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User adoption of mobile commerce in Bangladesh: Integrating perceived risk, perceived cost and personal awareness with TAM

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Abstract

This paper develops and tests a model for predicting user adoption of mobile commerce (i.e. e-commerce using mobile phones) in developing countries. The model takes up the Technology Acceptance Model (TAM) determinants of perceived usefulness and perceived ease of use, and extends these through the inclusion of three further determinants: perceived risk, perceived cost and personal awareness to enable prediction of the likelihood of mobile commerce adoption by users in the developing world. 575 usable surveys were gathered from the urban, semi-urban and rural areas of Bangladesh. Perceived risk and perceived usefulness were found to be the most influential factors effecting mobile commerce adoption, while the effect of perceived ease of use and personal awareness was found to be low although significant. The study reconfirmed the need of extending TAM model, in the context of mobile commerce, to address both it's transactional and non-transactional components. Service providers need to ensure high levels of security and privacy to reduce user's perceptions of risk. Mobile commerce services and technologies should be upgraded to world standard to make them more useful to users.

Key words: Mobile commerce, Adoption, Technology Acceptance Model (TAM), Developing Countries

1. Introduction

Mobile commerce or m-commerce, a subset of e-commerce[65], comprises those e-commerce transactions that take place through mobile phones or any portable wireless devices. Electronic commerce means conducting financial transaction electronically over the internet, whereas mobile commerce is defined as buying and selling goods and services through wireless handheld devices such as cellular phones and Personal Digital Assistants (PDA) [83]. Others view mobile commerce as the use of wireless technology, particularly handheld mobile devices and mobile Internet, to facilitate transactions, information searches and other user tasks[14]. The number of mobile phone subscribers in the world has exceeded 6.8 billion, with more than half of them (approximately 3.5 billion) within the Asia-Pacific region[41]. The fast penetration of mobile phone devices coupled with their key characteristics of being ubiquitous, versatile, personalised and always on, along with their convenience, has given mobile commerce a huge potential in the global market place[76]. Mobile commerce has transformed many traditional transactions into mobile transactions such as mobile banking, mobile shopping, mobile wallet, mobile advertising, mobile education, mobile agriculture, mobile health, mobile entertainment, mobile internet and mobile GPS[76, 97]. Gartner Research reported that transactions valued at $105.9 billion were made through mobile phones in 2011[34], and predicted this to reach $617 billion by 2016. Today 40% of subscribers are accessing different mobile commerce services such as watching videos, sports, TV, reading newspapers and playing video games through mobile phones[86].

The mobile-cellular market has become saturated and it's growth rate has come down to 2.6%, the lowest

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growth rate ever. However developing countries have maintained higher growth rates of mobile phone subscriptions, 6.1% in 2013, when compared to developed countries which recorded 3.7% in the same year[41]. Mobile phone penetration rates in developing countries are also getting closer to that of the developed world, 89% versus 128% respectively[41]. The penetration rate of mobile broadband, one of the key elements of mobile commerce, presents a different scenario where developed countries are far ahead of developing countries; with penetration rates of 74% in developed countries compared to only 19% in the developing world[42]. In some developing countries this rate is even lower than the average, being only 5% in Indonesia, 1.2% in Sri Lanka and 0.9% in India[75]. Mobile banking, mobile shopping, mobile advertising, mobile ticketing, mobile movies and mobile videos are commonly used applications in developed countries, while in the developing world the mobile phone is still being used mainly for communication[77]. There is a need for research that investigates the reasons behind this low adoption of mobile commerce in developing countries, which could assist the stakeholders of mobile commerce in redesigning their strategies. This research aims to extend the Technology Acceptance Model (TAM) by adding three important determinants: perceived risk; perceived cost; and personal awareness; in order to enable more accurate prediction of the future adoption of mobile commerce in the developing world.

Lack of user acceptance is the most serious impediment to the success of any new information system[27]. There are few studies of user acceptance of mobile commerce in developing countries (see Refs. 1, 13, 54, 63 and 94); while in the developed world these are abundant (e.g. Refs. 7, 10, 11, 18, 19, 21, 23, 25, 27, 30,35, 36, 44, 46, 48, 50, 53, 58, 59, 60, 61, 66, 69, 70, 72, 73, 74, 84, 90, 91 and 93). This research redresses this shortcoming by providing more information on the influences affecting the adoption of mobile commerce in developing countries.

The objective of this study is to develop and test an extension to the TAM model that could be used to identify the most significant factors affecting user intention to use mobile commerce in developing countries. Bangladesh has been chosen as the subject of this study due to its developing country status and its substantial achievements over time in mobile phone penetration, the precondition to mobile commerce use. The main research question addressed in this research is: "*What factors influence the users in developing countries to adopt mobile commerce?" – decomposed as:*

- To what degree does personal awareness influence a user's intention to adopt mobile commerce?
- In what way does perceived risk influence a user's intention to adopt mobile commerce?
- To what degree does perceived cost influence a user's intention to adopt mobile commerce?

2. Literature Review:

2.1 Theoretical background

Prior studies have used various models/theories to investigate the factors affecting technology adoption; example of these models/theories are Technology acceptance model (TAM)[26], Theory of planned behaviour (TPB)[4] and Diffusion of innovation theory (DOI)[81]. Majority of these models/theories were actually the extended versions of Theory of Reasoned Action (TRA, figure 1), derived from social psychology proposed[32], that is used to predict and explain human behaviour and intention in various fields[98]. According to TRA, a person's actual behaviour is determined by his or her behavioural Intention (BI) to perform, which is in turn measured by the combination of the person's attitude (A) towards that Behaviour and the subjective norm (SN) [28].

TPB extended TRA with additional determinant (perceived behavioral control) stated that user's behavioral intention to act should be affected by three factors rather than two (as stated in TRA) such as attitude, perceived behavioral control, and subjective norm[4, 96, 33]. Rogers in his Diffusion of innovation theory (DOI), proposed five stages of innovation-decision process a person usually goes through before deciding to accept or reject an innovation[81]. These five stages are knowledge, persuasion, decision, implementation and confirmation[81]. Although innovation-decision process explains how an innovation becomes adopted, rejected or abandoned it does not say about the rate of adoption. Therefore five perceived attributes of the innovation such as relative advantage, compatibility, complexity, trialability and observability were proposed[81].

TAM model (figure 2), an extended version of TRA, has two major determinants such as perceived usefulness (PU) and perceived ease of use (PEOU) which influence Attitude (A) and in turn influence Behavioural Intention (BI) and Actual Behaviour[26]. The major two determinants of TAM are also influenced by external variables; the nature of which was not mentioned specifically rather was left for future research and extension. TAM has been used to successfully predict 40% of the variance in usage intention and Behaviour[91]. Numerous empirical studies have validated TAM as a successful model to predict user adoption of different technologies (e.g. text editor, Email, Word processor, spread sheet, telemedicine

software and mobile commerce); with different user groups (e.g. students, professionals, managers, physicians); under different situations; and in different regions (see Refs. 27, 38, 89 and 95). A number of researchers used TAM model in the context of mobile commerce to explain the adopter's behavioural pattern (see Refs. 7, 12, 59, 67).

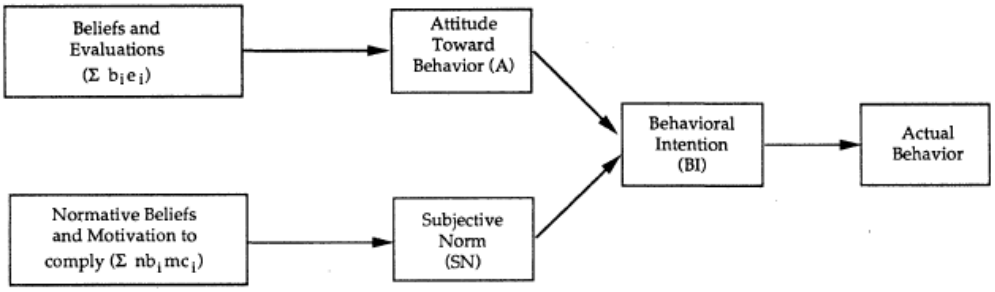

Figure 1: Theory of Reasoned Action (TRA) (see Ref. 28, p.984).

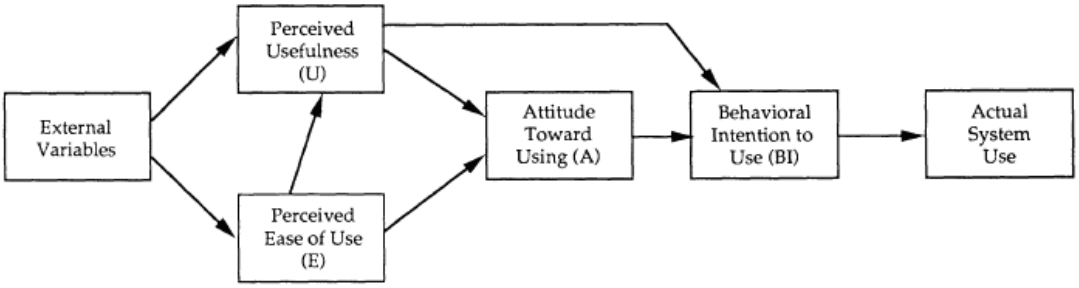

Figure 2: Technology Acceptance Model (TAM) (see Ref. 28, p.985).

Although TAM was tested to be competent by many studies it was not sufficient to explain a user's intention to accept technology just by two determinants: perceived ease-of-use and perceived usefulness as proposed by the TAM[36]. As previously mentioned that mobile commerce incorporates both transactional and non-transactional dimensions, user's perception to adopt mobile commerce can be seen as multi-dimensional behavioural intention[7, 72]. Recently there have been some mixed results in predicting the adoption of mobile services while using the TAM model (see Refs. 38, 51, 52 and 74) indicating the need for extension or modification of the TAM model for mobile commerce services[74]. Therefore researchers have realized the limitations of TAM, and proposed that it (TAM) has to be extended to explain mobile commerce adoption more accurately.

2.2 Factors affecting mobile commerce adoption

Wu and Wang, added three more constructs to TAM model such as perceived risk, perceived cost and compatibility to see how that effect user's behavioural intention to adopt mobile commerce services[98]. They surveyed 310 mobile commerce users in Taiwan and found that perceived usefulness and compatibility were positively affecting user's intention to use mobile commerce. The effect of cost and perceived risk was also found to be significant but negatively and positively respectively. However they did not find any significant impact of perceived ease of use in the adoption of mobile commerce in Taiwan.

By adding a number of resource based constructs, Cheong and Park employed Technology Acceptance Model (TAM) to explore the factors affecting mobile internet adoption in Korea[18]. The analysis of 1279 usable online surveys in Korea identified attitude to be the most significant factor affecting mobile internet adoption. Similar to prior research positive role of perceived usefulness and negative role of perceived price level were also found to be significant in developing attitude as well as behavioural intention to use mobile internet. The hypotheses predicting the positive causal relationships of 'perceived contents quality – perceived usefulness', 'perceived system quality– perceived usefulness' and 'internet experience–perceived ease of use' were also supported.

Pagani extended TAM model by price and speed of use to investigate the factors influencing 3G mobile multimedia services[70]. By performing an exploratory quantitative study among 1000 mobile users in Italy she concluded that perceived usefulness, perceived ease of use, price and speed of use play an important role behind the adoption of 3G mobile multimedia services. Her findings also suggest that the importance of determinants differs by age groups or segments. Oliveira et al. proposed an adoption model of mobile ICT in least developed countries[68]. They extended TAM by adding further determinants including level of education, age, gender, cultural influence, accessibility and reliability; but in contrast to Pagani[70] - age, gender and education were not found to have played any role in mobile commerce adoption.

TAM has also been extended by one trust-based construct ('perceived credibility') and two resource-based constructs ('perceived self-efficacy' and 'perceived financial cost') in a study[57], which set to explore the most significant determinants affecting mobile banking adoption. Their analysis of 180 usable surveys in Taiwan concluded that self efficacy, perceived cost, perceived credibility, perceived usefulness, perceived ease of use significantly influence mobile banking adoption.

However perceived ease of use, perceived cost and trust were not found to be significant in adoption of mobile banking in Germany by a study that employed TAM model, extended by additional constructs such as compatibility, credibility, perceived cost, trust and risk[49]. The study surveyed 263 young people in Germany to investigate the factors influencing mobile banking adoption. Compatibility, perceived usefulness, and risk were found to be the most significant indicators for the adoption of mobile banking services in that study. Gu, Lee and Suh, conducted a similar study based on extended TAM, that gathered 910 usable responses through web survey in Korea to explore the determinants affecting mobile banking adoption[36]. In contrast to other study[49] they found perceived ease of use, perceived usefulness and trust significantly influencing mobile banking adoption.

By integrating TAM with Diffusion of innovation theory (DOI) Mallat et al., intended to explore the determinants influencing mobile ticketing service[60]. They surveyed 360 participants in Finland, and found that perceived ease of use, compatibility and use context significantly influence mobile ticketing adoption. However perceived usefulness was not found significant[60]. Chen also integrated TAM with DOI to investigate the most significant factors causing users to accept mobile banking[15]. The analysis of 425 email surveys concluded that perceived usefulness, perceived ease of use, perceived risk and compatibility significantly influence mobile payment adoption.

In order to explore the reasons behind mobile commerce adoption in Malaysia, Wei et al., extended TAM by including three additional constructs such as social influence, perceived cost and trust; borrowed the first two (social influence and perceived cost) from Theory of Planned Behavior (TPB) and DOI theories[96]. They conducted a survey of 222 participants in Malaysia and found that all additional constructs: social influence, perceived cost and trust were significantly affecting mobile commerce adoption in Malaysia. Perceived usefulness, the original construct of TAM was also found to be significant; but not perceived ease of use - the effect of which was found to be least significant on mobile commerce adoption. Somewhat contradictory finding was obtained by Luo et al., which explored the determinants influencing mobile commerce adoption in USA[58]. A study of 122 valid surveys among the undergrad students in USA did not find trust to be significant in affecting use's intention to use mobile commerce services. Table 1 listed a number of empirical research that extended TAM model by adding numerous constructs for investigating the adoption of mobile commerce in different countries.

Table 1: Theory based empirical research in mobile commerce adoption

Authors	Theories	Sampling & Countries	Major Findings
[7]	TAM	1000 consumers were surveyed in Finland.	Perceived usefulness, perceived ease of use, cost, flexibility and enhanced communication feature significantly influence mobile commerce adoption. *However* security risk was not found to be significant.
[54]	TAM	Survey of 128 MBA students in China.	Perceived usefulness, perceived ease of use, trust, complexity, social influence significantly influence mobile internet adoption. *However* Facilitating condition was not found to be significant.
[74]	Extended TAM	Survey of 459 trial users of mobile parking services in Norway.	Perceived usefulness, attitude and perceived self-expressiveness significantly influence mobile parking adoption.

[70]	TAM	1000 mobile users in Italy.	Perceived usefulness, perceived ease of use, price, and speed of use significantly influence 3G mobile multimedia services. *However* the importance of determinants differs by age groups or segments.
[18]	TAM	Online survey of 1279 respondents in Korea.	Attitude, perceived usefulness, perceived ease of use, perceived price level significantly influence mobile internet adoption. The positive causal relationships of 'perceived contents quality – perceived usefulness', 'perceived system quality– perceived usefulness' and 'internet experience– perceived ease of use' were also witnessed.
[63]	TAM	198 hard copy survey to Nigeria and Kenya.	Accessibility and reliability significantly influence mobile ICT adoption. *However* Perceived ease of use influence perceived usefulness but not behavioral intention. Also cultural influence, age, gender and education were not found to be significant.
[66]	-	Four individual surveys such as 658 text message surveys, 684 contact services survey, 495 payment services survey and 201 gaming services survey.	Perceived ease of use, enjoyment, expressiveness, normative pressure and perceived control significantly influence mobile commerce adoption. *However* Perceived usefulness was not found to be significant
[57]	TAM	180 participants in Taiwan.	Self efficacy, cost, perceived credibility, perceived usefulness, perceived ease of use significantly influence mobile banking adoption.
[98]	TAM + DOI	310 mobile commerce users in Taiwan.	Compatibility, perceived usefulness and perceived cost significantly influence mobile commerce adoption. *However* perceived ease of use was not found to be significant.
[6]	TAM	158 bank customers Malaysia.	Mobile banking adoption – perceived ease of use, perceived credibility, awareness (or information/knowledge), perceived usefulness were found to be significant.
[15]	TAM & DOI	Email survey of 425 individuals.	Perceived usefulness, perceived ease of use, perceived risk and compatibility significantly influence mobile payment adoption.
[44]	TAM & TPB	Email survey of 202 mobile users in HongKong.	Perceived usefulness and self-efficacy significantly influence mobile commerce adoption. *However* perceived ease of use and subjective norm were not found to be significant.
[24]	TAM	Survey of 271 people in Ghana.	Perceived usefulness, perceived ease of use, facilitating conditions, perceived credibility, attitude and behavioural intention and efficacy significantly influence mobile commerce adoption. However age and gender were not found to be significant.
[25]	TAM	A survey was conducted on 190 Individual mobile commerce users in China and USA.	*In China:* Perceived usefulness, perceived ease of use, innovativeness, perceived cost and subjective norm were found to be significantly affecting mobile commerce adoption. *In US:* Perceived usefulness, privacy, compatibility and perceived enjoyment were found to be significantly affecting mobile commerce adoption.
[30]	TAM	Web-based survey of 314 respondents in Australia.	Perceived usefulness, compatibility, perceived risk, perceived cost and attitude significantly influence mobile banking adoption.
[36]	TAM	Web Survey in Korea 910 usable responses.	Perceived usefulness, perceived ease of use and trust significantly influence mobile banking adoption.
[55]	TAM extended	357 MBA students in US.	Perceived usefulness, perceived ease of use, personal innovativeness were found to be significant; *But* not social influence.
[56]	TAM	369 professional participants were surveyed in Taiwan.	Enjoyment, perceived usefulness, compatibility and anxiety significantly influence mobile shopping adoption. *However* perceived ease of use was not found to be significant.

[60]	TAM & DOI	Mail survey of 360 participants in Finland.	Perceived ease of use, compatibility and use context significantly influence mobile ticketing adoption. *However* perceived usefulness was not found significant.
[96]	Extended TAM	222 respondents in Malaysia.	Perceived usefulness, social influence, perceived financial cost and trust significantly influence mobile commerce adoption. *However* perceived ease of use was not found to be significant.
[49]	Extended TAM	263 young people in Germany.	Compatibility, perceived usefulness, and risk are significant indicators for the adoption of mobile banking services. *However* trust, perceived ease of use, and cost were not found to be significant.
[58]	-	A total of 122 usable responses were received from undergrad students in USA.	Performance expectancy, perceived risk significantly influence mobile commerce adoption. *However* Trust belief was not found to be significant.
[80]	TAM & TAM2	600 e-banking users were surveyed in Singapore.	Mobile banking adoption – perceived usefulness, perceived ease of use, social influence, perceived risk and relative advantage played major role there.
[85]	TAM & TPB	121 email survey in Thailand.	Perceived usefulness, perceived ease of use, subjective norm, self-efficacy, cost and perceived risk affecting mobile banking adoption in Thailand.
[40]	-	100 face to face survey in Bangladesh.	Pricing and cost, rich and fast information, and Security and privacy significantly influence mobile commerce adoption. *However* Awareness and knowledge, convenience and perceived usefulness were not found to be significant.
[45]	DOI	301 bank customers Jordan.	Self-efficacy, compatibility, relative advantage, complexity were found to be most influential factors effecting mobile banking adoption.
[5]	TAM	435 University students in Turkey.	Perceived usefulness, attitude and perceived benefit significantly influence mobile banking adoption. *However* perceived ease of use, privacy & security were not found to be significant.
[16]	DOI	610 banks customers in Taiwan surveyed	Attitude, perceived risk, relative advantage, triability effect mobile banking adoption significantly. *However* Image, observability, awareness were not found to be significant.
[20]	TAM	275 participants in Zimbabwe.	Perceived usefulness, perceived ease of use, cost, perceived risk, social influence and relative advantage significantly influence mobile banking adoption.
[62]	TAM	210 participants surveyed in Persia.	Perceived usefulness, perceived ease of use and trust significantly influence mobile banking adoption.
[3]	TAM	372 mobile users in Bahrain.	Perceived usefulness and perceived ease of use significantly influence mobile banking adoption. *However* perceived risk and cost were not found to be significant.
[29]	TAM & DOI	600 participants in India.	Perceived usefulness, attitude, social influence, facilitating condition significantly influence mobile banking adoption. *However* perceived ease of use and privacy & security were not found to be significant.

It is obvious that a larger number of determinants have been added to TAM model in different studies in different contexts to explain the adoption of mobile commerce more accurately. Among them few were frequently added, although not found to be always significant, such as attitude, social influence, trust, compatibility, facilitating condition, perceived risk, perceived cost and awareness.

Attitude was found to be significant by many studies (See Refs. 5, 18, 24, 30, 69 and 29). However the dependent variable 'attitude', from the original TAM model, has been omitted from the proposed model as many studies concluded that 'attitude' has no significant effect on the intention to use information and communication technology (see Refs. 90, 98, 92 and 28) also agreed that 'attitude' may not play an important role when other factors such as usefulness are independently taken into account. The weak effect of the variable 'attitude' led a number of researchers, including the authors of the current paper, to omit it while extending TAM model in their studies (see Refs. 17, 25, 56, 96, 98, 40, 63, 15, 36, 53, 44, 48, 50, 72, 46 and 60).

Mixed result was found for trust; some found that to be significant (see Refs. 54, 36, 96 and 62) and some did not (se Refs. 49, 58 and 99). Trust is a psychological force that lets one party to believe that the other party will behave according to its expectation and the former will be fairly treated[47]. According to Kim, Shin and Lee four factors influence customer's initial trust on mobile commerce such as relative benefits; trust propensity or disposition to trust structural assurance and firm reputation[47, 58]. Relative benefit is a similar concept to 'perceived usefulness' proposed by Davis for the first time in his TAM model[26]. Structural assurance, part of which might be covered in perceived risk, is defined as the perception of the client towards the legal and technical structures of mobile banking that ensures the security and confidentiality of a mobile transaction, and guarantees the refund of any balance lost through online hacking or fraudulent activities[58, 47]. Luo et al., found that 'trust' negatively correlated with 'perceived risk' in mobile banking. Besides that trust has many dimensions, each having relationship with different factors such as trust in vendor integrity & predictability → I [35], trust in vendor ability → I[35], trust on Govt. → lower Risk[10], trust on bank → I & perceived risk[58] and trust on Internet → lower Risk[10]. Measuring all these relationships could require a separate study for trust (for example see Refs. 10 and 46) which is beyond the scope of this study.

Contradictory findings were also observed for social influence/subjective norm [for example: *Significant* (see Refs. 96, 69, 54, 29, 20, 85) and *Non-Significant* (see Refs. 63, 55, 25, 44, 95, 68 and 92) did not find any strong evidence to support the relationship of facilitating condition → behavioural intention. The finding is consistent some studies (see Refs. 54 and 61) but contradicted with others (see Refs. 29 and 24). Venkatesh et al., argued that the core concepts within the facilitating condition constructs are largely captured by the constructs of perceived ease of use and effort expectancy; and can be found significant only when examined in conjunction with moderating effect of age and experience[92].

Compatibility has been found to be significant in many studies (see Refs. 2, 60, 45, 49, 98, 30, 56, 15) except for one study in China[25]. Most of these studies were conducted either in developed countries or in the countries where customers engage in mobile commerce transactions independently using their own mobile phones. The mobile commerce scenario in Bangladesh is a little different, where most of the mobile commerce transactions (i.e. mobile ticketing, mobile billing, mobile payment etc.) are conducted via a third party such as telco's customer care points[76]. Here customers may have perceptions on the usefulness, cost and risk of mobile commerce transactions; but they are less likely to have clear perceptions of its compatibility. How compatible the mobile phone is for conducting mobile commerce transactions is unknown as they do not use their own mobile device for that purpose. The same qualification can be applied for perceived ease of use in measuring the degree of user friendliness of mobile commerce technologies. However as perceived ease of use is the original construct of TAM, the authors have maintained it in the proposed model to ensure consistency with previous studies. In the next section the Research model and its hypotheses along with the development of the proposed model and its constructs will be further justified.

3. Research model and hypotheses

In their review of the literature the authors investigated a series of determinants and concluded, based on their analysis, that perceived risk, cost and personal awareness were highly important for mobile commerce adoption in developing countries like Bangladesh. The effectiveness and suitability of these determinants will be further justified in the next sections. In the proposed model TAM has been extended by these three factors to more accurately explain mobile commerce adoption in Bangladesh. This proposed extended TAM model is depicted in figure 3, with the added determinants being shaded.

3.1 Perceived usefulness

Perceived usefulness is defined as the degree to which a user believes that using a particular technology would improve his or her job performance[26]. There is strong evidence that perceived usefulness (PU) played an important role behind the adoption of new technologies. A large number of studies found perceived usefulness to be highly significant in influencing the adoption of mobile commerce (See Refs. 3, 5, 6, 7, 15, 18, 20, 24, 25, 29, 30, 36, 44, 49, 54-57, 62, 74, 70, 80, 85, 98, , 96,). Therefore it is hypothesized that

H1: Perceived usefulness positively affects consumer's intention to use mobile commerce.

3.2 Perceived ease of use

Perceived ease of use is defined as user's belief on the degree of user friendliness of a particular technology[26]. It is the second most significant factor, in the TAM model, that found to be affecting the adoption of new technology[26]. Many studies in the field of mobile commerce of adoption witnessed that evidence which found the relationship of perceived ease of use → behavioural intention to be highly significant (see Refs.

3, 6,7, 15, 18, 20, 24, 25, 36, 54, 55, 60, 62, 66, 70, 80 and 85). Although few studies did not find perceived ease of use to be significant (see Refs. 5, 29, 40, 49, 56, 96 and 98) still the author decided not to exclude this determinant because it is the original determinant of TAM model and the proposed model is just an extension of TAM rather it's modification. Therefore the following hypothesis is proposed.

H2: Perceived ease of use positively affects consumer's intention to use mobile commerce.

3.3 Perceived cost

Perceived cost is defined as the degree to which a perspective user thinks that mobile commerce services are expensive[96, 98]. TAM was originally designed for investigating user's behavioural intention to use IT services mainly[26, 91], where the chance of monetary transaction being involved was very low, hence cost was never introduced in the original TAM model[7]. Later on, TAM was used to explain the adoption different technologies including mobile commerce which has both transactional and non-transactional dimensions in it; and as far as the monetary transaction is concerned it is expected that perceived cost would play an important role in the adoption of that service[7, 72]. Most of the empirical research in developing countries also support the hypothesis that perceived cost negatively effects user's intention to use mobile commerce services [For example, see Ref. 40 – studied 100 participants in Bangladesh; Ref. 20 – studied 275 participants in Zimbabwe; Ref. 96 – studied 222 respondents in Malaysia; Ref. 25 – studied 190 mobile commerce users in China; Ref. 85 – studied 121 email survey in Thailand; and Ref. 98 – studied 310 mobile commerce users in Taiwan].

A majority of developing countries have some basic characteristics in common such as poverty, low GDP and high unemployment rate. There is nothing different for Bangladesh, the subject of this study, where 45% of the total population is living below the poverty line with an unemployment rate of 2.5% [22]. Therefore perceived cost is expected to be an influential factor for mobile commerce adoption, hence hypothesised as follows:

H3: Perceived cost negatively affects consumer's intention to use mobile commerce

3.4 Perceived risk

The risk of having financial loss and fraud can't be avoided in financial transactions. The gross financial loss due to cyber crime exceeds £1 trillion annually worldwide[78]. Perceived risk is defined as the degree to which the perspective user thinks that it would be risky to use mobile commerce services[15]. Chen integrated TAM and DOI to investigate the factors affecting mobile payment adoption and found that perceived risk significantly affect user's intention to accept mobile payment services[15]. Chitunga & Munongo surveyed 275 participants in Zimbabwe that also support for the role of perceived risk on mobile banking adoption[20]. Another study also found the similar result when investigating the factors affecting mobile commerce adoption in USA[58]. Their analysis of the 122 usable responses, from undergrad students in USA, revealed that perceived risk alone can explain 22% of the variance in the behaviour intention to use mobile commerce adoption[58].

Besides that the number of empirical studies, investigating mobile commerce adoption, that found perceived risk to be significant were much higher than those that did not find it significant [for example, *Significant*: Refs. 2, 15, 16, 20, 30, 49, 58, 80 and 85; *Non-Significant:* Refs. 3, 7]. Hence the following hypothesis is developed:

H4: Perceived risk negatively affects consumer's intention to use mobile commerce

3.5 Personal awareness

The proposed model considered 'personal awareness' to be another construct for the extended TAM. 'Personal awareness' is defined as the degree to which the perspective user is aware of mobile commerce applications and technologies, a concept adapted from Refs. (59, 64 and 93) and modified according to the context of the current research. Lack of awareness has been noted as one of the major barriers preventing e-government reaching its desired outcomes[93]. In Bangladesh, the lack of awareness of ICT is found to be so great that it affects every sector from government officials to the general public[39]. Cancer screening research has pointed out "lack of awareness" as the most common barrier for patient participation in screening tests[82]. A survey conducted in 2000 revealed that 47% of the respondents were unaware of screening for colorectal cancer; in case of mammography and pap test screening this rate was lower yet significant, at 17.1% and 11% respectively[82]. However the effect of awareness or knowledge was not found to be significant for mobile commerce adoption in Bangladesh[40]; but some empirical studies supported that the lack of awareness or knowledge act as a barrier to mobile banking adoption[6, 88].

Therefore it is hypothesized that

H5: Personal awareness positively affects user's intention to use mobile commerce.

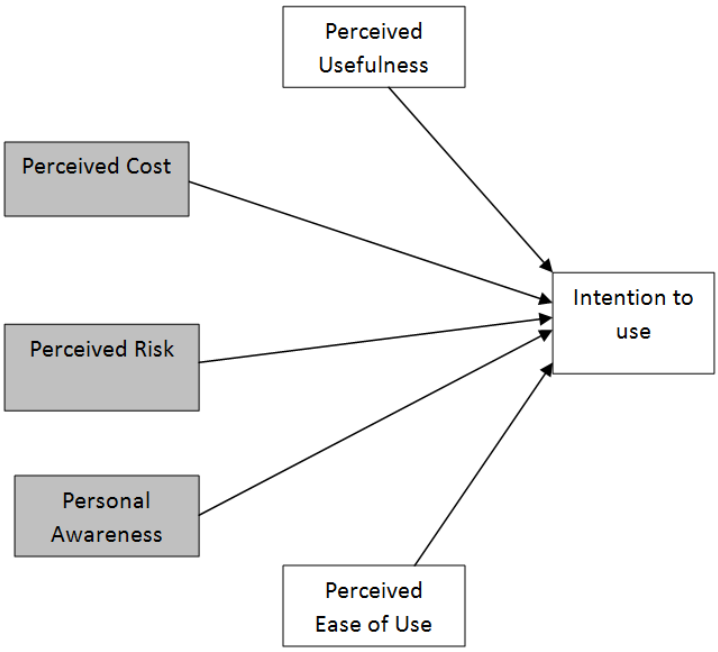

Figure 3: Proposed extended TAM model for mobile commerce adoption in developing countries.

4. Methodology

4.1 Sampling and data collection

The target population of this study was the mobile phone users in Bangladesh, those who are more likely to adopt mobile commerce in future than those without access to a mobile phone. Non probability judgement sampling was used in this study. For this sampling a researcher, with prior knowledge and experience of the population and its elements, used their expertise to select portions of the population as samples that best serve the purpose of the research[87]. Being a Bangladeshi national by birth the main author had been engaged in continuous observation of the progress of mobile commerce in Bangladesh. Although this type of sampling may not accurately represent the whole country, it is argued that the selection of the sub-populations sampled in the current survey was not based on convenience alone, but on valid criteria that lessen the impact of its non-random nature.

The two main cities of Bangladesh, Dhaka and Chittagong, were selected for the purpose of sourcing high users of mobile commerce as the majority of all technological advancements are expected to initially occur in these two cities. Conversely, medium or low users are predicted to be found in the district towns and rural areas. Therefore the two district towns such as Mymensingh and Kishoreganj and their surrounding rural areas, including rural areas of Chittagong as well, were selected for the study. Male and female, rich and poor within the age group of 16 to 65 were the target populations sampled in those areas.

Since a large number of the participants were expected within the semi-literate and illiterate people, face to face surveys were conducted in the study. Although the face to face survey was time consuming, the reliability and the response rate of this method is much higher than any other process. All the surveys were returned from the total of 630 surveys delivered. Fifty five were filtered out due to null or incomplete answers leaving only 575 usable responses; meaning the response rate was 91.25% which was better than many other cases that did not use a face to face survey for data collection.

4.2 Variable measurements

The survey instrument of the final 23 items under five constructs was developed from previous research on technology adoption (see table 4, including factor loading). The constructs of 'perceived usefulness', 'perceived ease of use' and 'intention to use' were adapted from the works of (see Refs. 13, 19, 26, 28, 90, 91 and 98). 'Perceived risk' was adapted from (see Refs. 19, 31 and 98) and 'perceived cost' from (see Refs. 13, 70 and 96). 'Personal awareness', although found to have been less studied, has been adapted partially from[93]. Each question/item was measured using a seven-point Likert scales ranging from strongly agree (1) to strongly disagree (7). Pilot testing of the survey via the responses of ten Bangladeshi expatriates

was undertaken to ensure its readability, understand ability and consistency.

5. Data Analysis

5.1 Profile of respondents

The demographic profile of the respondents presented in table 2 indicates that 72.2 % were male and 27.8 % female. The age group of '16-25' comprises the vast majority (59%) among all the respondents, with only 2.1% falls within the age group of '56-55'. In terms of their educational background – 17.9% were illiterate, 15.3% studied up to grade 7 or below, 24.7% had the qualification between grade 8 and 12, and 42.1% were beyond grade 12 respectively. The figure 4 shows the categories of mobile commerce services, including the frequency of usage, that were experienced by the respondents.

Table 2: Participant's profile

Item	Sub item	Frequency	Percentage
Number of respondents		575	100%
Gender	Male	415	72.2%
	Female	160	27.8%
User of any mobile commerce service	Adopter	511	88.9%
	Non Adopter	64	11.1%
Age	16-25	339	59%
	26-35	139	24.1%
	36-45	58	10.1%
	46-55	27	4.7%
	56-65	12	2.1%
Suburb	Dhaka (Urban)	212	36.9%
	Chittagong (Urban & Rural)	208	36.2%
	Mymensingh (Semi urban & Rural)	119	20.7%
	Kishoreganj (Semi urban & Rural)	36	6.4%
Literacy	Illiterate	103	17.9%
	Grade 7 or below	88	15.3%
	Grade 8 to Grade 12	142	24.7%
	Grade 12 or above	242	42.1%
Income	Nil	267	46.4%
	Tk. 5K or below/ month	68	11.8%
	Tk. 5K to 10K/month	120	20.9%
	Tk. 10.1K to 20K/month	78	13.6%
	Tk. 20.1K to 50K/month	35	6.1%
	Tk. 50.1K or Up/ month	7	1.2%
Mobile bill/month	Up to Tk. 200	139	24.2%
	Tk. 201 to Tk. 500	197	34.3%
	Tk. 501 to Tk. 1000	139	24.2%
	Above Tk. 1000	84	14.6%
	Not reported	16	2.7%

A large number of participants (80%) used their mobile phone for listening FM radio, followed by the users of mobile internet (60%), mobile credit transfer (40%), mobile billing (28.5%), mobile ticketing (21%) and mobile banking (10%) respectively. The total number of mobile commerce users (whoever used any sort of the mobile commerce services) in this sample was 511 (i.e. 88.8%), out of which 366 (71.6%) of them were male and 145 (28.3%) were female. The detailed list of the participant's mobile commerce usage is shown in table 3.

5.2 Factor analysis and scale reliability

Factor analysis was performed to assess the construct validity; the degree to which a scale measures what it is intended to measure[96]. In order to assess construct validity all the 28 items were subject to principal component analysis (PCA) with direct Oblimin rotation using SPSS 18. Prior to performing PCA the suitability of data for factor analysis was assessed. The presence of a correlation coefficient of 0.3 or above in the correlation matrix met the preliminary requirement. Additionally, the Kaiser-Meyer-Oklin value was found to be 0.801 which is above the threshold value[71] of 0.6 and the Bartlett's Test of Sphericity reached statistical

significance[71]. All of these measures supported the suitability of the data set for factor analysis. PCA revealed the presence of seven components with eigenvalues exceeding 1, explaining 15.7%, 11.1%, 9.8%, 5.1%, 4.3% and 4.2%, 3.6% and 3.5% of the variance respectively. The screeplot (figure 5) showed a break after the fifth component which indicated for five component analysis[71]. The five component solution explained a total of 46.1% of the variance. Five items were excluded because of low factor loadings. The factor loading of the majority items was 0.7 or above, hence the construct validity was established based on these results. The factor loading of each item was sorted and is presented in table 4.

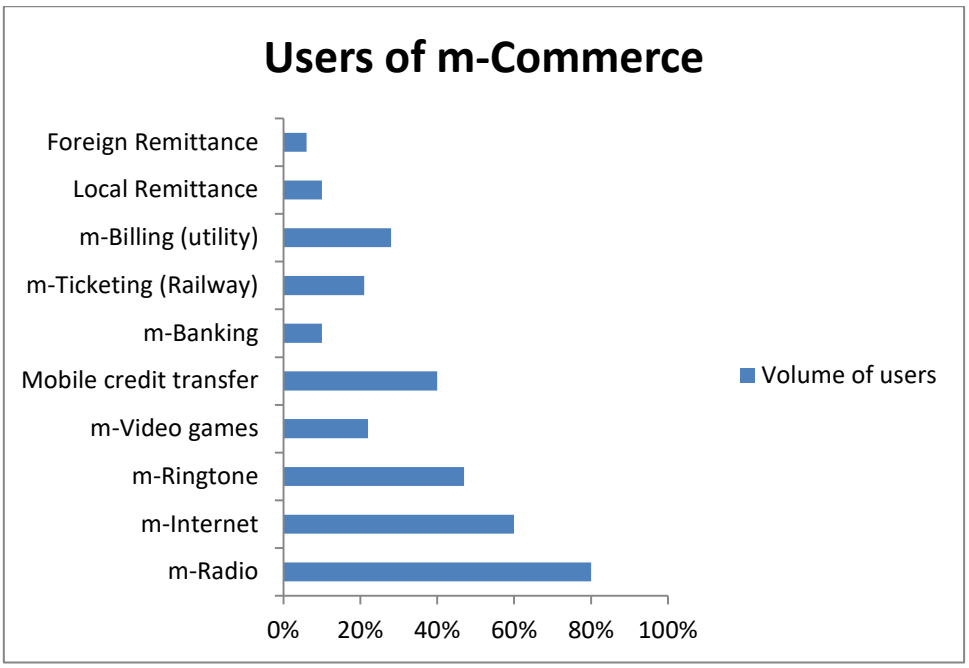

Figure 4: How is mobile commerce used in Bangladesh.

Table 3: Various types of mobile commerce usage, categorized between male and female

	Gender					
	Female		Male		Total	
	Count	%	Count	%	Count	%
I used mobile phone for m-Railway ticketing	29	18%	94	22.6%	123	21.4%
I used mobile phone for m-Billing	38	23.7%	126	30.3%	164	28.5%
I used mobile phone for local Remittance	11	7%	48	11.5%	59	10.2%
I used mobile phone for foreign Remittance	6	3.7%	29	7%	35	6%
I used mobile phone for m-banking	12	7.5%	48	11.5%	60	10.4%
I used mobile phone for balance transfer	62	38.7%	171	41.2%	233	40.5%
I used mobile phone for listening radio	132	82.5%	329	79.2%	461	80%
I used mobile phone for updated news	68	42.5%	188	45.3%	256	44.5%
I used mobile phone for internet modem	43	26.8%	126	30.3%	169	29.3%
I used mobile internet for my mobile phone	101	63%	246	59.3%	347	60.3%
I used mobile phone for Facebook	85	53%	188	45.3%	273	47.4%
I used mobile phone for email	62	38.7%	146	35.2%	208	36%
I used mobile phone for reading newspaper	44	27.5%	110	26.5%	154	26.8%
I used mobile phone for ringtones downloads	66	41.2%	206	49.6%	272	47.3%
I used mobile phone for video games	22	13.7%	106	25.5%	128	22.2%
I used mobile phone for videos	24	15%	104	25%	128	22.2%

Table 4: Factor loading of the items

Variable	Scale item	Factor loading	Eigen value	% of variance
Personal Awareness (PA)	I don't know very well about mobile railway ticket	0.755	4.396	15.7%
	I don't know very well that mobile phone can be used for paying bills	0.797		
	I don't know very well that m-remittance	0.579		
	I don't know very well that mobile phone can be used for banking	0.479		
	I don't know very well that mobile phone can be used for listening radio	0.554		
	I don't know very about mobile internet	0.728		
	I don't know very well about buying ringtones in mobile phone	0.632		
	I don't know very well mobile video games	0.621		
Perceived Risk (PR)	I don't feel safe in online transaction through mobile phone	0.777	3.108	11.1%
	Transaction through mobile phone is not confidential	0.776		
	Transaction through mobile phone will create unexpected problems	0.740		
	I prefer cash transaction over mobile transaction	0.436		
Perceived Usefulness (PU)	I think mobile commerce is very in useful in my daily life	0.652	2.747	9.8%
	I think mobile commerce does enhance my performance in my daily life	0.818		
	I think mobile commerce does enhance my effectiveness in my daily life	0.800		
	I think mobile commerce does enhance my productivity in my daily life	0.800		
	I think I can save time by using mobile commerce services	0.646		
	I think I can save money by using mobile commerce services	0.440		
Perceived ease of Use (PEOU)	I think it needs a lot of mental effort to use mobile commerce services	-0.596	1.430	5.1%
	I think mobile commerce services are very user-friendly	0.680		
	I can learn mobile commerce without any customer support	0.687		
Perceived Cost (PC)	M-commerce enabled mobile phone is very expensive	0.673	1.215	4.3%
	Mobile bill will be very high for using m-commerce services	0.781		

The reliability of the questionnaire was tested using Cronbach Alpha (α) which measures the internal consistency among the items of each construct. The Cronbach Alpha (α) for each independent variable was as follows: personal awareness (0.789), perceived usefulness (0.79), perceived risk (0.677), perceived ease of use (0.606), and perceived cost (0.567). The first two values were above 0.7 exceeding the recommended value but others were not. This was because of the low number of items belonging to these constructs, in which case the expected value of Cronbach Alpha (α) could be 0.5 (see Ref. 71). The values of Cronbach's Alpha (α) for all the constructs were found to be satisfactory although 'Cost' had the lowest value of all i.e. 0.567 due to the low number of items that constitute that construct. In such a case this value is accepted[71].

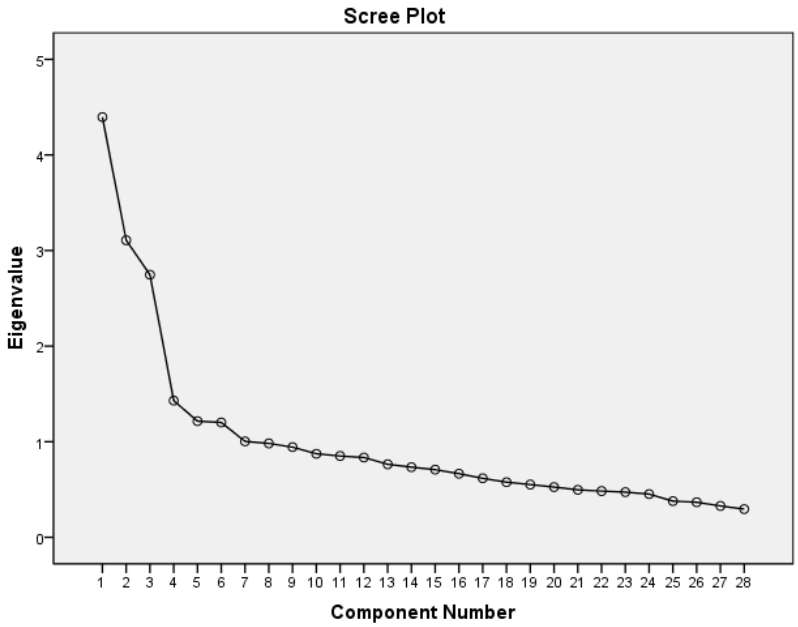

Figure 5: Scree Plot of Explanatory Factor Analysis.

5.3 Correlation analysis

Relationships among the variables were separately examined using the nonparametric correlation coefficient of Spearman's Rho[71]. All correlation coefficients were found to be under 0.8, ensuring the nonexistence of significant multicollinearity. The relationship between Intention and perceived risk (PR) was found to be the strongest among others, but negative, which has the correlation coefficient of -0.455, followed by the relationship of Intention vs. PU (perceived usefulness) with the coefficient of 0.359. However the correlation coefficient of 0.182, between Intention and PA (personal awareness), was found to be the lowest, indicating the weakest correlation between them. Table 5 shows the correlation coefficients for all pairs of variables.

Table 5: Correlation analysis

	PU	PEOU	PR	PC	PA	I
Perceived Usefulness (PU)	1	0.166*	-0.160*	-0.015	0.195*	0.359*
Perceived Ease of Use (PEOU)	0.166*	1	-0.240*	-0.196*	0.304*	0.256*
Perceived Risk (PR)	-0.160*	-0.240*	1	0.294*	-0.117*	-0.455*
Perceived Cost (PC)	-0.015	-0.196*	0.294*	1	-0.058	-0.263*
Personal Awareness (PA)	0.195*	0.304*	-0.117*	-0.058	1	0.182*
Intention (I)	0.359*	0.256*	-0.455*	-0.263*	0.182*	1

5.4 Multiple regression analysis

Multiple regression analysis was employed to test the hypotheses. This method of analysis is considered to be effective for investigating the relationship between a single dependent variable and several independent variables (see Refs. 96 and 37). It also determines how much of the variance in the dependent variable (i.e. Intention) can be explained by the independent variables (PU, PEOU, PC, PR and PA) (see Refs. 71, 87 and 96). Multiple regression has been adopted by a large number of studies investigating mobile commerce or ecommerce adoption using extended TAM model, which seek to analyse a dependent variable by incorporating as many independent variables as may be necessary (e.g. Res. 19, 26, 27, 30, 31, 40, 43, 45, 50, 53, 79 and 96). Pairwise cases were excluded from the analysis and Mahalanobis and Cook's distance were selected. The basic assumptions, such as the nonexistence of multicollinearity, singularity and outliers, as well as the existence of normality and linearity were checked in the first stage of the analysis. The results of the regression analysis are presented in table 6.

Table 6: Result of regression analysis

	Standardized Coefficient (β)	T	Sig	Part (Correlation)	$(Part)^2$ In (%)	Tolerance	VIF
Constant		10.094	.000				
Perceived Usefulness (PU)	0.251	7.175	.000	0.244	5.95%	0.944	1.060
Perceived ease of use (PEOU)	0.082	2.182	.030	0.074	0.5%	0.814	1.229
Perceived Risk (PR)	-0.373	-10.204	.000	-0.347	12%	0.867	1.154
Perceived Cost (PC)	-0.139	-3.845	.000	-0.131	1.7%	0.885	1.130
Personal Awareness (PA)	0.103	2.826	.005	0.096	0.9%	0.877	1.140
$R = 0.585$; $R^2 = 0.342$; Adjusted $R^2 = 0.337$; $N = 575$							

All correlation coefficients between the pairs of variables were found to be much lower than 0.9, ensuring the nonexistence of multicollinearity[71]. The minimum value for Tolerance (> 0.1) and the maximum value for Variance-inflation factor (< 10) also indicate no possibility of multicollinearity (see Refs. 71 and 96). The straight diagonal line of the Normal Probability Plot (see Appendix) ensures that there is no major deviation from normality[71]. Regression analysis shows that all of the independent variables significantly affect the intention to use mobile commerce at level $p < 0.0005$, except for PEOU (Sig: 0.03) and PA (Sig: 0.005) although below $p < 0.05$. Hence all the hypotheses were supported. The summary of the hypotheses testing is shown in the table 7, however the correlation analysis (see table 5) indicated that the most influential factors effecting user's intention to use mobile commerce were perceived risk (PR) and Perceived usefulness (PU), followed by perceived cost (PC) and perceived ease of use (PEOU) respectively. The effect of personal awareness on mobile commerce adoption was found to be the lowest.

The R square value 0.342 suggests that 34.2% of the variance in the dependent variable (Intention) can be explained by this model[71]. The percentage of actual unique contribution of each independent variable could be found from the Part value of the table 6. For example, the part value of perceived risk (PR) was found to be -0.347, if squared then 0.120, means the unique contribution of PR to explaining the variance in the dependent variable (Intention) was 12%, while the whole model explains only 34.2%. Similarly the unique contribution of other independent variables such as PU and PC were found to be 5.95% and 1.7% respectively. PEOU and PA had little effect to independently explain the variance in the intention to use.

Table 7: Summary of hypotheses testing

	Hypotheses	*Correlation*	*Result*
H1	*Perceived usefulness positively affects consumer's intention to use mobile commerce.*	*Strong, positive*	*Supported*
H2	*Perceived ease of use positively affects consumer's intention to use mobile commerce.*	*Moderate, positive*	*Supported*
H3	*Perceived cost negatively affects consumer's intention to use mobile commerce*	*Moderate, negative*	*Supported*
H4	*Perceived risk negatively affects consumer's intention to use mobile commerce*	*Strong, positive*	*Supported*
H5	*Personal awareness positively affects user's intention to use mobile commerce.*	*Weak, positive*	*Supported*

Regression analysis was conducted separately for urban (Dhaka and Chittagong cities) and semi urban and rural (Mymensingh and Kishoreganj districts) areas to compare the results between these regions, as shown in table 8. The results varied significantly in some cases, for example, the variance explained by the model in urban areas was 33.4%, whereas in the semi urban and rural areas that value jumped to 45.5%, quite higher than the former one. In urban areas the unique contribution of perceived risk was the highest (22.3%); but in semi urban and rural areas perceived usefulness was found to be the most significant factor accounted for 13.54% of the variance in the behavioural intention to use, followed by perceived risk (10.24%). It means that the people in the rural and semi urban areas are less concerned about the risk of mobile commerce. Perhaps they found it convenient and useful because banks or other alternatives of mobile commerce are not easily available to them.

Table 8: Comparison of regression analysis between two areas

	Urban area (Dhaka and Chittagong) $R = 0.578$; $R^2 = 0.334$ Adjusted $R^2 = 0.326$; N = 420			Semi urban/ Rural area (Mymensingh and Kishoreganj) $R = 0.675$; $R^2 = 0.455$ Adjusted $R^2 = 0.437$; N = 155		
	Part	$(Part)^2$ in (%)	Sig	Part	$(Part)^2$ In (%)	Sig
PU	0.27	7.3%	.000	0.320	10.24%	.000
PEOU	0.064	0.4%	.191	0.095	0.9%	.117
PR	-0.473	22.3%	.000	-0.368	13.54%	.000
PC	-0.278	7.73%	.000	-0.100	1%	0.099
PA	0.130	1.6%	.000	0.021	0.04%	.724

6. Highlighting the research outcomes:

The major research question of this study was to find out the key factors that affect user adoption of m-commerce. In the other words to investigate why people use mobile commerce services, what are the reasons or factors behind this adoption. The study was based on TAM model because of its credibility of predicting the user adoption of various technologies over time. The major question was subdivided into three sub-questions such as "To what degree do personal awareness, perceived risk and perceived cost influence a user's intention to adopt mobile commerce respectively". The empirical study with a quantitative approach was sought to test extended TAM model to answer the research questions.

The survey was designed to investigate the influence of five potential determinants affecting user adoption of mobile commerce. These are perceived usefulness, perceived ease of use, perceived cost, perceived risk and personal awareness. Perceived risk (PR) and perceived usefulness (PU) were found to be the two most significant factors influencing user's intention to use mobile commerce, where the unique contribution of them to explaining the variance in the dependent

variable (Intention) were found to be 12% and 6% respectively. The effect of other factors were found to be significant at level $p < 0.05$, hence validating all the hypotheses, but its unique contribution to explaining the variance in the intention to use were comparatively lower such as 1.7% for perceived cost (PC), 0.9% for personal awareness (PA) and 0.5% for perceived ease of use (PEOU) respectively. The outcome reignites the debate of incorporating PEOU within TAM model as many studies did not find it significant for mobile commerce adoption (see Refs. 5, 29, 40, 49, 56, 96 and 98).

7. Discussing contribution to literature

Perceived usefulness (PU) was found to be one of the most significant factors affecting mobile commerce adoption in Bangladesh as expected, supporting findings of previous research (see Refs. 6, 7, 15, 18, 24, 25, 30, 36, 44, 54, 55, 57, 70, 74 and 98). PU explained 6% of the variance in behavioral intention, although lower than perceived risk but higher than the contribution of any other individual factor. This value was found to be much higher in rural areas than in urban when these were analyzed separately. For example, the unique contribution of PU in rural and semi urban areas was found to be 10.25%, higher than urban areas where it was only 7.3. This finding might surprise other researchers but in the context Bangladesh it is expected as mobile remittance has higher adoption in the rural areas than in urban areas. Of the 40% of users of mobile remittance, 81% were from rural and semi urban areas. As the majority people in the rural areas of Bangladesh do not have a bank account, they use mobile remittance as an alternative to ordinary banking[76]; hence they perceive mobile remittance or mobile commerce to be more useful. In general it can be said that consumers will adopt mobile commerce services when they find it useful. Service providers should continue their research on making mobile commerce services more useful.

Perceived ease of use (PEOU), another determinant of the TAM model, has been empirically tested and found to be significant in a large number of studies in different countries (see Refs. 3, 6, 7, 15, 18, 20, 24, 25, 36, 54, 55, 57, 60, 62, 66, 70, 80 and 85). However others found no evidence to support perceived ease of use having any significant effect on mobile commerce adoption (see Refs. 5, 29, 40, 49, 56 and 98). While perceived ease of use (PEOU) was found to be significant in the current study, it's unique contribution to explaining the variance in user's intention was very low at 0.5%. While exploring the reasons the authors observed that the users in Bangladesh usually get a third party such as 'customer care centers of telcos' to conduct various types of mobile commerce services (i.e. mobile ticketing, mobile billing and mobile payment) on their behalf[76]. As a result they do not have firsthand experience on the user-friendliness of mobile commerce technologies, especially for these services, hence do not a have a clear perception on it's ease of use. This may have caused perceived ease use to have a minimum effect on mobile commerce adoption in Bangladesh; meaning whether mobile commerce is easy to use or not that would not affect consumer's decision to use mobile commerce services. Therefore greater 'user friendliness' has no guarantee that it would increase mobile commerce adoption in Bangladesh.

Consistent with prior studies, Perceived Risk was found to be highly significant in effecting user's intention to use mobile commerce negatively in Bangladesh (see Refs. 15, 16, 20, 30, 49, 58 and 80). This reflects the consumer's concern about privacy and security, the main items that build the construct of perceived risk, of mobile commerce in Bangladesh. Regression analysis showed that 12% of the variance, the highest among all, in the dependent variable (i.e. intention to use mobile commerce) could be explained by perceived risk alone. In the urban areas this value is much higher i.e. 22.3%, than in the semi urban and rural areas where it is only 13.5%. As most of the technological advancements take place in the urban areas of Bangladesh, it can be said that those who are more aware of online vulnerabilities, the people in urban areas, perceive mobile commerce to be more risky than those who are comparatively less aware of this.

The effect of cost was previously assumed to be a strong determinant for mobile commerce adoption in Bangladesh as 45% of the population live below the poverty line[22]. However the effect of perceived cost in the current study was found to be moderate although significant; which negatively effects user's intention to use mobile commerce. Regression analysis showed that 'perceived cost' alone explained only 1.7% of the variance in the intention to use. There might be multiple reasons behind that; one of them could be the average price of a mobile phone in Bangladesh phones are inexpensive, ranging from $15 to $22, equivalent to the world's cheapest phone launched by Vodafone in 2010[9]. Further, smart phone or mobile internet is not required for conducting mobile commerce (especially mobile banking) in Bangladesh as the medium of access of all mobile commerce transactions in Bangladesh is SMS[76]. Thus a person with a normal mobile phone will be able access mobile commerce services in Bangladesh. The service fee is also not very high, for example the fee for paying utility bills (electricity, gas etc.) through a mobile phone ranges

between $0.06 and $0.30[8], and can be afforded by the majority of the people of Bangladesh whose GDP per capita (PPP) is $1700[22].

A weakest positive correlation was found between personal awareness and intention to use mobile commerce in Bangladesh. The correlation coefficient 'Spearman's Rho' between personal awareness and the intention to use was evaluated as 0.182, the lowest among all tested pairs. The regression analysis also showed that only 0.9% of the variance in the intention to use mobile commerce could be explained by personal awareness alone. This result for personal awareness is also supported by previous research on mobile commerce adoption in Bangladesh (e.g. Ref. 40), but contradicted by other findings in different countries (e.g. Julias et al., 2003 and Vrechopoukis et al., 2002 cited in Ref. 40). Media awareness and advertising are powerful tools in making people aware of any products or services. The mobile phone has become one of the top 10 listed TV commercials in Bangladesh, 11% of all TV commercials belong to the mobile operators[77]. Through mass advertising, people may have been well aware of mobile phone and its services, but the adoption of those services is not satisfactory. Hence the research concludes that personal awareness can be considered a prerequisite, but not a major factor, that could affect the user's intention to use mobile commerce in Bangladesh.

8. Discussing practical implications

This research contributes to the body of knowledge in many ways. Firstly it reconfirms the need for extending the TAM model in the context of mobile commerce because unlike information systems, which were studied in the original TAM, it has the two dimensions of transactional and non-transactional that need to be addressed. Perceived risk was found to be a highly influential factor effecting mobile commerce adoption in the current study, with this finding supporting many prior studies (see Refs. 2, 15, 16, 20, 30, 49, 58, 80 and 85); but contradicting a few (see Refs. 3 and 7). Stakeholders of mobile commerce, such as banks and telcos, should develop a system that ensures higher levels of security and privacy to reduce user's perception of risk. Users should be able to feel that the system is secure enough to protect their identity, personal information and money from being hacked by a third party or cyber attack. The government should be implementing strict rules and regulations, so banks are bound to offer full guarantees for any financial losses of customers using m-commerce.

Consistent to prior studies perceived usefulness (PU), the main construct of TAM, was found to be highly significant for mobile commerce adoption. The authors reconfirmed the significant unique contribution of perceived usefulness in explaining the variance in intention to use mobile commerce; which is supported by many studies (see Refs. 6,7, 15, 18, 24, 25, 30, 36, 54, 55, 57, 70, 74 and 98). Scholars should reinforce the inclusion of perceived usefulness in TAM model for investigating any kind of technologies, not only mobile commerce. Continuous efforts should be made by the service providers to upgrade and redesign the mobile commerce contents and technologies so that users can keep up with a fast-paced life style.

Although perceived ease of use (PEOU) was found to be affecting mobile commerce adoption significantly it's unique contribution explaining the variance in dependent variable was found to be very low. It reflects the findings of Rahman who reported that people in Bangladesh heavily relied on telco's customer care points or outlets for conducting any kind of mobile payment services; where customers do not do anything other than request the customer care officers to make a mobile transaction (for paying bills, buying tickets) on their behalf[76]. Therefore neither the customer nor his/her mobile phone is used for the mobile payment service; it is done by the customer care point operator through their own mobile phone. As a result customers might not have a clear perception on how easy it is to use mobile payment services. However customers do have perceptions of the non-transactional components of mobile commerce which is usually done by themselves by using their own mobile phone such as browsing internet, listening music and radio, reading news paper etc. Had the customers used all kinds of (both transactional and non-transactional) mobile commerce services by themselves with their own mobile phone, the result of perceived ease of use may have been different.

Contradictory results are frequently seen for PEOU in the context of mobile commerce. Some found PEOU to be significant (see Refs. 6, 7, 15, 18, 24, 25, 36, 54, 55, 57, 60, 66 and 70) while others did not (see Refs. 5, 29, 40, 49, 56, 96 and 98). Researchers may rethink keeping or removing PEOU when extending or modifying the TAM model in investigating user's acceptance of mobile commerce. Further, Bangladeshi stakeholders of mobile commerce should take some initiatives to ensure that the actual users are engaged in conducting all kinds of mobile payment services independently with their own mobile phone, so they could enjoy the incredible benefits of mobile commerce services such ubiquitous, personalization, versatility, 24/7, using on the move and convenience. Without this the full utility of using mobile commerce will not be achieved.

As this model was designed to test mobile commerce adoption in developing countries such as Bangladesh where the poverty and unemployment rates are high, perceived cost was added. Perceive cost was found to be moderately significant for mobile commerce adoption in Bangladesh. This finding validated prior studies that found perceived cost to be significant (see Refs. 20, 25, 40, 85 and 98). Therefore if the price is reduced mobile commerce adoption is expected to rise in Bangladesh. As transaction is involved in mobile commerce and consumers are price sensitive, scholars are advised to consider perceived cost to be an important additional factor for extended TAM model in the context of mobile commerce or e-commerce, especially in developing countries.

Another contribution in the proposed model is the empirical testing the effect of awareness for mobile commerce uptake. Little prior research was found that examined the role of awareness for mobile commerce adoption. Lack of awareness was found to be a significant barrier to adoption of many new technologies[6, 88, 93]. Especially in Bangladesh, lack of awareness acts as an impediment to e-government uptake[39]. Therefore it was expected that awareness would play an important role for mobile commerce adoption. Although the effect of personal awareness was found to be significant it's unique contribution to explaining the variance in the intention to use was very low (0.9%). This is consistent with another finding that investigated the effect of awareness for mobile commerce uptake in Bangladesh[40]. Therefore the stakeholders may limit their budget in mass media advertising to build up public awareness of mobile commerce.

It should be noted that the survey questionnaire for personal awareness was based on that of Verdegem & Verleye[93], modified suitably to determine the participant's awareness of different mobile commerce applications and services available in Bangladesh. A limitation of this construct (i.e. personal awareness) is that it doesn't measure the level of the participant's knowledge of various aspects of mobile commerce. Rather, it only assesses whether the participants had heard of different types of mobile commerce services or not, but did not reflect their in-depth knowledge; meaning whether they know about the advantages and disadvantages of mobile commerce, its price and policies, or how to get registered for this service etc. This detail, if included, would have been a separate research study dealing with the awareness/knowledge of mobile commerce - but was beyond the scope of the current study. Personal awareness therefore may not represent the participant's in-depth knowledge of mobile commerce, but rather report whether a person is knowledgeable about various mobile commerce services or not. The result may have been different if the participant's in-depth knowledge of mobile commerce was measured and tested to see how that in-depth knowledge effects their intention to use mobile commerce services.

9. Limitation and Future research

This research faces several limitations. Firstly, it is neither a technical paper of mobile commerce nor does it discuss the government policies or regulations; rather the adoption behaviour of this technology is studied across a wide range of the population of a developing country. Secondly, although Bangladesh has been selected as an example of developing country, what works in Bangladesh may not be universally transferable to other developing countries. Thirdly, research employed quantitative method and relied on surveys only. This approach may not be the best for a detailed understanding of the research problem considered. A more qualitative approach such as a field study or case study may be better get a deeper understanding of the problem.

Although mobile commerce means buying and selling goods and services through mobile devices such as mobile phone, PDA, iPAD or smart phone etc. only mobile phones have been considered as a medium for mobile commerce in this study as the adoption rate of mobile phone is much higher in Bangladesh than PDA or iPAD.

The face to face survey method used in this research has many advantages over other survey methods but there are some disadvantages too. For example, in this research there were some people who had never heard of any mobile commerce services and these people may have been biased by the surveyor's introductory speech. The surveyor always made every attempt to remain unbiased while discussing various issues of mobile commerce relevant to the survey, but participants may not always have perceived this in the same way. There were also occasions when groups of people, such as students in a class room or staff in an office, who participated in the survey at the same time, may have discussed it with each other even though they were instructed to discuss it only with the surveyor. In such cases, one might have been influenced by the other. However, initiatives were taken to ensure all the ethical standards of data collection were met.

The model proposed in the current research only explains 34% of variance. This would be improved if it had been within the scope of the research to investigate other issues as well, including subjective norm, social influence, compatibility, speed, convenience and

experience. All these factors had been previously tested by various other researchers, mostly in the context of developed countries, but their conclusions were mixed. These previous researchers did however, not conduct their investigations in developing countries and had they done so, the outcomes would have informed and enriched this current research. Also the comparative studies of mobile commerce adoption between developed and developing countries could have been conducted to see how the user's different perceptions of the same factors impact differently in two different situations, and enable the identification of factors that are effective in developing countries but are perhaps not as effective as in the developed world.

It would be interesting to study the link between awareness of mobile commerce and media advertising to make clear to stakeholders the effectiveness of their advertising. How a company's performance, growth, reputation, solvency and profitability can impact the adoption of mobile commerce- might be another dimension for future work. It would however be too complicated to study all of these factors in one research project, therefore separate research is required to best measure the impact of each.

10. Conclusion

The goal of this research was to identify the factors that positively or negatively affect the adoption of mobile commerce in Bangladesh. Empirical study using quantitative method was conducted to answer the research question "*What factors influence the users in developing countries to adopt mobile commerce?"* Bangladesh has been chosen as the subject of this study because of its rapid penetration of mobile phone, the rate of which is over 50%. Even the poorest people such as rickshaw puller, farmer and daily labour have a mobile phone. Although the concept of m-commerce is relatively new in Bangladesh many people were found to have used varieties of m-commerce services, such as m-billing, m-ticketing, m-remittance without realising that these are the applications of m-commerce. In general it can be said that people may not know the definition of m-commerce but are well aware of the mobile financial services available in Bangladesh.
Perceived risk and perceived usefulness were statistically the two most influential factors that negatively and positively affect user's intention to use mobile commerce in Bangladesh respectively. There could be a variety of reasons of why perceived risk was found to be the most significant determinant in Bangladesh rather than perceived usefulness. M-commerce is a very new technology in developing countries especially in Bangladesh. The people haven't realized the power and usefulness of this technology yet. On the other hand trust might not have been developed yet to such as a level that the people could use this technology without skepticism. This is reflected by one of the findings of the current study where majority people prefer cash transaction (27.5%) over online transaction (22%). The effect of PU and PR within semi urban/rural was found to be equivalent, but quite different in urban areas where perceived risk was much higher. That means the people in the urban areas are more concerned about the risk of m-commerce services than the semi urban/rural participants. Lack of alternate electronic services could lead the people of semi urban/rural areas to think about the convenience and usefulness of m-commerce services which might cause PU to be more effective in these areas rather than urban circle.

Mobile banking or mobile financial services, if implemented successfully, could become the primary method of doing small financial transactions in Bangladesh. It could overtake the cash transaction used by the majority of the people there today. A large number of unbanked populations, the largest majority of them are in rural and semi urban areas can be brought under the banking services through mobile banking. People in rural and semi urban areas perceive m-commerce to be more useful than the people in urban areas. It means that the rural population; although a majority of them are poor and illiterate possess high potential for the m-commerce market in Bangladesh. Therefore it's hoped that the consumers of all categories, literate and illiterate, rich and poor, rural and urban, will get involved in m-commerce services once they perceive it as useful, secure, cheap and trustworthy.

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Appendix: Normal P-P Plot