.0 Literature review

2.1 Overview of NFC mobile credit card (NFC-MCC)

NFC (Near Field Communication) is a technology for the wireless connection of devices and thus links the online and offline worlds. It is based on the development of RFID (Radio Frequency Identification) technology, in which the data on a transponder can be read and stored contactless. NFC extends RFID technology for example to include the possibility of

linking two mobile devices or a Smartphone with a cash register terminal, the retail point of sale (POS). Emphasis should be placed on the simplicity with which this link-up is established: if two mobile devices are within range of one another they establish a connection very rapidly. The range for NFC has deliberately been limited to a maximum of between 10 and 20 cm so that the user can keep the communication under the best possible control.

NFC has been regarded as the future of MP services (Ondrus and Pigneur, 2006). Initially, the payment method was carried out for VISA and MasterCard PayPass program (Pasquet et al., 2008). NFC can transfer data either in active or passive modes via a short-range high-frequency wireless communication technology (Ruijun and Yao, 2010). The operational distance under passive mode is 10 cm, while the inactive mode is 20 cm (Chen et al., 2010). Hence, the NFC technology enables transactions to be conducted merely by holding a mobile phone within the range of the NFC reader. The technology has since been adopted in USA, Canada, Hong Kong, Korea, Japan and Taiwan (Chen and Chang, 2011; Pope et al., 2011).

The application of NFC technology in various industries, which includes manufacturing industry, tourism sector, transportation, financial institutions, automobile industry, medical, advertising and etc. The integration of NFC technology into mobile devices offers many reliable applications; specifically payment, ticketing, loyalty services, identification, access control, content distribution, smart advertising, peer-to-peer data/money transfers and set-up services.

In Bangladesh, mobile payment has been used by various forms. A total number of transaction has been done by December 2014 is BDT 74.473 million takes and percentage change from November to December 2014 is 22.28%. There are 4 million Debit Card and 1 million Credit Card users are existing in Bangladesh.

2.2 Factors influencing NFC Mobile Credit Card (NFC-MCC) adoption

Over the years, a considerable number of theories have been established to understand consumers' intention to adopt new technology. Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975), Technology Acceptance Model (TAM) (Davis, 1989), Theory of Planned Behavior (TPB) (Ajzen, 1991), the Diffusion of Innovation (DOI) (Rogers, 2003), the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh, Morris, Davis and Davis, 2003).

The original TAM consists of five constructs which are perceived ease of use (PEOU), perceived usefulness (PU), and attitude towards using (ATU), behavioral intention to use (BI), and the actual system use (AU). The TAM model was retained with the introduction of eight new constructs, i.e., social influence (SI), personal innovativeness in information technology (PIIT), perceived financial cost (PFC). Environmental concern (EC), Perceived Marketplace Influence (PMI), Time Risk

(TR), Trust and Perceived Risk (PR).

A considerable number of frameworks have been developed over the years to understand consumers' intention to adopt certain IT. Among them include the Theory of Reasoned Action (TRA) (Fishbein and Ajzen, 1975), Technology Acceptance Model (TAM) (Davis, 1989), Theory of Planned Behavior (TPB) (Ajzen, 1991), and the Diffusion of Innovation (DOI) (Rogers, 2003).

TAM was also adapted from TRA to model user's acceptance and behavior of new information systems (Fishbein and Ajzen, 1975). The original TAM consists of five constructs which are perceived ease of use (PEOU), perceived usefulness (PU), and attitude towards using (ATU), behavioral intention to use (BI), and the actual system use (AU). As ATU is a weak predictor, the construct was subsequently eliminated in the revised TAM (Davis, 1989). TAM, however, is not adequate to portray the actual influences of technology use. Venkatesh and Davis (2003) commented that the model only describes up to 40% of its variance.

Rogers (2003) introduces the DOI, which provides a perspective of how innovation among consumers moves from early adoption to mass adoption. As the speed of adoption of innovation differs for each of the consumer groups, Rogers segmented the market into five categories based on the relative passage of time. Agarwal and Prasad (1998) observe that consumers with higher personal innovativeness have a higher likelihood to develop positive attitudes towards IT adoption compare to lesser innovative consumers given the same level of belief. They are usually risk takers and have the tendency to break the general rules.

3.0 Objectives and hypotheses of the study

The main objective of the study is to identify the adoption of Mobile Credit Card in Bangladesh.

The other objective is to understand the factors which influence the adoption of Mobile Credit Card.

Hypotheses of the study are as follows:

H1. PU has a significant relationship with MCC adoption in Bangladesh.

H2. PEOU has a significant relationship towards MCC adoption in Bangladesh.

H3. PFC has significant relationship towards MCC adoption in Bangladesh.

H4. EC has significant relationship towards MCC adoption in Bangladesh.

H5. PMI has significant relationship towards MCC adoption in Bangladesh.

H6. SI has significant relationship towards MCC adoption in Bangladesh.

H7. PIIT has a significant relationship towards MCC adoption in Bangladesh.

H8. TR has a significant relationship towards MCC adoption in Bangladesh.

H9. PR has a significant relationship towards MCC adoption in Bangladesh.

H10. Gender moderates the relationships

among the variables in the research framework.

4.0 Research methodology

Since the group of Credit Card user has increased in a large number in a relatively short time, the researcher finds it relevant to study them, and analyze how they interact with their surroundings to shape their uses. This is interesting that, the Mobile Credit Card in spite of performing various corporate, personal and socially driven roles, sometimes do not give much importance to the certain skills required in developing the business, thus this research is set out to make in-depth case studies of perception to adapt the technology by the people of Bangladesh.

4.1 *Sampling design*

The target populations and sample sources were all from urban, semi-urban and rural people in Bangladesh. Actually, data have been collected from 245 respondents out of which usable questionnaire was 200 for this study. So the sample size was considered two hundred (200) in this study. For the study, two types of sampling technique namely simple random sampling and convenient sampling have been used.

4.2 *Data collection*

Based on the extensive literature review and discussion with social business experts in Bangladesh, where we have identified 37 variables those affect on the growth of social entrepreneurship. Then, the relationships of similarities and dissimilarities (+, -) among the variables were portrayed based on empirical research. Then respondents comment and ideas were incorporated into the design of the final questionnaire. After the several round revisions, a total number of 37 attributes were considered for designing final questionnaire which we tried to collect data from the respondents. Finally, we have collected and analyzed the data with the help of SPSS (Version 16), the results are given below.

4.3 *Measurement scales*

In the questionnaire, the respondents were asked about the attributes those are usually considered for social entrepreneurship. The respondents were asked about different attributes using 7 points Likert scale (7 for strongly agree, 6 for agree, 5 for somewhat agree, 4 for neither agree nor disagree, 3 for somewhat disagree, 2 for disagree and 1 for strongly disagree) to measure the overall support of the attributes. For scale reliability, Alpha value is considered. In addition, the nominal scale was used to measure socio-demographic characteristics of participants through structured questionnaire in the exploratory phase.

4.4 *Data analysis and interpretation*

After collecting data the researchers have analyzed the data with the help of different statistical tools. In this paper, they have used the percentage method, mean, standard deviation, variance and etc. Finally, they have interpreted the data in table, chart, and graph.

5.0 Findings and discussions

The data analysis is done on a number of steps. For factor analysis and chi-square

test, the effect of underlying variables is transformed to a generalized value by data transformation. For descriptive data analyses, the usual procedure is used. Then for the factors that affecting the growth of the social entrepreneurship in Bangladesh are observed through a series of statistical techniques are given below.

5.1 Influential factors affecting an adaptation of NFC mobile credit card in bangladesh:

5.1.1 Profile of respondents

Table 1 presents the profile of survey respondents. 81.5% of the respondents are male and 18.5% female. 5.5% of the age of the respondents is below 20 years, 66% are from 21 years to 30 years, 13.5% are from 31 years to 40 years, 7.5% are from 41 years to 50 years, 4% are from 51 years to 60 years and 3.5% are above 60 years. 0.5% of the highest educational level of the respondents is no college degree, 2.5% are from diploma or advanced diploma, 66% are from bachelor degree, 31% are from postgraduate qualification. 28.5% of the professions of the respondents are other, 38% are students, 5.5% are from manufacturing, 3% are from retail, 10% are from IT, 4% are from banking, 5.5% are from financial institutions, 3.5% are from telecommunications and 2% are from tourism. 52% of the monthly income of the respondents is from below 10,000/-, 18.5% are 10,001/- to 30,000/-, 20% are from 30,001/- to 60,000/-, 9.5% are from above 60,001/-. The respondents have mostly known and experienced about NFC Mobile Credit Card.

Table 1: Demographic profile

Age	Frequency	%	Cumulative %	Gender	Frequency	%	Cumulative %
Below 20 years	11	5.5	5.5	Female	37	18.5	18.5
21 years to 30 years	132	66.0	71.5	Male	163	81.5	100
31 years to 40 years	27	13.5	85.0	Total	200	100	
41 years to 50 years	15	7.5	92.5	**Highest Educational Level**			
51 years to 60 years	8	4.0	96.5	No college degree	1	.5	.5
Above 60 years	7	3.5	100.0	Diploma	5	2.5	3.0
Total	200	100		Bachelor degree	132	66.0	69.0
Profession				Postgraduate qualification	62	31	100
Banking	8	4.0	4.0	Total	200	100	
Financial institutions	11	5.5	9.5	**Monthly Income**			
IT-related	20	10.0	19.5	Below 10,000/-	104	52.0	52.0
Manufacturing	11	5.5	25.0	10,000/- to 30,000/-	37	18.5	70.5
Retail	6	3.0	28.0	30,001/- to 60,000/-	40	20.0	90.5
Telecommunications	7	3.5	31.5	Above 60,001/-	19	9.5	100.0
Tourism	4	2.0	33.5	Total	200	100	
Education	76	38.0	71.5				
Other	57	28.5	100.0				
Total	200	100					

5.1.2. Scale reliability

To test the internal consistency of each of the attributes and items on the growth of the social entrepreneurship we have applied the Cronbach's Alpha reliability test. In this study, a total 14 items have been considered. In scale, reliability analyses we found that the value of Alpha is 0.526 which is moderately reliable.

Table 2: Showing reliability coefficients for each variable

Reliability Statistics		
Measure	**Cronbach's Alpha**	**N of items**
Influential Factors	0.9650719240921064	31

Source: Primary Data collected from 200 respondents and analysis at SPSS.

5.1.3. Exploratory factor analysis

In order to identify the influential factors and attributes for the growth of the social entrepreneurship, we have conducted an exploratory factor analysis. Initially, we have considered 31 variables.

5.1.4. Kaiser-meyer-olkin (KMO)

The KMO measure of sample adequacy test was applied on influential factors to test whether the sample was adequate to consider the data was normally distributed or not. The KMO value was 0.94623 indicating that the sample size was adequate to consider the data normally distributed as the KMO values above 0.70 are considered to indicate normality of data.

Table 3: Showing the KMO test results

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin (KMO) Measure of Sampling adequacy.		0.9462767700042928
Bartlett's Test of Sphericity	Approx. Chi- Square	4434.146483491619
	Df	465.0
	Sig.	0.00

Source: Primary Data collected from 200 respondents and analysis at SPSS.

Bartlett's Test of Sphericity has been used to test the null hypotheses that the variables in the study are not correlated. The Chi-Square test value was 4434.14648, which was significant at 0.00 level of significant. The test indicated that variables in the study are correlated and rejected the null hypothesis (The population correlation matrix is an identity matrix). Therefore, the data was suitable for factor analysis.

Table 4: All information related exploratory factor analysis

Rotated Component Matrix								
	Raw Component							
PU1	.718							
PU2	.745							
PU3	.743							
PU4	.738							
PU5	.732							
PEOU1		.727						
PEOU2		.639						
PEOU3		.707						
PEOU4		.739						
PFC1			.567					
PFC2			.586					
PFC3			.471					
EC1				.738				
EC2				.642				
EC3				.687				
EC4				.712				
PMI1					.762			
PMI2					.742			
PMI3					.710			
SI1						.583		
SI2						.677		
PIIT1							.750	
PIIT2							.798	
TR1								.776
TR2								.717
TR3								.663
ITU1								.711
ITU2								.791
ITU3								.778
ITU4								.762
ITU5								.711

Source: Primary Data collected from 200 respondents and analysis at SPSS.

The adaptation of NFC Mobile Credit Card by the surveyed data, where perceived usefulness (PU) 73.52%, perceived ease of use (PEOU) 70.30%, perceived financial cost (PFC) 54.13%, **e**nvironmental concern (EC) 68.90%, perceived marketplace influence (PMI) 73.80%, social risk (SR) 63.00%, personal innovativeness in information technology (PIIT) 77.40%, trust 71.87% and intention to use (IU) 75.06%.

By the above data, it is derived that the personal innovativeness in information technology is more influential than the other factors. Whereas perceived financial cost is less influential than the other factors.

All the factors have been satisfied towards the hypothesis drawn. The overall situation must be considered in the analysis of all factors.

5.0 Conclusion:

The study focuses on NFC Mobile Credit Card acceptance in Bangladesh in general, a payment method which is still marginally adopted through the use of an extended Technology Acceptance Model. It is hoped that the findings shed lights not only in terms of the theoretical contributions it makes but also provides valuable information not only for mobile phone manufacturers but also bank decision makers, merchants, software developers, governments, and practitioners when formulating their communication and business strategies related to NFC Mobile Credit Card adoption.

Appendix:

NFC Mobile Credit Card (MCC):
Adaptation and Usability Future Mobile Payment system

Name of the respondent

_____

City _____

Country _____

Monthly Income < 10000 10000 to 30000 30001 to 60000 > 60001

Strongly Disagree = 1; Disagree = 2;
Neutral = 3; Agree = 4; Strongly Agree = 5

Appendix:

NFC Mobile Credit Card (MCC): Adaptation and Usability Future Mobile Payment System

Name of the Respondent _____ City _____

Country _____

Monthly Income ◯ 0000 10◯ to 30000 30001 ◯ 0000 > 60001 ◯

Strongly Disagree = 1; Disagree = 2; Neutral = 3; Agree = 4; Strongly Agree = 5

Perceived Usefulness (PU)						
a. Using mobile credit card will enable me to accomplish my transaction more quickly	1	2	3	4	5
b. Using mobile credit card increases my productivity performance	1	2	3	4	5
c. Using mobile credit card would enhance my effectiveness in my daily work	1	2	3	4	5
d. Using mobile credit card makes the handling of payment easier	1	2	3	4	5
e. Overall I would find mobile credit card to be advantageous	1	2	3	4	5
Perceived Ease of Use (PEOU)					
a. Learning to use mobile credit card will be easy for me	1	2	3	4	5
b. Using mobile credit card does not require a lot of mental efforts	1	2	3	4	5
c. It would be easy for me to become skillful at using mobile credit card	1	2	3	4	5
d. Since an MCC uses my mobile phone, hence a mobile phone credit card is easy to use	1	2	3	4	5
Perceived Financial Cost (PFC)					
a. The annual fees for mobile credit card services is expensive for me	1	2	3	4	5
b. The transaction fees is expensive	1	2	3	4	5
c. The cost of mobile phone is high for me	1	2	3	4	5
Environmental Concern (EC)					
a. When deciding what to use, I should focus on the best practice for the environment and society.	1	2	3	4	5
b. Replacing the plastic credit card by mobile credit card is the greatest reason which should reduce the environmentally harmful plastic from society.	1	2	3	4	5
c. Users should consider the environment as one of their stakeholders when making decisions.	1	2	3	4	5
d. To be environmentally responsible, the user needs to use the environmentally friendly product that accounts for the earth's physical and social limits.	1	2	3	4	5
Perceived Marketplace Influence (PMI)					
a. I believe my individual efforts to be environmentally friendly will persuade others in my community to use environmentally friendly Mobile Credit Card.	1	2	3	4	5
b. The choices I make can influence what institutions provide in the marketplace.	1	2	3	4	5
c. If I use environmentally friendly Mobile Credit Card, Banks will provide more of them.	1	2	3	4	5
Social Risk (SR)					
a. My decision to use a mobile credit card will influence to my friends and family.	1	2	3	4	5
b. Social acceptance of my decision to use a mobile credit card.	1	2	3	4	5
Personal Innovativeness in Information Technology (PIIT)					
a. I like to experiment with new ways of doing things.	1	2	3	4	5
b. I like to take a chance on new technology adoption.	1	2	3	4	5
Trust					
a. I would trust my bank to offer secure mobile credit card services	1	2	3	4	5
b. I would trust my mobile phone manufacturer to provide a mobile phone which is appropriate for conducting mobile credit card services.	1	2	3	4	5
c. I believe that if an outsider gains access to my mobile credit card account, the bank will take complete responsibility for my money.	1	2	3	4	5
Intention to Use (IU)					
a. I am likely to use Mobile Credit Card in the near future.	1	2	3	4	5
b. Given the opportunity, I will use mobile credit card	1	2	3	4	5
c. I am willing to use Mobile Credit Card in the near future	1	2	3	4	5
d. I will think about using a mobile phone credit card	1	2	3	4	5
e. I intend to use mobile payment services when the opportunity arises	1	2	3	4	5

This information is based on Personal Identification –

Gender : Male ◯ Female ◯

Age : ◯ Below 20 ◯ 21 – 25 ◯ 26 – 30 ◯ 31 – 35 ◯ 36 – 40 ◯ Above 40

Marital Status : Single ◯ Married ◯

Highest Educational Level : ◯ No college degree ◯ Diploma/advanced diploma

◯ Bachelor degree/professional qualification ◯ Postgraduate qualification

Respondent's Industry : ◯ Banking ◯ Financial institutions ◯ IT-related

◯ Manufacturing ◯ Retail ◯ Telecommunications ◯ Tourism ◯ Education

Period of credit card use : ◯ Less than 3 years ◯ 3–6 years ◯ over 6 years

Frequency of credit card use (per month) : ◯ 1–3 times ◯ 4–10 times ◯ 11–20 times

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