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Examining mobile based payment services adoption issues: A new approach using hierarchical clustering and self-organizing maps

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A new approach using hierarchical clustering and self-organizing maps

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Abstract

Purpose – The purpose of this paper is to make a unified approach in identifying the issues affecting usage intention of mobile-based payment services. The work aims to analyze the reduced factors from data obtained from a survey to highlight the influencers of usage intention mobile-based payment in an integrated manner by incorporating the technical characteristics, technology-specific characteristics, user-specific characteristics and task-specific characteristics.

Design/methodology/approach – A nationwide primary survey was conducted using validated questionnaire requesting response for 11 factors obtained from published literature. In all, 196 respondents participated in the survey in India. Valid responses were analyzed using Growing Hierarchical Self-Organizing Map (GHSOM) model. The interactive GHSOM application was applied to automatically determine the filtering rules for clustering.

Findings – The hierarchical structure of clusters as obtained by applying GHSOM is mainly influenced by factors like innovativeness, discomfort, system quality, perceived usefulness, perceived ease of use, task-fit, connectivity, absorptive capacity and structural assurance.

Research limitations/implications – Increasing trend of online and mobile-based payment has been observed and reported by several studies in India. The frequency of online transactions by women have shown a steady increase over a short period of time. But the survey obtained higher percentage of data from males. Thus future researchers could focus on this aspect to study the influence of this rising trend on adoption of services like mobile-based payment. Trust and existence of physical institutions seem to affect the perception and usage intention. Future researchers may explore the influence of these two issues in situations where there has been some reported cases of breach of trust.

Originality/value – There has been very few studies conducted which reported mobile-based transfer payment adoption issues where-in the transfer mechanism is independent of formal banking. Also no other study adopted the GHSOM approach to analyze the data. The findings would be beneficial for service providers of mobile-based payment services to understand their subscribers and roll out value-added services.

Keywords Technology acceptance, Hierarchical clustering, Mobile transfer payment
Paper type Research paper

1. Introduction

Mobile-based money transfer is a practical and innovative transactional service that uses information and communication technologies (ICTs) tools and non-banking channels (mainly retail) to offer and extend the financial services to subscribers who are not profitable to be reached by formal and traditional financial services providers like banks. Examples of mobile money transfer services are *e*-wallets which facilitate

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transfer payments and a host of others payments. The term mobile money transfer (hereafter *m*-payment) refers to any process of monetary exchange that is generated from a mobile device with due authorization and conformance to legal policy. Traditional banks provide their own mobile banking facility. There are different applications provided by banks which can be installed on a wide range of mobile platforms and can be used with ease. However, one has to understand the difference between mobile banking and *m*-payment. In case of mobile banking, the transactions are done between the customer and the bank, or may be customer to another third party, but still bank intermediates between the two. The medium of communication can be different, i.e., customer and the third party may be subscribers to different internet/mobile service providers. But, in case of *m*-payment, the process is different. Telecom companies with support from central bank are offering "mobile money" as a service. Monetary transactions happen between two parties (users and merchants) where both of them are subscribers of the same *m*-payment service in the same telecom service provider's domain. Technologies like near field communications are being used to make mobile phone an instrument of payment without having to sign any vouchers thus making the process secure. The authorized agent handles the monetary transactions between the parties.

Several leading telecom companies saw immense business opportunity in this area of mobile-based money transfer which can operate independent of any formal bank account and launched product and services to tap this growing segment. Such services can be availed using smart phones (with internet connectivity) or using basic mobile phones (without internet connectivity). However, though the penetration of cellular services has been pervasive in general, the adoption of such value-added services like that of *m*-money is surprisingly low. This is particularly true for a country like India which has the second largest mobile phone subscriber base with mobile phone subscribers (903 million) comprised nearly 96 percent of the total telephone subscribers (1,048) till the end of January 2012 (Yadav *et al.*, 2014; www.coai.com/Statistics/Telecom-Statistics/National), however, subscribers using mobile-based banking or money transfer services is less than 4 percent of the overall subscriber base.

In the present study we take a unified approach to identify the various factors which have been found in published literature in the context to technology adoption as a whole and then try to focus on reduced factors influencing the adoption of *m*-payment services. As there are a large number of variables in the data set therefore, any commonly used methodology could not be easily construed. Growing Hierarchical Self-Organizing Map (GHSOM), an extension of Self-Organizing Map (SOM) which is an unsupervised neural network for clustering and has been applied in this study. The interactive GHSOM application was applied to automatically determine the filtering rules to give the important information of sightseeing spot for Mobile Phone-based Participatory Sensing system (Ichimura and Kamada, 2012).

In particular, the proposed approach uses data to train a GHSOM and then studies the topological pattern among their corresponding subgroups. That is, the proposed approach performs the clustering through feature extraction based on similarity of patterns. Lee *et al.* (2011) developed an extensive analysis of measurement quality by investigating factors influencing the intention to use mobile financial services (MFS) include general technology perceptions, technology-specific perceptions, user characteristics and task-user characteristics using the confirmatory factor analysis techniques. The complexity of working with such high-dimensional data was well elucidated, and a number of patterns abbreviating main parameters to explain the

MFS variables interactions have been developed. The interpretation of these latent variables is not straightforward and spontaneous, and the quantity of missing information owing to dimensionality reduction is complicated to evaluate. Patterns suitable for factors influencing the intention to use MFS modeling have been yet effectively made. Furthermore, Lee *et al.* (2011) reported in their work that additional examination of alternative models is necessary to best explain the intention to use MFS.

Therefore, the present study endeavors to apply an unsupervised GHSOM model to the data set with the following objectives:

(1) supervision of the high-dimensional data and application of hierarchical clustering of the data set; and

(2) recognizing suitable clustering of influencing the intention to use MFS in relation to the needs of management.

The paper is organized as follows: a theoretical background of this study through literature review is presented in the next section. Section 3 elaborates on the research design as used in this study. Section 4 discusses the research methodology outlining the development of the survey instrument and the data collection methodology. The process of data analysis is presented in Section 5 and a discussion of the results obtained has been presented in Section 6 along with managerial implications of the results. Finally we conclude the paper in Section 7 by highlighting areas for future research and possible limitations of this study.

2. Background

The techno-Social acceptability of any new technology proves the real value and its reason for existence. Extensive research has been done by using technology adoption theories to examine mobile banking behavior. Notable among them are Technology Acceptance Model (TAM), innovation diffusion theory (IDT) (Mallat, 2007), and the unified theory of acceptance and use of technology (UTAUT). It needs to be pointed that almost the above mentioned studied which have been extensively focussed on examining user's mobile banking behavior. Those few publications which focussed on usage intention of financial services also basically concentrated on mobile banking (Lee *et al.*, 2011).This paper does not capture mobile banking user intention but concentrates on transfer payment using mobile phones where-in the transactions does not involve bank accounts. This study attempts to identify the factors affecting the acceptance of such types of transfer payment mechanism which are being projected as simple and trust-worthy by the service providers.

Published literature reports models that have tried to explain or predict a user's technology acceptance like the theory of planned behavior (TPB; Ajzen and Fishbein, 1985), the TAM (Davis, 1985), and the UTAUT (Venkatesh *et al.*, 2003). The approach of TPB and the TAM are quite generic in nature. As per the TPB, an user's acceptance of a technology can be explained by their intention, which is determined by a combination of attitude, subjective norms and user's perceived behavioral control. The TPB has been tested to explain a user's behavior in social settings such as health care (Conner and Sparks, 1996) and in acceptance and adoption of technology theory (e.g. Chau and Hu, 2001). The existing empirical evidence divulges the power and ability to predict user intention (Venkatesh and Davis, 2000).

Most of this study examines customers (*m*-payment service subscriber) usage intention and attempts to find answers to questions like as to why is the adoption of *m*-money has been slower than that of mobile internet in general? Such services can be availed without internet connectivity using basic mobile phones and are considered safe and convenient. In spite of the inherent advantages of such services, the adoption has been very slow. This study is an attempt to examine this issue by focussing on the key factors affecting the usage intention of a service like *m*-money in a growing economy. In published literature there are rare works considering visual clustering to explore detail hierarchical pattern influencing the intention to use mobile payment services using a hierarchical approach.

In the visual clustering of market segmentation there are two approaches (Hung and Tsai, 2008). The first approach involves the classical statistical method, such as the hierarchical cluster analysis and Principal component analysis (PCA). In the second approach, artificial intelligence-based SOM algorithm is used that projects and clusters high-dimensional data onto a low-dimensional SOM map, typically two-dimensional for visualization. Motivated by the association of biological neurons with similar task are positioned together, SOM is capable to map similar data onto the similar low-dimensional map output units. Thus, output units will self-organized, preserving the topology and maintain the neighborhood relation. The topology preserving means that the SOM preserves the relative distance between the points. Hence, the SOM has a striking unsupervised learning character for clustering high-dimensional data.

The major drawback of SOM is that it is compulsory to know beforehand the adequate size of the output map and incapability to represent the information in a hierarchical architecture.

The present work will apply the GHSOM that are dynamic multilayer hierarchical network structures which have been developed to address the above limitations. Since we deal with surveyed data on mobile-based payment and the number of variables involved is very large, thus the GHSOM approach may be very relevant. Due to the flexible and hierarchical nature the GHSOM is capable to extract even more complex clustering with a very faster training process. GHSOMs have been adopted in many fields, including image recognition (Palomo *et al.*, 2009, 2013), marketing (de Brito and Oliveira, 2012; Ichimura *et al.*, 2012), finance (Huang *et al.*, 2014), text mining (Shih *et al.*, 2008), data mining (Soriano-Asensi *et al.*, 2008), Time series (Hsu and Chen, 2014), network security (Zolotukhin *et al.*, 2013), and in other emerging areas of research.

However, the authors did not find any study that applied visual clustering to explore detail hierarchical pattern influencing the intention to use a mobile-based payment services using a hierarchical approach.

3. Research design

m-Payment as a service offering is still emerging. Though such services has been in offer by several telecom service providers for the last one year but its adoption has not been satisfactory. Extant research has used information technology adoption theories and models (the notable ones has been discussed in the previous section) to analyze technology adoption and usage intention. Most of them (TAM, IDT and UTAUT) have tried to focus on specific characteristic in the context of information system adoption. Even in context to MFS, researchers have focussed on usage

intention in context to mobile banking (Kim *et al.*, 2009; Lee *et al.*, 2011) but this study takes an unified approach to study usage intention of mobile-based money transfer system which is independent of bank accounts. Other frequently reported factors are as follows:

(1) Usage intention: Fishbein and Ajzen (1975) in their Theory of Reasoned Action (TRA) reported that perceived usefulness significantly affect usage intention. Davis (1985) adapted this model to explain user acceptance of an information system to develop TAM. He defined perceived usefulness as the degree to which an individual believes that using a particular system would enhance their performance. Perceived ease of use is defined as the degree to which using a particular system would be free of physical and mental effort (Davis, 1985). Perceived usefulness has been reported to affect continuance usage (Venkatesh and Davis, 2000). Several other studies (Lu *et al.*, 2010; Shin *et al.*, 2010) have also reported significance of perceived usefulness on usage intention.

(2) System quality: this refers to the access speed, ease of use, navigational and appearance of interface (Kim *et al.*, 2004a, b; Vance *et al.*, 2008). Poor system quality will lower the user's perception toward adoption of services like *m*-payment. If users encounter frequent service interruption and/or service unavailability then payment services would get affected and hence will decrease user expectation and its usage and adoption.

(3) Discomfort: Diffusion of Innovation Theory (DIT) by Rogers (2003) is frequently used in explaining information system adoption issues. Compared with TAM, the DIT is deemed more suitable as subjects used in the study are consumers and not organizational users as in TAM. Complexity in using a system results in discomfort for the end user and affects its usage. Also consumers ability to integrate the service without much discomfort in their daily life impacts such adoption.

(4) Personal innovativeness: it implies the user's willingness to adopt a new system or service (Rogers, 2003). Consumers who are innovative by nature actively seek new ideas and feel less perceived danger (Joseph and Vyas, 1984; Ko *et al.*, 2010). Previous studies reported personal innovativeness to affect acceptance of technology and technology-based service (Venkatesh and Davis, 2000; Lin, 2006). Pagani (2004) in his study showed that perceived innovativeness influences acceptance attitude toward mobile services.

(5) Absorptive capacity: the concept of absorptive capacity was proposed by Cohen and Levinthal (1990). It has found its application in various fields of studies including that of information system adoption. It implies that if users have prior working knowledge of internet and of mobile application then they are more likely to understand and adopt mobile-based services.

(6) Task-technology fit: Goodhue (1998) defines fit as the degree to which users believe a certain technology meets their needs. Previous research (Cooper and Zmud, 1990; Chen *et al.*, 2002) reported that task-technology fit has a significant impact on customer's perceptions of using technology. So on the basis of the above studies, technology is likely to be adopted if it is appropriate for users' tasks (Goodhue and Thompson, 1995).

(7) Monetary value: value has been conceptualized as the monetary or non-monetary benefit of purchasing a product or service (Naumann, 1995). In context to this study, perceived monetary value emphasizes the financial perspective. Do subscribers feel that the fees (or service charge) are offset by the benefits they experience (Hong and Tam, 2006) by using *m*-money? Customers perceived monetary value is positive when the perceived quality is greater than the personal sacrifice (Dodds *et al.*, 1991).

(8) Structural assurance: it refers to the existence of technological and legal institutions to ensure payment security. McKnight *et al.* (2002b) in their study reported structural assurance in the form of institution-based trust mechanism affect user's usage intention. Zhou (2011) provided empirical evidence of the significance to initial trust in mobile-based banking which can be ensured through structural assurance.

4. Research methodology

The methodology adopted in this study has been diagrammatically represented in the Figure 1.

4.1 Data collection

The data for this study have been obtained from cell phone users through a nationwide primary survey. The respondents have been using cell phone (smart phones as well as basic mobile phones) for not less than two years. Since *m*-payment is a service which does not require mobile internet connectivity for performing transactions basic phone users were targeted for data. Data used in this study have been collected mainly from tier 1 cities in addition to tier 2 and tier 3 cities as service providers of *m*-payment had primarily focussed on tier 1 cities during the lunch of their services. Of late they have started targeting tier 2 and tier 3 cities as well for obtaining greater subscriber base.

A total of 196 respondents participated in the survey between January 2014 and March 2014 out of which 184 responses were found to be completed in all respect and were considered for analysis. Table I displays the demographic statistics of the respondents. The sample consists of more male (56.5 percent) than females (43.5 percent) and are predominantly (70 percent) in the age-group 30-40. Nearly 90 percent of the sample have an average income in the range of 2-5 K and 5-10 K per month. Predominantly *m*-payment as a service is used for making transfer payment to their dependents in their native place. The sample has more or less evenly represents all the four regions in the country and thus can be considered as a representative from the entire country.

4.2 Survey instrument development

This study have used instrument adapted from extant review of literature in the context of adoption of mobile banking to improve the content validity. However, some of the items were modified to suit the purpose of this study which captures user intention for mobile-based payment services which are different from typical mobile banking applications. The scale items are measured on a five-point Likert scale (1 = "strongly disagree" and 5 = "strongly agree"). When the instrument was developed, it was tested among ten users with *m*-payment experience (see the Appendix for listing of the items used in the study). Then according to their suggestions, few items were revised to improve the clarity and understandability. The final items along with their code as used in data analysis are listed in Table II.

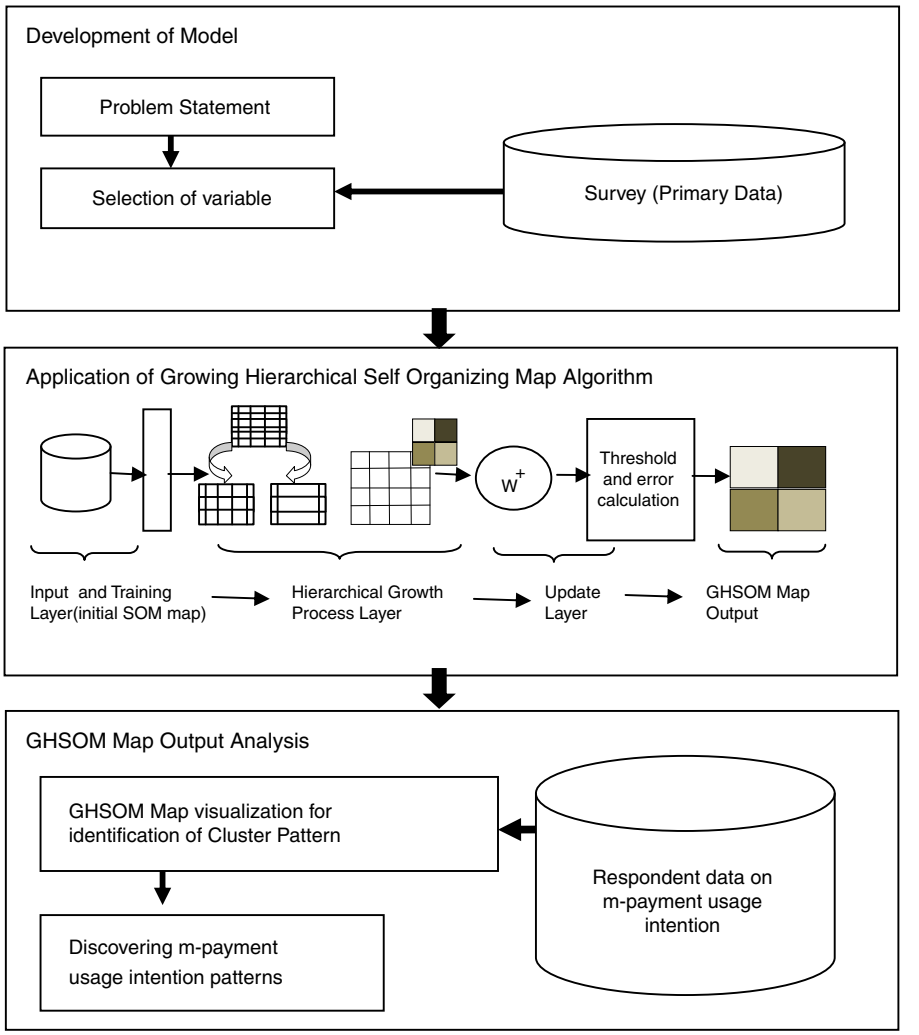

Figure 1.
Overview of research methodology steps

Perceived usefulness is measured by items adopted from Lee *et al.* (2005, 2006), Venkatesh and Davis (2000); items of perceived ease of use are adopted from Venkatesh (2000) and Venkatesh and Davis (2000). Items of system availability is measured by items adopted from Kim *et al.* (2004a, b) which includes items like access speed. Items of structural assurance are adopted from McKnight *et al.* (2002a) to reflect the legal and technological structure. Monetary value is measured by items capturing cost and time savings adapted from Monroe and Krishnan (1985) and Hong and Tam (2006). Items of connectivity were adapted from Kannan *et al.* (2001), Kalakota and Robinson (2001) and Hong and Tam (2006). Personal innovativeness is measured using items based on the study by Goldsmith and Flynn (1992). Absorptive capacity is measured using items adapted from Cohen and Levinthal (1990) and Xu and Ma (2008). Items of discomfort include complexity

Demographics	$n = 184$	% (approx.)
Gender		
Male	104	56.5
Female	80	43.5
Age		
Less than 30	22	12
between 30-40	128	70
between 40-50	24	13
More than 50	10	5
Education level		
School	82	44.6
College	78	42.4
Masters	24	13
Monthly income		
Less than 1000	4	2.2
between 2 and 5 K	104	56.5
between 5 and 10 K	60	32.6
More than 10K	16	8.7
m-Payment usage frequency		
Everyday	12	6.5
3-4times/week	32	17.4
1-2 times/month	124	67.4
less than once/month	16	8.7
m-Payment usage for		
Making utility payment	30	16
Sending money home	154	84
Residing in		
Northern region	56	30.4
Western region	45	24.5
Eastern region	35	19
Southern region	48	26.1

Table I. Demographic statistics of user groups

in usage and has been adopted from the study by Zhou and Wang (2010). Finally items of usage intention are adopted from Venkatesh (2000) and Venkatesh and Davis (2000).

5. Data analysis

During data analysis, tests for reliability and validity were conducted along with test for common method variance. Harman's single factor test to confirm presence of common method bias (Podsakoff *et al.*, 2003) was done. In the study all 11 factors had eigenvalue greater than 1 with the largest factor accounting for 12.43 percent of the variance thereby indicating the absence of common method bias in the data set. Tests for validity includes convergent validity and discriminant validity. Table II displays the values for standardized item loading, average variance extracted (AVE), composite reliability (CR) and the values of Cronbach α. Since most items show loading more than 0.7 (with t-values significant at 0.001), all AVEs exceed 0.5 and all CR exceed 0.7 hence it can be accepted that the scale exhibits good convergent validity (Gefen *et al.*, 2000). The α values were also found to be larger than 0.70 thereby showing good reliability (Nunnally, 1978).

Factor	Item	Standard loading	AVE	CR	α
Externalities	Xk1	0.794	0.58	0.78	0.84
	Xk2	0.807			
	Xk3	0.762			
	Xk4	0.756			
System quality	Xd1	0.743	0.58	0.81	0.80
	Xd2	0.719			
	Xd3	0.773			
	Xd4	0.798			
Innovativeness	Xb1	0.675	0.57	0.74	0.84
	Xb2	0.945			
	Xb3	0.896			
Task-fit	Xg1	0.807	0.53	0.76	0.81
	Xg2	0.754			
	Xg3	0.698			
	Xg4	0.702			
Per. ease of use	Xf1	0.807	0.64	0.82	0.84
	Xf2	0.784			
	Xf3	0.765			
	Xf4	0.702			
	Xf5	0.692			
Discomfort	Xc1	0.786	0.62	0.78	0.78
	Xc2	0.694			
	Xc3	0.912			
	Xc4	0.748			
Connectivity	Xi1	0.765	0.58	0.82	0.81
	Xi2	0.780			
	Xi3	0.762			
Absorptive capacity	Xj1	0.870	0.63	0.80	0.84
	Xj2	0.902			
	Xj3	0.860			
Ease of use	Xa1	0.894	0.66	0.85	0.80
	Xa2	0.782			
	Xa3	0.695			
	Xa4	0.784			
Per. usefulness	Xe1	0.910	0.58	0.82	0.82
	Xe2	0.891			
	Xe3	0.864			
	Xe4	0.690			
Monetory value	Eh1	0.782	0.62	0.84	0.84
	Eh2	0.896			

Table II.
Factors and the final items with their loadings

To test for discriminant validity, the square root of AVE was compared with factor co-relation co-efficients. For each factor, the square root of AVE was found to be larger than the its co-relation co-efficients with other factors thereby indicating a good discriminant validity (Gefen *et al.*, 2000).

The SOM approach is able to project data from a high-dimensional space to a low-dimensional space so it is considered a visualized approach for explaining a complicated data set. However, it suffers from some limitations like the predefined fixed map size, interpretability of large complex data set and lack of revealing hierarchical relation from high-dimensional data to a low-dimensional data. Therefore, one promising

solution for an extensive data set is using the SOM in a hierarchical manner. To overcome the above mentioned drawbacks of SOMs within a combine approach, Dittenbach *et al.* proposed artificial neural network model, called GHSOM that present an automatic SOM hierarchy. It applies a hierarchical structure of multiple layers, where each layer consists of a number of independent SOMs. GHSOM starts with one SOM at the 1st layer with and grows a whole row or column of units at a time to the next layer of the hierarchy if the difference of input data mapped to it attains a fixed threshold. The algorithm is repeated for the subsequent layers in hierarchy. Before starts of the training process the values of two thresholds must be determined.

Figure 2 illustrates the hierarchical organization of the data consisting of 71 variables as extracted in 1st layer labeled with four patterns. In this 1st level the training process has resulted in the creation of a 2×2 map, organizing the variables into four major patterns of variables as follows:

(1) cluster A: the upper-left (1, 1 position) represents (d1, d2, d4, xf1, d3, xb2, xc1, xf9, xb1, xc3, xc6, xf5, xf7, xd2, xf3, d5, xd7) mainly the pattern as A (quality of service perception);

(2) cluster B: lower-left (2, 1 position) mainly represents a (xd3, xf4, xj4, xk1, xd4, d7, xc4, d6, xb5, xb3, xb4, xk5, xa5, xh3) mainly the pattern as B (ease, innovation and value perception);

(3) cluster C: the upper-right (1, 2 position) represents (xe1, xe4, xe5, xe6, xe7, xe9, xe2, xg1, xg2, xg3, xe8, d8, xk2, y1, xe3) mainly the pattern as C (task-fit and externality perception); and

(4) cluster D: lower-right (2, 2 position) represents (xf2, xj1, xj2, xk4, xf8, xj3, xf6, xf10, y2, y3, xa1, xc5, xa3, xd1, xd5, xd6, xa2, xa4, xh2, xk3, xc2, xh1, xi1, xi2, xi3) mainly the pattern as D (technology absorption perception).

Most of these four first level grouping are further refined on the second level. For example, the upper-left unit representing quality of service perception is divided into

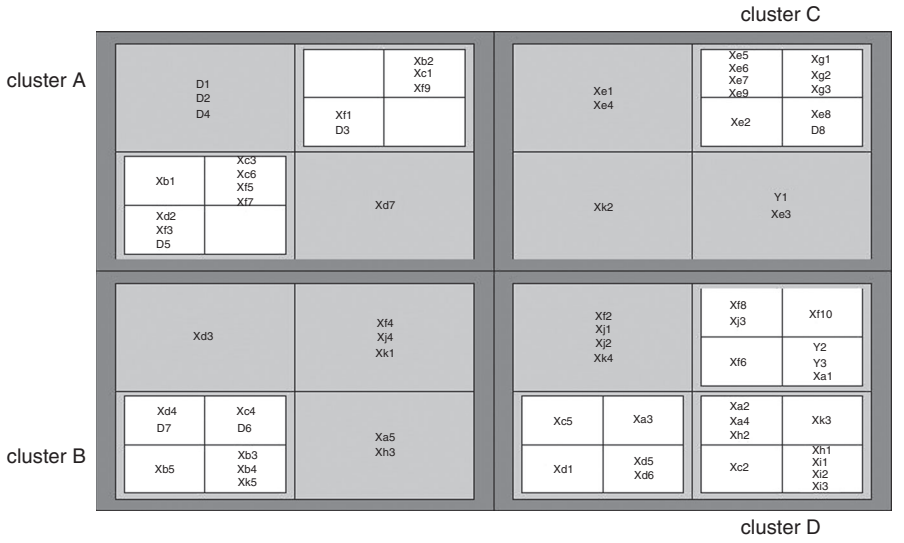

Figure 2.
Variables after clustering

four further sub-groupings. Of these four sub-groupings the upper-left represents (d1, d2, d4) lower-left represents (xb1, xc3, xc6, xf5, xf7, xd2, xf3, d5), Upper-right represents (xf1, d3, xb2, xc1, xf9) and lower-right represents only xd7.

Note that the third level refinement of the cluster A separates the (xf1, d3) from the (xb2, xc1, xf9) and in the lower-left xb1 is separated from (xd2, xf3, d5) and from (xc3, xc6, xf5, xf7).

The cluster B has been separated xd3 from (xa5, xh3), from (xf4, xj4, xk1) and from (xd4, d7, xc4, d6, xb5, xb3, xb4, xk5) in the second level.

The third level refinement in the cluster B distinguishes xb5 from (xd4, d7) and from (xc4, d6) and from (xb3, xb4, xb5).

In the second level the cluster C segregates into following sub-groupings (xe1, xe4), xk2, (xe5, xe6, xe7, xe9, xe2, xg1, xg2, xg3, xe8, d8) and (Y1, xe3).

In cluster C the third level extraction separates the xe2 from (xe5, xe6, xe7, xe9), from (xg1, xg2, xg3) and from (xe8, d8).

The cluster D has been sub-categorized into (xf2, xj1, xj2, xk4), (xf8, xj3, xf6, xf10, y2, y3, xa1), (xc5, xa3, xd1, xd5, xd6), and (xa2, xa4, xh2, xk3, xc2, xh1, xi1, xi2, xi3) in the second level of extraction.

In cluster D, the third level extraction segregates in lower-left each of the xc5, xa3, xd1 from xd5, xd6 in the upper-right xf6 is separated from xf10, and (xf8, xj3) and (Y2, Y3, xa1). Further in lower-left xc2 is separated from xk3 and also both (xa2, xa4, xh2) and (xh1, xf1, xf2, xf3) distinguished from each other in the third level of extraction.

6. Discussion, managerial implications and lessons learnt

The present work aims to analyze the reduced factors that influence the intention of using MFS in an integrated manner, including the technical characteristics, technology-specific characteristics, user characteristics and job characteristics. The GHSOM model investigates this issue by determining the key factors of *m*-payment usage intention by constructing clustering of MFS data which largely corroborate the prospect of *m*-payment usage intention. The hierarchical structure of clusters is mainly influenced by ease of use, innovativeness, discomfort, system quality, perceived usefulness, perceived ease of use, task-fit, monetary value, connectivity, absorptive capacity, externalities parameters.

Quality of service perception of users is affected by issues such as network connectivity and ubiquity of service. Users of such services are doing transactions at locations which are not in proximity to cities and metro's and seek service quality comparable to those available at cities and locations where they travel for work. In general, users experience a drop in service levels as they move out of cities and hence are apprehensive about the usefulness *m*-payment services.

Task-fit and externality perception have been reported by several previous researchers. However, in context to *m*-payment adoption specific issues like to what extent would this service fulfill their requirement of making transfer payment seem to be of prominence. Users seek completeness of their transactions and seek assurance from established legal agencies (mainly government) in case there is any failure of service or cases of breach of trust by *m*-payment service providers. Although the central bank of the country has been coming out with policies to bring clarity and control in such types of payment mechanism but there still remains gray areas which needs attention on a priority basis.

Ease of use, personal innovativeness and monetary value affects usage intention of *m*-payment services. Given the user's profile for using *m*-payment (predominantly for sending money to their native place) and income profile monetary value for using

m-payment is quite a prominent one. Users who showed interest to adopt *m*-payment services seek user friendly and innovative applications and devices that can offer value to them and make their life easier. Service providers therefore should innovate their service offering and make them more and more user friendly. They need to design their service bearing in mind that a sizeable chunk of their potential subscribers may not be using smart phone and hence fancy mobile-based application may not be of much use for the targeted users.

The findings of this study may be useful to service providers as general issues in technology absorption like perceived ease of use and absorption ability has also been found to be prominent in this study. The service providers should try and ensure that potential users of such services should be given more opportunities to learn about such value-added service. Service providers can perhaps demonstrate the usage in locations and outlets where the users generally approach to load money or seek assistance for making *m*-payment.

Finally, the service providers must identify many other tasks appropriate for usage of *m*-payment and also work on improving the acceptance by merchants and increasing its visibility. Given the fact that the number of users availing mobile telecom services is more than double the number of people having any formal bank account and that the penetration of internet is growing at a rate of 35 percent over the last three years (as per American Express Bank study in December 2013) there is immense business scope of such services.

7. Conclusion, limitation and future research

This study attempted to focus on issues influencing the usage intention of mobile-based payment services using a tool which has been not been applied before to explore technology adoption issues. The study found that perceptions regarding service quality, task-fit and presence of external agencies to instill confidence among the users are prominent. This implies that in order that such service receives greater acceptability and adoption, service providers should work with the government agencies to provide more institutional legality and support. Service providers can only ensure better service quality and innovative service but absence of external institutional agency may prove to be a deterrent for greater acceptability. User friendly interfaces with convincing value proposition impacts the adoption of services like *m*-payment.

There is no denying the fact that the adoption rate of such value-added service is going to exhibit steadier upward trend in near future but the service providers alone cannot influence the rate. This can deduced from the results of this study. However, the researchers feel that this study still suffers from the following limitations:

(1) The survey was mainly carried out in the metro cities in the four regions of the country and hence opinions of subscribers from other parts of the country which are far away from the metro cities could not be obtained. The *m*-payment service providers has of late started targeting these far flung cities and rural subscribers to drive their business.

(2) Increasing trend of online and mobile-based payment has been observed and reported by several studies in India where the transactions by women have shown a steady increase over a short period of time. This is particularly true for urban India. But the survey obtained higher percentage of data from males. Thus future researchers could focus on this aspect to study the influence of this rising trend on adoption of services like *m*-payment.

(3) Trust and existence of physical institutions seem to affect the perception and usage intention. Future researchers may explore the influence of these two issues in situations where there has been some reported cases of breach of trust.

Finally, service providers should launch extensive campaign program to create awareness of such services and strive to increase the acceptance of such mode of payments by more outlets including government and semi-government agencies. This would go a long way in popularizing services like *m*-payment and ensure a faster adoption rate among the masses. The mobile money transfer service is now available across 300 key cities in India. Though this service promises to be a fast, simple and secure service that allows its users to load cash on their mobile devices and make payment, it is yet to register a satisfactory subscriber base in India since it was launched a year ago. This paper has tried to offer supportive and cost-effective management for market participants, including mobile service providers and application developers, users and similar organization and future service providers to improve the adoption rate of services like *m*-payment.

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Appendix. Questionnaire items

Usage intention

1. I intend to use/reuse mobile financial services shortly.(Y1)
2. Assuming that I have access to mobile financial services, I intend to use it.(Y2)
3. Given that I have access mobile financial services, I predict that I would use it.(Y3)

Ease of use

1. Mobile financial services gives people more control over their daily financial transactions.(Xa1)
2. Mobile financial services that use the newest mobile technologies are much more convenient to use.(Xa2)
3. You prefer to use the most advanced mobile financial services available.(Xa3)
4. Mobile Financial Services gives you more freedom of mobility.(Xa4)
5. You feel confident that mobile phones would carry out financial transactions as instructed them to do.(Xa5)

Personal innovativeness

1. Other people come to you for advice on new mobile technologies and services.(Xb1)
2. In general, you are among the first in your circle of friends to acquire new mobile technology and services when it appears.(Xb2)
3. You can usually figure out new high tech products and services without help from others.(Xb3)
4. You have fewer problems than other people in making technology based services work for you.(Xb4)
5. You enjoy the challenge of figuring out high tech gadgets and their usage.(Xb5)

Discomfort

1. Sometimes, you think that technology systems and services are not designed for use by ordinary people.(Xc1)
2. User manual for high tech product or services should be written in plain language.(Xc2)
3. When you get technical support from a provider of a high tech product or service, you sometimes feel as if you are being taken advantage of by someone who knows more than you do.(Xc3)
4. Many new technologies have health or safety risks that are not discovered until after people have used them.(Xc4)
5. New mobile technology makes it too easy for governments and companies to spy on people.(Xc5)
6. Mobile Technology always seems to fail at the worst possible time.(Xc6)

System quality

1. You do not consider it safe giving out a credit card number over a mobile.(Xd1)
2. You do not consider it safe to do any kind of financial business through mobile phone.(Xd2)
3. You worry that information you send over the mobile will be used by other people.(Xd3)
4. Any business transaction you do using mobile should be confirmed later something in writing.(Xd4)
5. Whenever something gets automated, you need to check carefully that the machine is not making mistakes.(Xd5)
6. When you call a business, you prefer to talk to a person rather than a machine.(Xd6)
7. If you provide information to a machine or over the internet, you can never be sure it really gets to the right place.(Xd7)

Perceived usefulness

1. My job would be difficult to perform without mobile financial services.(Xe1)
2. Using mobile financial services gives me greater control over my work.(Xe2)
3. Mobile financial services enables me to accomplish tasks more quickly.(Xe3)
4. Mobile financial services supports critical aspects of my job.(Xe4)
5. Using mobile financial services improves my job performance.(Xe5)v
6. Using mobile financial services allows me to accomplish more work than would otherwise be possible.(Xe6)
7. Using mobile financial services enhances my effectiveness on the job.(Xe7)
8. Using mobile financial services makes it easier to do my job.(Xe8)
9. Overall, I find mobile financial services system useful in my job.(Xe9)

Perceived ease of use

1. I find it cumbersome to use the mobile financial services system.(Xf1)
2. Learning to operate the mobile financial services system is easy for me.(Xf2)
3. Interacting with the mobile financial services system is often frustrating.(Xf3)
4. I find it easy to get the mobile financial services system to do what I want it to do.(Xf4)
5. The mobile financial services system is rigid and inflexible to interact with.(Xf5)
6. It is easy for me to remember how to perform tasks using the mobile financial services system.(Xf6)
7. Interacting with the mobile financial services system requires a lot of my mental effort.(Xf7)
8. My interaction with the mobile financial services system is clear and understandable.(Xf8)
9. I find it takes a lot of effort to become skillful at using mobile financial services.(Xf9)
10. Overall,I find the mobile financial services system easy to use.(Xf10)

Task-technology fit

1. Use of the mobile financial service is relevant to my work.(Xg1)
2. Use of the mobile financial services is helpful for my work.(Xg2)
3. Use of the mobile financial services is desirable for my work.(Xg3)

Monetary value

1. I expect that mobile financial services to be reasonably priced.(Xh1)
2. Mobile financial services would offer good value for money.(Xh2)
3. I believe that at the current price and fee, mobile financial services would provide a good value.(Xh3)

Connectivity

1. I expect that the mobile financial services would be available anywhere, anytime.(Xh4)
2. The services should be easily accessible and portable.(Xh5)
3. I expect the services to be available whenever I need it.(Xh6)

Absorptive capacity

1. I have the technical competence to absorb mobile financial services.(Xi1)
2. I have the necessary knowledge to understand mobile financial services.(Xi2)
3. I have a clear understanding about the goals, tasks and responsibilities of mobile financial services.(Xi3)
4. I have information on state of the art mobile financial services.(Xi4)

Structural assurance

1. I find that not many outlets/merchants accept mobile financial services.(Xj1)
2. There are inadequate outlets offering facility of loading and disbursing mobile money.(Xj2)
3. Increase in number of outlets offering such services would popularize such services.(Xj3)
4. The government has a major role in ensuring the success of such services.(Xj4)
5. The mobile framework is adequate in our India to ensure success of such services.(Xj5)

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