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PRIORITIZATION OF MOBILE BANKING ADOPTION FACTORS

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EXECUTIVE SUMMARY

The advancement of the internet and information technology has been a great vehicle for the development of solutions for all human endeavors. The banking and the financial services sector has advanced from traditional banking services to internet-based banking. In recent times, banks and financial services firms have developed software solutions such as, ATM locator, Mobile banking and others which makes it easier and convenient for the user to have access to the bank without ever walking into the banking hall. The general adoption of mobile banking solutions worldwide is still not that encouraging. There are several drivers which affect the adoption of these internet-based banking solutions, such as socio-economic factors, mobile device adoption, and user behavior to name a few. The present project focuses on enumerating the key factors for user adoption of mobile banking solutions. The factors are then grouped into multiple perspectives and prioritized using the Hierarchical Decision Model (HDM). The results are ranked, discussed and then appropriate suggestions and conclusions are drawn. Our results show that all the factors are important but reliability and privacy are the most important factors that banks should pay much attention to during design and development of mobile banking solutions. We conclude that if a bank pays attention to providing a solution that meets the user's reliability expectation, then the privacy risk can be further minimized since the user might have more confidence that their information will also be handled in the right way, which will not compromise their privacy.

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1 INTRODUCTION

Mobile banking is a system which allows the customers of a financial institutions to conduct transactions through mobile communication technology in conjunction with mobile devices such as a smartphone or a tablet. The earliest form of mobile banking was SMS banking which allowed users to receive simple messages about changes on their account and assessing their account balance [27]. In recent years, this system of banking has evolved and expanded mainly due to the proliferation of smartphones and other mobile devices which allow the creation of rich software applications and content. Consequently, banks and financial institutions in their quest to reach more customers and sustain their existing customers, are creating robust solutions for mobile platforms. In addition to reaching more customers, this will allow them to provide their services to the customers in a very flexible fashion at a reduced cost. This does not require many banking outlets or ATM machines as can be noted with traditional banking.

The US banking market saw the introduction of the mobile banking system in 2007 as an extension of the features of the existing online banking which had been quite successful at the time [27]. As of the beginning of 2014, the US mobile banking market has seen a growth with 33% of mobile phone users using a mobile banking services in the last 12 months [7]. The global adoption rate is expected to keep growing as mobile devices keep penetrating different countries and the consumer markets [7].

The adoption of mobile banking services is incumbent on different factors such as technology development, consumer lifestyle, and socio-economic environments [17]. For instance, as mobile devices and communication technology become more robust, financial institutions will be able to leverage that to create more sophisticated solutions to satisfy customers' needs. Our research focuses on investigating the mobile banking adoption factors from a customer's perspective. We recognize that the financial institutions main goal is to find out what the key factors are that customers consider while making an adoption decision of mobile banking applications. The knowledge of these factors will help them to develop the best possible solution in a very cost effective way.

Although mobile banking has been shown by [27] and other papers to be cost effective and provides personalized and convenient services, the adoption rate is still not encouraging. For instance [8] shows that though mobile phone adoption has jumped to about 105% in the US, the adoption rate of mobile banking services is still around 30%. This trend can be noted in developed markets where mobile phone adoption is high [8].

This research aims to investigate the factors which influence the decision of a potential customer to adopt mobile banking application. The research assumes that other barriers, such as mobile phone adoption, wireless network communication, and socio-economic factors have been considered and found suitable.

The work done under this project is organized in the following way:

- A literature review of mobile banking adoption factors was performed to analyze and identify various factors.
- The factors are then grouped in perspectives using Hierarchical Decision Model (HDM) to group the factors into perspectives, and
- Conduct a customer survey to evaluate which of the factors are important.
- The results are analyzed, and conclusion are drawn.

2 LITERATURE REVIEW

Cognitive barriers of individuals who are reluctant to use new information technology cost an organization millions of dollars, researchers have pointed out. A better understanding of those barriers could improve the efficiency and effectiveness of the firm, as well as the quality of resulting information underlying management decisions [7]. To conduct this kinds of user behavior studies about technology adoption, researchers have used tools such as the technology adoption model (TAM) and the

Theory of Reasoned Action (TRA) to study the importance of various determinants [17].

2.1 EVOLUTION OF MOBILE BANKING

Mobile banking allows users to access banking services conveniently through their mobile devices such as a smartphone or a tablet. The concept of mobile banking has being in existence in the late 90's [17], taking off from advancement in online banking which allowed customers to perform basic transactions via the internet browser. The earliest form of mobile banking was introduced by European banks in the form of SMS banking, where users had basic functionality on their account through SMS alerts and notifications [18]. Mobile Internet allowed users to access the existing online banking channels through optimized browsers for the mobile devices. This allowed for many more banking services to be delivered on mobile devices [27].

In 2007, banks in the United States started to create mobile software applications which were specially developed to work with mobile devices and was perceived by the industry as the most cost effective as compared to the existing channels [27].

2.2 COMMON FEATURES AND SERVICES OF MOBILE BANKING

Most large banks especially in the U.S offer a basic mobile banking solution for their consumers. The most common services available today are:

- Account alerts, security alerts and reminders
- Account balances, updates and history
- Customer service via mobile
- Branch or ATM location information
- Bill pay i.e., electric bill, deliver online payments by secure agents and mobile client applications

- Funds transfers
- Transaction verification
- Mortgage alerts

Advancement in technology has allowed many complicated and robust solutions such as e-commerce payments, contactless payments using Near Field Communications (NFC), to become easily accessible to bank customers [20].

Table 1 is a summary of the factors mentioned in most literatures affecting technology adoption in general and specifically mobile banking.

Table 1: Technology adoption factors

Factors	**Description**	**References**
Phone adoption	Cell phone technology adoption [Mobile User]	[7][8][20][29][34]
Privacy	Concern for Personal Information	[4][6][13][20][22][29][34]
Cost of usage	Cost of services/applications	[3][6][8][12][13][20][25][26][29][34]
Competitive advantage	Competing with other banks	[15]
Cost of maintenance	Updates, maintenance and technical service for the application	[15]
Market size	Mobile user/OS market share	[7][20]
Ubiquity	Use anywhere	[13][15][20][22][36]
Perceived Ease of Use	How easy is it to use	[4][5][8][13][20][22][28][29][35][36]
Perceived Usefulness/Services Delivered	How useful is it	[4][8][20][28][29][35][36]
Design	UI/Flow	[20][29]

Factors	Description	References
Regulation	Regional/State/Federal minimum requirements	[7][15][36]
Life style Compatibility	Compatibility with new innovations	[8][13][28][34]
Technical Compatibility	Compatible with mobile OS version (install from App store or install an software executable)	[1][5][8][11][14][26][29]
Convenience	Convenience of access anytime and anywhere, and ability to react immediately.	[4][8][13][35]
Security	The degree to which a user's information is free from theft	ALL

3 TECHNOLOGY ADOPTION PERSPECTIVES

[16] and [17] have discussed the fact that there are several perspectives toward an individual's decision to adopt a technology; some of being include organizational factors such as training, economical benefits and social networks. For our purposes, we limit our research to two mobile banking end user perspectives: Technical perspective and Personal perspective.

The technical perspective reflects a technology's functioning and observable characteristics as depicted in [19]. In this research the technical perspective covers all the user adoption factors relating to how a mobile banking application functions. The personal perspective similarly is shown in [19], as the subjective opinions of individuals which can have an impact on decision making. The personal perspective in this research mirrors a user's subjective perception about mobile banking solution.

From summary of factors in Table 1 the factors which directly impacts a user's decision assuming a mobile banking application has been developed and is introduced into the market are selected. There are grouped in Table 2.

Table 2: Factors Impacting a Mobile Banking User's Decision

Adoption Perspective	Adoption Criteria	Definition
Personal	Privacy	Users faith in the bank, application developer, and the mobile platform to keep the information safe
	Cost	Perceived cost reflects either direct or indirect charges associated with mobile banking application.
	Perceived Ease of Use	Perceived ease of use can be defined as the degree to which a person believes that using a particular system is free of effort.
	Perceived Usefulness	Perceived Usefulness reflects the quality and quantity of services delivered via mobile banking.
Technical	Reliability	Reliability reflects level of confidence that the user has that he/she will be able to able to successfully complete a task/service begun from the mobile application.
	Compatibility	Technical compatibility related to the current version of mobile environment and its compatibility with the mobile application.
	Ubiquity	Ubiquity means that with the help of mobile terminals and networks, users can access mobile banking at anytime from anywhere.

3.1 PERSONAL PERSPECTIVE

Privacy

Privacy relates to the user's trust that their information will not be compromised in the process of using the ensuing solution. [4] identifies this factor as trust and was cited as the contributing factor which inhibits the adoption of a mobile application. This factor

relates with security is much concerned with who is authorized to see the customer's information during the process of transactions. [6] mentions that during the adoption of mobile banking solutions, customers are concerned about their information being available to third parties. [20] presents privacy as a dominant factor to consider in the design of a mobile banking deployment. [2] places authorized access as one of the key factors to the design requirement of a mobile bank application for which customers will be satisfied. We have selected it to reflect this highly recommended position by the reviewed literatures.

Perceived Cost

In [24] the key factors stimulating and hindering the adoption of mobile-banking were identified and tested. The research also pointed to the effect of user's attitude on the intention of use. The outcome of their research came with some significant results; one of them was perceived cost and its significant effects on the adoption of Mobile-banking. Researchers in [3]and [12] referred in their previous studies to the perceived cost can be a large barrier to adoption of mobile-banking. [25] found out that costs have a significant negative effect on behavioral inclination for using cell-phone for business. On the other hand, [26] emphasized that low costs can encourage customers to use e-banking. Other researchers concluded that there is a negative relationship between perceived cost and intention to use mobile-banking. With more clarification, this means that the higher the cost of using a new technology such as mobile-banking, lesser will be its use.

Perceived Ease of Use

Perceived ease of use was defined in [5] as "the degree to which a person believes that using a particular system is free of effort". [22] indicates that Perceived ease of use reflects the difficulty of using mobile banking due to constraints such as small screens, inconvenient inputs and difficulty in operating in the absence of a good interface. An easy to use mobile application will provide an intuitive interface, innovative entry methods, ample tips and suggestions on how to perform a task, and corrective feedback

when necessary. This will allow the user to spend less time in the application figuring out the structure and menu system and efficiently get through the task.

Perceived usefulness

Technology adoption model (TAM) proposes that a consumer of a given innovation or solution considers its usefulness in their quest to adopt it. This perceived usefulness according to researchers affects a user's intent to buy into the solution or not [28]. With regard to mobile banking adoption, perceived usefulness is crafted as relative advantage by [28], where it is defined as "the degree to which the application is a better alternative relative to current products and services". Also, [29] discusses design requirements emanating from customer needs for a mobile application development and created variables surrounding how the application can be personalized, scaled and have functionalities aside from the core banking needs. These variables constitute perceived usefulness. [30] argues that customers do not chose the mobile banking solutions because they are not sufficiently diversified. Furthermore, [8] conducted a survey on the factors affecting the adoption of mobile banking and concluded that perceived usefulness was a key factor to the adoption.

3.2 TECHNICAL PERSPECTIVE

Reliability

Reliability reflects level of confidence that the user has that he/she will be able to successfully complete a task/service begun from the mobile application. It is nothing but a consumer's confidence that a new technology performs its job precisely and consistently [14]. Reliability and other factors may also differ from person to person. For example a student may need mobile banking application for less cost and may want more functionality, whereas professionals may need reliability of the application and ease of use [31].

Ubiquity

Ubiquity has been explained by [22] as the availability of mobile banking services with the help of mobile terminal and networks allowing users access at anytime from anywhere without any restrictions. [23] describes ubiquity as a means by which the user should be able to access the mobile banking services independent of his or her current geographic location. In today's fast paced world an average user wants to be able to access information instantaneously. With availability of 'smart' technologically advanced mobile devices with connectivity services, such as Wireless Fidelity (Wi-Fi) and cellular services, users enjoy freedom from time and location.

Technical compatibility

Compatibility has been found influential in the adoption of the virtual store. [11] referred to the likely relation between compatibility and adaption that will hold in the context of mobile banking. Compatibility is an important aspect of innovation as conformance with users' lifestyles can propel a faster rate of adoption [21]. A number of previous researches have examined the important factors with the involvement of the mobile banking adoption including some attributes that have relationship with innovation adoption [9]. Compatibility had significant correlation with computer adaption, the relation between compatibility and adaption will hold in the context of mobile banking [11].

3.3 SECURITY

From our literature review, Security has been found as the most important factor. One of the key challenges that a customer faces in adoption of mobile banking is the lack of confidence in security [32]. Since the security risk of a banking system is of importance not only to the customers but could expose the bank to exploitation, it was a dominant concern raised in all the literatures as major factor banks need to be concerned about. Since security is an important factor that needs to be considered at all costs, it was taken out of the analysis.

4 RESEARCH MODEL AND METHODOLOGY

We have opted for HDM - a multi criteria decision tool to evaluate and prioritize our factors because it refines the classic AHP (Analytic Hierarchy Process) by evaluating subjective judgements. This process evaluates factors by pairwise comparison and measures them with a constant-sum measurement scale from 1-99 values.

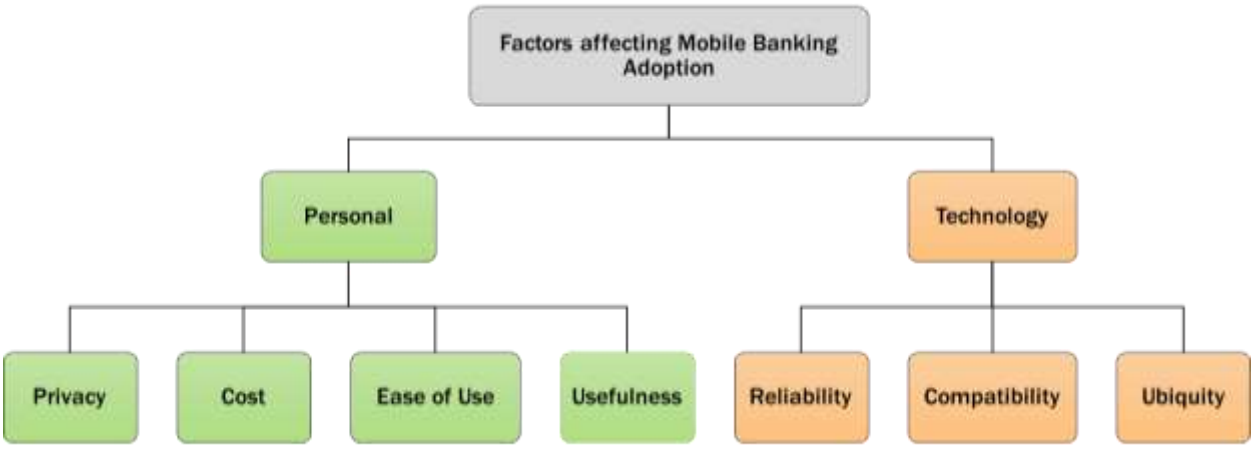

Figure 1: HDM Research model for Factor Prioritization

Using the rubrics of the HDM methodology, we organized the technology adoption criteria into the two categories which portray the logical organization of ideas as is known for multi criteria decision tools. The top level of the HDM method is the objective of the decision; in our case this refers to the prioritization of the customer mobile banking adoption factors. The second level shows the technology adoption perspectives discussed in the previous sections ie., Technical (Technology) and Personal perspectives. The factors under investigation: Privacy, Perceived Ease of Use, Perceived Usefulness, Perceived Cost, Technical Compatibility, Ubiquity, and Reliability are organized as shown the Figure 1.

Since our research was to study and prioritize the factors which influence the adoption decision of customers, we designed our survey to target existing customers and potential customers of banking solutions. Each of the people in our sample space was educated and have at least a first degree. Also they each have used or were aware of mobile banking software applications.

5 DATA COLLECTION

The HDM model was created using the web-tool developed in house at ETM department. The link to the web-tool with the hierarchical model was then sent out random number of individuals. Sufficient care was taken that the surveyors either understood English language or were native English speakers. Also ample information was provided as to what the definitions of the factors are and the purpose of the survey so as to lessen the burden on the surveyors. A total of 20 individuals responded to the survey. The HDM web-tool is not only capable of creating the survey but simultaneous perform Pair-Wise Comparison Method (PCM) on the result set and then produce results as seen in Table 3.

Table 3: HDM Results

Surveyor	Privacy	Cost	Perceived Ease of Use	Perceived Usefulness	Reliability	Compatibility	Ubiquity	Inconsistency
A1	0.34	0.10	0.09	0.12	0.19	0.08	0.08	0.00
A2	0.05	0.08	0.09	0.13	0.35	0.17	0.13	0.00
A3	0.15	0.09	0.17	0.26	0.16	0.10	0.07	0.01
A4	0.65	0.01	0.01	0.07	0.25	0.00	0.00	0.01
A5	0.15	0.14	0.12	0.09	0.27	0.12	0.12	0.01
A6	0.00	0.02	0.60	0.28	0.01	0.00	0.00	0.13
A7	0.12	0.05	0.18	0.64	0.01	0.00	0.00	0.08
A8	0.11	0.07	0.16	0.16	0.30	0.10	0.10	0.00
A9	0.28	0.03	0.01	0.08	0.38	0.15	0.06	0.06

Surveyor	Privacy	Cost	Perceived Ease of Use	Perceived Usefulness	Reliability	Compatibility	Ubiquity	Inconsistency
A10	0.15	0.04	0.16	0.15	0.13	0.10	0.27	0.01
A11	0.17	0.05	0.17	0.12	0.16	0.12	0.21	0.00
A12	0.03	0.06	0.08	0.13	0.13	0.35	0.22	0.03
A13	0.21	0.28	0.09	0.22	0.13	0.02	0.04	0.07
A14	0.11	0.05	0.11	0.22	0.14	0.17	0.19	0.01
A15	0.41	0.08	0.15	0.16	0.14	0.01	0.05	0.01
A16	0.20	0.11	0.14	0.16	0.13	0.12	0.13	0.00
A17	0.13	0.08	0.06	0.12	0.25	0.20	0.15	0.00
A18	0.07	0.03	0.04	0.10	0.36	0.30	0.11	0.01
A19	0.10	0.05	0.04	0.13	0.22	0.22	0.22	0.01
A20	0.17	0.05	0.13	0.15	0.19	0.13	0.19	0.01
Min	**0.00**	**0.01**	**0.01**	**0.07**	**0.01**	**0.00**	**0.00**	
Max	**0.65**	**0.28**	**0.60**	**0.64**	**0.38**	**0.35**	**0.27**	
Mean	**0.18**	**0.07**	**0.13**	**0.17**	**0.20**	**0.12**	**0.12**	
STD	**0.15**	**0.06**	**0.12**	**0.12**	**0.10**	**0.10**	**0.08**	
								Disagreement = 0.1

The results produced are further analyzed to see if some conclusions can be drawn either about the selections made by the surveyors or the surveyors stake of interest in the technology adoption as applied to Mobile Banking Application.

6 RESULTS AND DATA ANALYSIS

Total factors:

The line chart shows the weighted factors of 20 experts, A1 thru A20, across all seven factors (privacy, cost, perceived ease of use, perceived usefulness, reliability, compatibility and ubiquity).

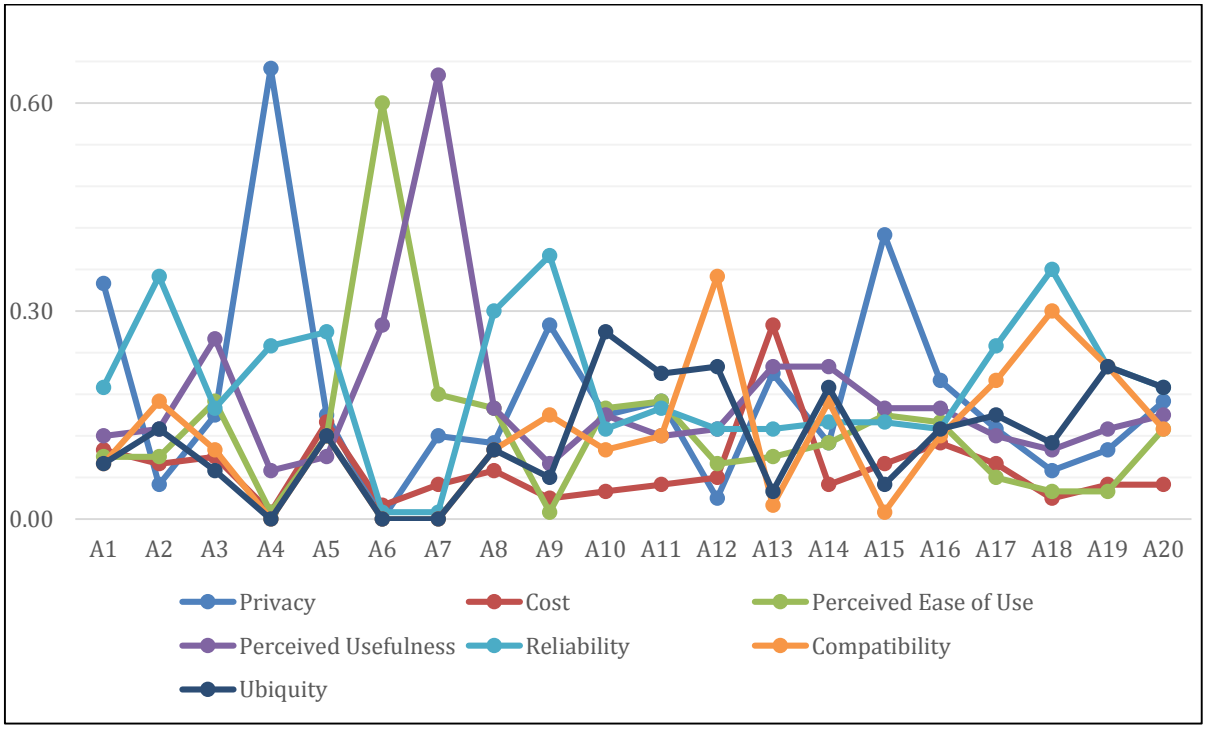

Figure 2: Chart Overlaying HDM Results

Among all these, reliability ranked highest amongst all factors with a mean of 0.20, while the cost ranked the lowest with 0.07. The privacy factor followed reliability with

0.18. Perceived usefulness and perceived ease of use ranked after privacy with 0.17 and 0.13 respectively. Finally, the ubiquity and compatibility factor show equal weights with 0.12.

Table 4: Scaled Ranking Results

Factors	Mean (Overall)	Ranking
Reliability	0.20	1
Privacy	0.18	2
Usefulness	0.17	3
Ease of Use	0.13	4
Ubiquity	0.12	5
Compatibility	0.12	5
Cost	0.07	7

Descriptive Statistics Analysis:

Reliability: The mean indicates that this factor was the most preferred of the factors considered in this survey. With a low standard deviation it indicates that the preference was in general for reliability of the mobile banking application.

Privacy: The mean indicates that privacy was preferred after reliability. The min and max are far apart on this factor with a standard deviation of 0.15, which seems to indicate that the surveyors were not too consistent in their selection of privacy. This is surprising as many articles that were researched, as referenced in Table 2, privacy was given a high importance in being a critical factor while considering the adoption of mobile banking application.

Cost: The min, max and the standard deviation seem to indicate that the surveyors consistently chose something else over cost of services or application.

Perceived Ease of Use and Perceived Usefulness: The data indicates that these options in general were favored less with a given few favoring it more than the others.

Compatibility and Ubiquity: The data indicates that these are the least favored after cost. The surveyors were consistent in their low ranking for these two technology factors.

Correlation Analysis:

The above data was further analyzed using the Data Analysis tools in Excel and thus producing the following Table 5 for correlation.

Table 5: Correlation Analysis

	Privacy	*Cost*	*Perceived Ease of Use*	*Perceived Usefulness*	*Reliability*	*Compatibility*	*Ubiquity*
Privacy	**1.000**						
Cost	**-0.013**	**1.000**					
Perceived Ease of Use	**-0.370**	**-0.132**	**1.000**				
Perceived Usefulness	**-0.259**	**0.023**	**0.401**	**1.000**			
Reliability	**0.125**	**-0.093**	**-0.619**	**-0.661**	**1.000**		
Compatibility	**-0.490**	**-0.191**	**-0.426**	**-0.414**	**0.438**	**1.000**	
Ubiquity	**-0.399**	**-0.139**	**-0.259**	**-0.382**	**0.097**	**0.648**	**1.000**

For the sake of analysis, a magnitude of correlation coefficient of less than 0.4 is considered to have weak correlation and is not discussed here, while a magnitude of correlation coefficient between 0.4 and 0.5 is considered to have slight correlation, and finally a magnitude of the coefficient higher than 0.5 is considered to have significant correlation [33].

From the table presented above, the following seem to have a positive correlation Compatibility and Ubiquity have the highest positive correlation. This seems to indicate that the surveyors who picked Compatibility would consider Ubiquity as one of the important factors affecting their mobile banking adoption. On the other hand Perceived Ease of Use and Perceived Usefulness both share a negative correlation with Reliability. This suggests that ones who considered reliability as a favorable factor did not weigh the usefulness and ease of use of the mobile application and vice versa. The table above highlights some of the other correlations as observed (green as positive correlation and red as negative correlation).

Inconsistency:

The HDM web-tool also provides a measure of inconsistency per surveyor to denote how the results from one surveyor significantly differs from rest. This inconsistency numbers for the 20 surveyors can be seen in Figure 3.

Figure 4 indicates the difference of experts' views on how to choose the key factors. The majority of views followed a fairly similar pattern among 6 out of 20 experts, all remaining at between 0 and 0.02. About 80% of total factors weighed between 0 and 0.3 scales, however a small set of factors exceeded up to 0.65.

In spite of the limited availability of time, the project experts' inconsistency (known as disagreement) is indicated with value of 0.1 which is deemed acceptable based on the recommendation of the ETM department faculty.

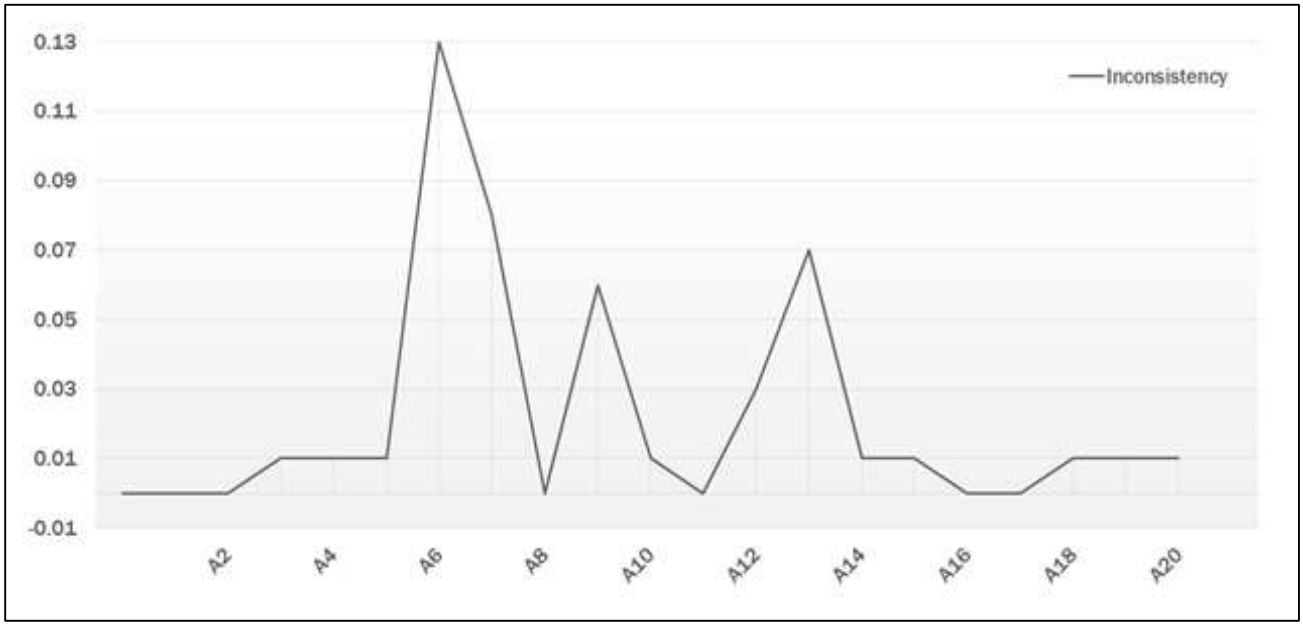

Figure 3: Inconsistency Results

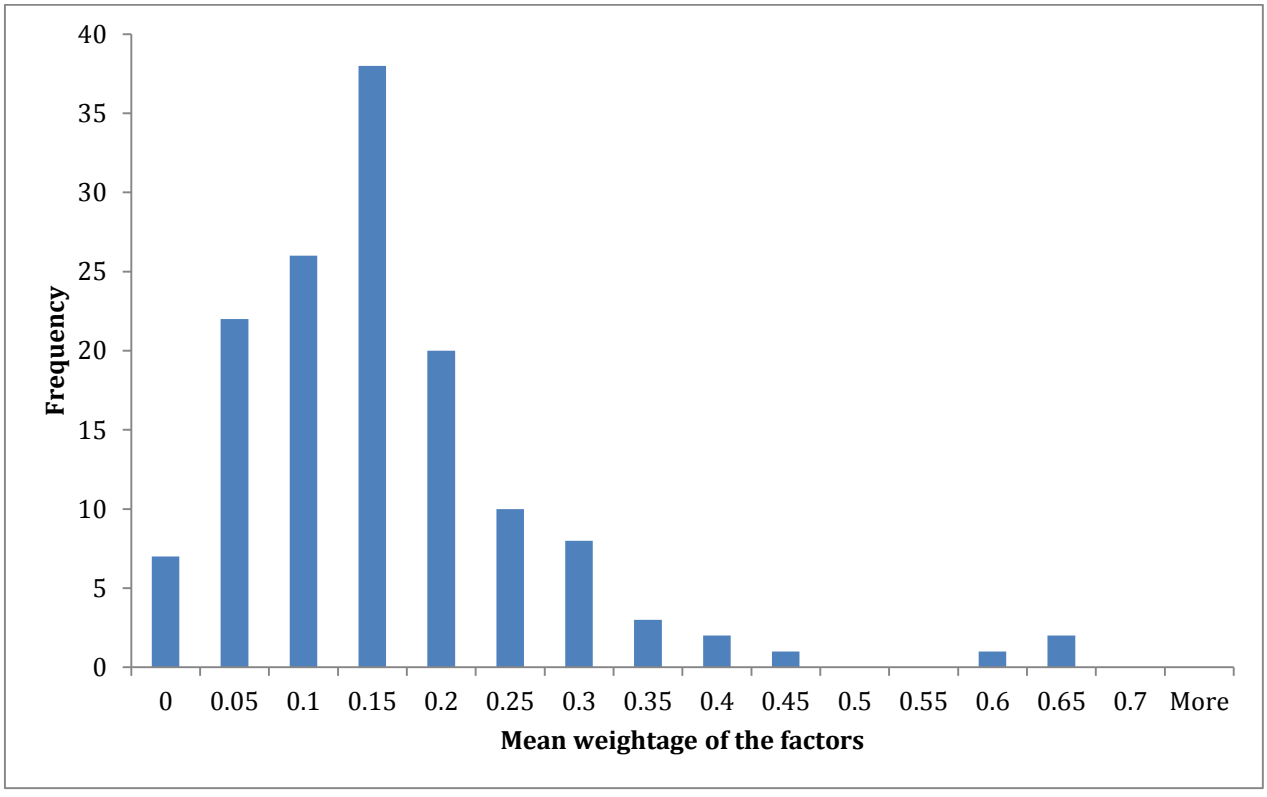

Figure 4: Histogram of HDM Results

7 CONCLUSIONS

In conclusion the survey was able to identify the key factors that typically affect the adoption of a mobile banking application. This survey was not intended to present a winner or loser as all the factors chosen here are all carefully considered and selected after research in the field of mobile banking adoption around the world.

The highest ranking factors here were reliability and privacy with reliability leading slightly over privacy. This can inferred as the user of the mobile application would prefer that the application be consistent and reliably provide services. That would essentially provide a sense of trust [22] and cultivate faith in the bank providing the mobile application and hence relieve some of the privacy concerns that the user may have.

The lowest ranking factors are Cost, Compatibility and Ubiquity with Cost as the least favorite. Cost of the mobile application and/or the services provided seem to be not a matter of concern as long as the application was reliable and provided the services needed.

From the correlation analysis, it seemed obvious that the users who picked Perceived Ease of Use and Perceived Usefulness did not really care for Reliability/Privacy or some of the other technology related factors. This seems to indicate that the user group that these factors were important for someone who was invested in latest technology and carried a level of personal innovation and perhaps can be said to be ones who are willing to take the risk. This user group is more likely to adopt a newer technology or application.

Correlation analysis also indicated that technology factors Compatibility and Ubiquity when favored seem to be less concerned with the personal factors which suggests the user group is less technology savvy and perhaps carried older technology products. This group is less likely to adopt newer technology or application.

One of the key factors that was carefully omitted during the research was Security. It was agreed and understood that Security was a very important factor in Mobile

banking application adoption. It is so important that if it was to be included in the survey, it would have undermined importance of other factors under this research. Even though the research indicates reliability, Security should be given utmost importance while considering the factors that affect Mobile Banking Adoption.

HDM web-tool proved to an excellent aid when considering such survey. It is powerful enough to crunch the numbers and provide the data so most time is spent on analyzing the data and not trying to do the PCM cumbersome math.

Banks need to take this survey into consideration while investing in the development of mobile banking applications and should push for security, reliability, and privacy as key factors. On an average the user will adopt and pay for any banking services, if the application possess such qualities.

8 LIMITATIONS AND FUTURE WORK

Limitations

Even though the survey provides excellent results, it is not without limitations. The survey was limited to individuals residing in United States and hence the results apply to only that market. If the same survey were to be conducted elsewhere the results would significantly vary per the demographics of that region. The survey response was limited to 20 respondents. With a significant more respondents, the results could've been different. Example: Privacy was leading the survey when only 18 individuals had responded to the survey.

Surveyor personal/demographic information was not collected. This could've shed some more light on user adoption trends. The HDM web-tool alone cannot be used for this kind of information gathering, additional survey needs to be sent out or somehow combined together to get most out of the tool.

Future Work:

This study needs to be performed on a larger scale and also consider personal/demographic information of the surveyor to provide a comprehensive picture of the user adoption of mobile banking. Security was removed from the scope of this research but there is much to be investigated to understand what aspects of security are more important to a user. Furthermore, mobile user profile should be taken into consideration to better understand what kind of a mobile user is less likely to adopt a new technology and what factors affect that user's technology adoption.

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