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IDENTIFYING CONSUMER RESISTANCE OF MOBILE PAYMENT DURING COVID-19: AN INTERPRETIVE STRUCTURAL MODELING (ISM) APPROACH

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Abstract. *Purpose* – Due to country-wise lockdown and state-wise curfews in COVID-19, people were not able to make offline payments (i.e. cash payments) during purchases in India. So, people are switching their payment behavior from offline to online mode. But, as per the central bank report, the rate of adoption through mobile payments is still slow. The paper focuses on identifying critical barriers to mobile payment systems (MPSs) adoption in India. Innovation resistance theory (IRT) has been used as a base model for barriers, despite the wide range of choices of barriers available in the MPSs context. Additionally, three external variables which are out of the wider coverage of IRT constructs were incorporated in this paper. The study, on the other hand, adds to innovation resistance theory in the frame of reference of MPSs from a theoretical perspective. Interpretive structural modeling (ISM), together with MICMAC analysis is brought into play to analyse the direct and indirect relationship amongst the barriers.

Research methodology – ISM approach has been used to establish the relationship among the eight (08) identified barriers, through literature and expert opinions. The key barriers to high driving power are then identified with the help of MICMAC analysis.

Findings – The results reveal that value barrier (b2), image barrier (b5) and visibility barrier (b7) are the most significant variables. Interestingly, IRTs' risk barrier (b3) and privacy barrier (b6) from the literature fall in the lowest level of the ISM model. The majority of the barriers fall under quadrant III of MICMAC analysis, indicating the high driving and dependence power.

Research limitations – The developed ISM model is based on the sentiments of five (05) experts, which could be biased and influence the structural model's final output. Due to COVID-19, data has been collected through online video conferencing mode, this may vary if data will be collected through an offline or face-to-face interview. The proposed model's key findings aim to assist in explaining the barriers that exist during MPS adoption.

Originality/Value – This study is the first attempt to use the ISM approach in conjunction with IRT to detect barriers within MPSs. The result of this paper will guide and motivate the researcher to analyse more critical barriers with IRT to contribute to the theoretical development.

Keywords: innovation resistance theory (IRT), interpretive structural modelling (ISM), mobile payment systems (MPSs), MICMAC analysis, transitivity analysis, adoption, barriers, leapfrog.

JEL Classification: E42, M15, O14, O33.

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Introduction

COVID-19 is triggered off by the virus SARS-CoV-2 (Severe Acute Respiratory Syndrome Coronavirus 2) (World Health Organization [WHO], 2020). This isn't the first time a coronavirus outbreak has reached crisis point. It is, however, the first time that a pandemic has had such a widespread impact. There were about 177 million active cases worldwide until June 23, 2021, with over 29 million instances in India (WHO, 2021). In many ways, COVID-19 coronavirus has had an impact on not only people's respective lives, but also absolute economies, industries, and countries around the globe (United Nations Industrial Development Organization [UNIDO], 2020). The WHO provide various guideline to break the chain of deadly virus, like, maintaining social distancing, covering mouth and nose, frequent hand washing, self-quarantine (if diagnosed) at least for 14 days etc. Many countries, including India, have taken precautionary actions to reduce extend and impact of the COVID-19 pandemic. As a result, the government of India (GOI) professed national lockdown on March 24, 2020. As a result of the global spread of the coronavirus pandemic, some industries have converted to remote working to reduce infectious disease transmission (COVID-19). Businesses, for example, have established cloud-based IT infrastructures in order to explore the possibility of providing contactless or contact-free services via mobile apps, video conferencing, enhanced telemedicine, e-learning, telecommuting, and mobile transactions (Pop et al., 2022; Xiao & Fan, 2020). Consumers' purchasing patterns have changed to online media as direct person-to-person contact has become less frequent. As a result, the pandemic has assisted the development of digital infrastructure across a wide range of industries (Kim, 2020).

Since social distance has been recommended or even mandated as a means of reducing COVID-19 dissemination (Guan et al., 2020; Lee & Lee, 2020), shifting the payment channel from traditional (i.e. cash-based) to online is a better alternative. This process would eventually deliver new wealth for the citizens of the country. In recent years, however, an alternative theory of "leapfrog" development has been growing in popularity as the development community has searched for new ways to leverage technological progress to drive growth and help emerging economies. Leapfrogging occurs when a nation bypasses traditional stages of development to either jump directly to the latest technologies (stage-skipping) or explore an alternative path of technological development involving emerging technologies with new benefits and new opportunities (path-creating) (Yayboke et al., 2020). People were forced to use digital payment apps due to social isolation and lockdown. But, during the initial period of the lockdown and curfew, there was a drop in MPSs; however, after a few months, the payments picked up with the progressive relaxations (Reserve Bank of India [RBI], 2021).

Over the last decade, India has gradually transitioned away from traditional payment methods towards online transactions through mobile phone (Sun et al., 2020; Fabris, 2019). Mobile payments refer to financial transactions that customers make in the absence of real cash primarily using their smartphones. As a result, mobile payment systems (MPSs) are becoming increasingly popular in a variety of industries, including hospitality, healthcare, retail, and tourism. Adopting cashless payments has numerous advantages for consumers. MPSs provide both convenience and speed (Teo et al., 2015). Unlike typical cash transactions, MPSs reduce theft and other money-related offense (Armey et al., 2014), because

users carry less physical currency while shopping. The COVID-19 pandemic is likely to have long-term consequences for standard payment methods in the post-pandemic era (Lee & Lee, 2021).

According to a survey released on January 14, 2021 by People Research on India's Consumer Economy (PRICE), a statutory body working under the canopy body of retail and digital payments National Payment Corporation of India [NPCI], one-third of the country's population uses digital payments, but more awareness and training is needed to increase adoption rates (NPCI, 2021a). Following that, on April 8, 2021, India's leading financier bank, State Bank of India (SBI), and the National Payments Corporation of India (NPCI) collaborated to unveiling a UPI awareness campaign to expand the reachability of mobile payments throughout the country (NPCI, 2021b). Consumer adoption of technical advancements such as mobile payments frequently necessitates effort and a learning process (Eriksson et al., 2021).

Innovations are always met with resistance at first, although resistance and adoption can accompany amidst the innovation's life cycle. As a result, it's essential to better comprehend resistance (Ram, 1987), particularly with respect to digital financial services (Laukkanen & Kiviniemi, 2010; Ram & Seth, 1989). In addition, according to theories of diffusion of innovations, the identified adopter categories (innovators, early adopters, early majority, late majority, and laggards) indicate varied degrees of innovation resistance in a population (Rogers, 2003). Resistance to advances such as mobile payment systems should not be considered as adverse; instead, it should be observed as consumers making plausible decisions (Szmigin & Foxall, 1998). Earlier studies have acknowledged a number of validated barriers to the adoption and usage of MPSs, including payment complexity (Mallat, 2007), a lack of extended merchant acceptance (Deloitte, 2019; Mallat, 2007), perceived risks such as security and privacy issues (Ramos de Luna et al., 2019; Kerviler et al., 2016; Oliveira et al., 2016; Yang et al., 2015; Mallat, 2007), lack of perceived usefulness (Deloitte, 2019; Oliveira et al., 2016) and lack of consumer knowledge (Deloitte, 2019). More exploration is necessitated, however, to better comprehend the causes for resistance and, as a result, what may be preventing MPSs from becoming more extensively take on board.

Multiple researches related to mobile payment adoption have been carried out in the past. Factors such as perceived risk (Yang et al., 2012), perceived security (Oliveira et al., 2016), perceived cost (de Sena Abrahão et al., 2016), anxiety (Bailey et al., 2017), switching cost (Zhou, 2015), habit (Keramati et al., 2012), technology competency (Changchit et al., 2017) etc. influence the user interface to adopt MPS as per the studies. However, when numerous factors having interactions among themselves influence the user adoption of MPS, a proper approach for adoption process is not found in any earlier study. For this reason, identification of relationships between factors that affect the user adoption is required. Interpretive structural modeling (ISM) is preferred in order to develop a relationship with rationale between the influencing factors. In order to develop the user adoption framework utilizing interpretive structural modeling, a variety of factors influencing user adoption are taken into consideration.

The purpose of this paper is to acquire an extensive level of detail into the causes of non-adoption of mobile payments utilising an ISM methodology, particularly in relation

to consumers who have not yet accepted mobile payments. At the same time, the study furthers the concept of technological innovation resistance in the context of MPS adoption. It is possible that this study will aid merchants, mobile service providers and Government by enabling them to better understand the challenges to MPS adoption.

The following is the outline of the article. To begin, the background of Innovation resistance theory (IRT) theory has been discussed using the model barrier (i.e. Functional and Psychological), as well as three other forms of barrier constraints (i.e. privacy barrier, visibility barrier, and design constraint barrier), trailed by a description of the ISM methodology using transitivity and MICMAC analysis. The findings are then provided, followed by conclusions, as well as some recommendations for future study and managerial implications.

1. Literature review

1.1. Innovation resistance theory

Ram (1987) proposed the innovation resistance theory (IRT), which was later enhanced by Ram and Sheth (1989). This theory delivers an explanation of why consumers are hesitant to adopt new technology. As customers seek out new solutions that disrupt their present way of doing things, they exhibit resistance to change, according to Hew et al. (2019). Consumer resistance is a major factor in determining whether or not an innovation is embraced (Ram & Sheth, 1989). If a new innovation changes a customer's lifestyle or position, they may be reluctant to accept it (Ram & Sheth, 1989). Barriers are alienated into dual categories by the IRT: functional and psychological (Ram & Sheth, 1989). The psychological barrier is subdivided into image and tradition, whereas the functional barrier is segregated into value, risk, and usage. Consumer resistance is classified as either active or passive according to Heidenreich and Handrich (2015). Active resistance has been labelled as a form of IRT functional barrier that arises from the characteristics of innovation (Kaur et al., 2020; Sivathanu, 2018; Yu & Chantatub, 2016; Tansuhaj et al., 1991). Passive resistance, on the contrary, is a psychological barrier that emerges from a contradiction in the consumer's existing belief system (Kaur et al., 2020; Sivathanu, 2018; Yu & Chantatub, 2016).

The whys and wherefores of IRT being appropriate for present study are, first, prior authors have used IRT to investigate innovation resistance in a variety of online domains, including virtual shopping (Gupta & Arora, 2017; Lian & Yen, 2013, 2014), mobile social tourism (Hew et al., 2017), online travel agency (Talwar et al., 2020; Jansukpum & Kettem, 2015), organic food industry (Kushwah et al., 2019), mobile services (Joachim et al., 2018), mobile banking (Laukkanen, 2015, 2016; Yu & Chantatub, 2016; Yu et al., 2015), mobile commerce (Moorthy et al., 2017), mobile gaming (Oktavianus et al., 2017), eco-friendly cosmetics (Sadiq et al., 2021) and similarly in context with MPSs (Sivathanu, 2018). Second, IRT barriers provide a useful framework for studying users' aversion to change. Finally, latest readings have highlighted the significance of the IRT framework in the milieu of MPSs, arguing that MPS adoption in India is hampered by innovation resistance (Kaur et al., 2020; Sivathanu, 2018).

1.1.1. Functional barriers

1.1.1.1. Usage barriers

Usage barriers manage the impediment imposed due to potential changes, particularly within the framework of implementing new innovation in contrast to existing systems (Ram & Sheth, 1989). The work necessary to learn and practise the novel system, along with the adjustments to old routines and habits, is an example of a usage barrier. Usability, ease-of-use, and product or service compatibility are all related to usage (Laukkanen et al., 2007). When present habits, practises, and norms clash with innovation, it manifests (Laukkanen, 2016). Consumers' current habits, routines, or lifestyles may be incompatible with a new product, necessitating frequent changes; this disparity and incompatibility may raise the need for adjustment, leading to increased resistance. This factor is also linked to "complexity", which means consumer's perceived difficulty in comprehending and implementing the innovation (Rogers, 1962). Users with limited technical abilities or expertise with MPSs may find the intricacy of MPSs to be a problem. According to Oktavianus et al. (2017), usage barriers cause digital inventions to be abandoned. On the other hand, according to Laukkanen and Cruz (2010), the usage barrier is most substantial to mobile payment among the five listed in the IRT framework. Because the intricacy of newer digital technologies' utilisation can damage their prospects of becoming mainstream innovations, usage barriers are an essential variable. Users' inefficiency due to knowledge levels (Rahman, 2013) and irregularity in mobile payment behaviour (Mahatanankoon & Vila-Ruiz, 2007) can be considered as usage barriers, and previous research has bolstered our argument. Innovations that require customers to adjust their habits or practices over a longer period of time also require more time for acceptance (Chen & Kuo, 2017; Lian & Yen, 2013). We propose that comparable difficulties could bolster the argument that usage constraints are undermining young adults' desire to use and recommend MPSs in India.

1.1.1.2. Value barriers

The value barrier arises when an innovative product's monetary worth and performance are equal to that of its substitutes (Ram & Sheth, 1989). In other words, value barriers relate to opposition that arises from incompatibility within the established value system, particularly with respect to equating the cost of adopting and understanding the innovation against the given benefits (Morar, 2013). In the meantime, a value barrier arises once customers view innovation to be incapable of providing superior functionality to alternatives utilising the similar economic resources (Kaur et al., 2020). Laukkanen et al. (2008) and Heidenreich and Spieth (2013) highlighted that when an innovation is unable to give a suitable performance-to-cost ratio in comparison to its substitutes, consumers will believe that changing the technology is unjustifiable. There is no need to change if the innovation is less than or equal to the cost of change (Chaouali & Souiden, 2019; Kim & Seo, 2017). Users will continue to use the current product because the disadvantages of departing from the established norm appear to outweigh the benefits (Kahneman et al., 2012).

1.1.1.3. Risk barriers

When consumers perceive that innovation is fraught with dangers, a risk barrier arises (Kaur et al., 2020; Ram & Sheth, 1989). It addresses the resistance that arises as a result of the level

of uncertainty, danger, and threat that is a normal element of any innovation adoption process (Laukkanen, 2016; Dunphy & Herbig, 1995; Ram & Sheth, 1989). Consequently, it may be stated that the larger the risk perception, the larger the resistance to change (Ram, 1987). Concerns about losing status, not being able to master new abilities, or getting estranged from friends may arise as a result of the uncertainty (Hirschheim & Newman, 1988). Physical, economic, functional, and social risks are among the four types of risks identified by Ram and Sheth (1989). Physical risk ascends when an innovation causes harm to an individual's life or assets; economic risk arises when an investment in an innovation proves to be unworthy or a lower priced product enters the market (Kim & Seo, 2017); and social risk arises from consumers' anxieties around the product's social views. Finally, there is the functional risk, which is concerned with whether the innovative product will function reliably (Heidenreich & Spieth, 2013). To put it another way, greater risk barriers lead to an adverse user behaviours like resistance. Users of MPSs may be exposed to the risk of fraud, money loss, inadequate Internet access, or poor functionality. MPSs are fraught with security and trust concerns (Vinerean et al., 2022; Marett et al., 2015). Losing money and causing security issues are two examples of probable risks. The lack of information regarding the security and trust aspects of digitalized services among potential and existing consumers may lead to the presence of risk barriers (Luo et al., 2010).

1.1.2. Psychological barriers

1.1.2.1. Tradition barriers

A tradition barrier refers to a consumer's aversion to any changes in their daily routines, values, norms, culture, behaviour, or habit that the innovation may bring about (Lian & Yen, 2013; Laukkanen et al., 2008; Ram & Sheth, 1989). Scholars have previously claimed that traditions are deeply ingrained in society and people's lives, and that any future disagreement with them results in considerable consumer reaction, such as negative word-of-mouth, unpleasant advertising, and boycott (Andrew & Klein, 2003). Consumers will develop habits and procedures that are very significant to them as a result of long-term use of a product or service (Laukkanen, 2016). Similarly, when innovation compels customers to break with tradition or diverge from social norms, they will become resistant to it (Ma & Lee, 2019). A tradition barrier may arise in the case of MPSs if a customer chooses to engage with banks in person to conduct financial transactions rather than adopting new technology (Kaur et al., 2020). Traditionally, payments were made with cash, but MPSs now use mobile devices to make payments that are cashless. MPSs, for example, demand users to make digital payments, which is in contrast to traditional cash-based payment systems. In India, the use of MPSs has resulted in a substantial shift in the way people make payments.

1.1.2.2. Image barriers

Generalizations about an innovation, which might associate to its country of foundation or a brand associated with it, create an image barrier (Kim & Seo, 2017; Laukkanen et al., 2007; Ram & Sheth, 1989). It is a crucial indicator for consumers when evaluating a product or service (Ma & Lee, 2019). Image barriers, according to Laukkanen (2016) and Lian and Yen (2013), relate with an unfavourable perception of an innovation resulting from a perceived

amount of complexity connected with its use or origin. Meanwhile, based on the product quality supplied by the point of origin, the style chosen for a specific group of customers, and the values presented by various brands, consumers could have a certain image perception of innovation (Ram & Sheth, 1989). Consumers, for example, do not typically regard MPSs to be secure, which contributes to a negative image (Hayashi, 2012).

1.2. Other constraint-based on barrier of adoption

1.2.1. Privacy barrier

"Do individuals care about their privacy while adopting technology?" is one of the most frequently asked question about privacy (Vimalkumar et al., 2021; Kokolakis, 2017). In the field of technology adoption, privacy is one of the oldest, most difficult, and contentious issue (Merhi et al., 2019; Herrero et al., 2017; Chen, 2013). The issue began with an article by Warren and Brandeis (1890) in the Harvard Law Review, in which the author defines privacy barrier as "the right to be left alone." The anxiety of providing sensitive information via the internet is linked to the privacy barrier (Khanra et al., 2020). People are concerned about their privacy when doing online transactions, making the new technology unfavourable initially. When using the MPSs, a consumer might be anxious with peculiar information, such as the consumer's identification being shared amid financial transactions (Chang et al., 2018). In addition, consumers may be concerned that during online purchases, too much personal information is accessed (Ozturk et al., 2017). The privacy barrier has been explored from a variety of viewpoints, including law, economics, psychology, management, marketing, and information systems. Self-privacy, attitudinal privacy, peer-group privacy, and data/information privacy are the four categories of privacy identified by Clarke (1999). According to studies, citizens of the digital era are anxious about the confidentiality of their personal information (Vimalkumar et al., 2021).

1.2.2. Visibility barrier

The degree to which an individual witness's others adopting the new innovation is referred to as visibility (Johnson et al., 2018; Moore & Benbasat, 1991). Visibility, according to Cruz et al. (2010), refers to how evident an innovation's usage is to potential users. Many earlier studies in technology innovation have explored visibility (Hsu et al., 2007; Van Slyke et al., 2007; Agarwal & Prasad, 1997). Rogers (1995), in the theory of Diffusion of innovation shows that the more evident the benefits of employing a new innovation are to an individual, the more likely they are to adopt it. As a result, high exposure means that people in society can easily and regularly notice an innovation (Talwar et al., 2020). It is realistic to anticipate that as the infrastructure supporting the service develops and expands, MPSs will become more apparent to the consumer. In the absence of visibility, potential consumers may be hesitant to adopt the technology (Kuo, 2020; Zhou, 2013).

1.2.3. Design constraints barrier

The term "design" refers to the new innovation's system quality (Pal et al., 2021). System quality with design features, according to Zhou (2013), comprises "ease of use, and navigation." It comprises device compatibility, system complexity, and comfortability in the context of

MPSs (Cruz et al., 2010; Mallat & Tuunainen, 2008). System complexity imposes a "cognitive burden" on task performance, is linked to design restrictions, and has been highlighted as a barrier to technological innovation (Ghasemaghaei, 2018). As far as barrier is concern, lack of ease of use, and low navigation make the technology less or unadaptable. Therefore, easy and compatible design constraints accelerate the user to use the technology, which further enhances the adoption rate of technology. These constraints are not created by the designer on purpose; nevertheless, they are a result of the technology used throughout the design process (Norman, 1988). Norman (one of the pioneers of affordance theories) is particularly interested in how humans alter their affordances in response to new technological design, particularly with respect to human-computer interfaces (Fayard & Weeks, 2014). Numerous types of users are likely to face different kind of design constraints, on the basis of their learning ability, frequency of usage, and peer group support (Song, 2011). As a result, we put forward design constraints as a barrier for MPSs as well, because complex app or device design is often seen as a negative aspect of technology adoption.

1.3. Introduction to ISM methodology

Warfield (1974) introduced the ISM approach, which is regarded as a complex mathematical system of calculations that produces relationships in binary form (ie. 0 & 1) to communicate interconnectedness. By bringing structure and direction to the complex links, it transforms ambiguous, inadequately structured interpretive models into clear, aptly described models suitable for a range of applications (Rana et al., 2019; Singh et al., 2018; Sahu & Singh, 2018; Hughes et al., 2016; Diabat et al., 2013; Mandal & Deshmukh, 1994; Sage, 1977). Because of its specialty in exposing interrelationships between antecedents of similar kind and revealing reasons of influence between them, ISM has become a well-established and widely utilised technique in academic studies. It's a system in which elements are connected in a number of ways, either directly or indirectly. It interprets the fixed element and simplifies the identification of system structure (Singh et al., 2018; Sahu & Singh, 2018; Kannan & Haq, 2007; Hawthorne & Sage, 1975). The variables in a problem are first recognised, and then the association between them is formed founded on the context. A structural self-interaction matrix (SSIM) will be created from the element set grounded on a pair-wise comparison of variables. The transitivity is verified, and a matrix model is created. ISM is descended from the element partition and the structural model extraction (Sage, 1977). Theoretical and computational powers are used in this technique to describe the contextual relationship between the variables. As a result, ISM is one of the most suitable method for gaining a deep understanding of the underlying factors that prevent MPS adoption (Singh et al., 2018; Sahu & Singh, 2018; Jharkharia & Shankar, 2005; Sage, 1977; Warfield, 1974). ISM uses an interpretive technique (based on expert verdict) to determine the contextual relationship between various directly relevant variables of a particular issue, (Singh et al., 2018; Sahu & Singh, 2018; Mudgal et al., 2009; Sage, 1977; Warfield, 1974). It is the use of simple graph theory notations to define a composite network of relationships (Singh et al., 2018; Sahu & Singh, 2018; Ravi et al., 2005; Singh et al., 2003; Malone, 1975).

This study employs the ISM methodology with the objective of identifying interdependencies among the barriers. An expert participant group was used to identify the relationship

among the barrier. Five of the eight barriers stated in the previous section are part of the IRT model and are used as required factors for the ISM method's implementation. ISM has the potential to bring a group of people together to gain a common thought over a critical problem (Jharkharia & Shankar, 2005).

Due to the COVID-19 pandemic and its constraints, the ISM-based questionnaire tool (annexure 1) was being sent to experts on their email addresses. The experts were then briefed of the process to fill in the SSIM matrix through video conferencing which took place on Microsoft Teams software. Determining direct and indirect links between the variables leads to a consensus of the components based on previous research.

2. Method

The study begins by obtaining, evaluating, and analysing the key antecedents that limit MPS adoption intentions in India in COVID-19 crisis. The main barriers to adoption are then based on this information. This research makes use of ISM, a mathematically created technique that enables the organized representation of a problem or a collection of varied beliefs (Warfield, 1974). The goal of the whole procedure is to identify the most significant barrier of MPSs adoption and represent in a hierarchical structure on the basis of expert opinions. Five experts from academia (i.e. higher education) were chosen, each with more than ten years of teaching proficiency in the arena of technology adoption but no experience with mobile payment systems. Online survey has been conducted with the help of Google Form sent over the expert's official email ID. The gender ratio among the experts are 3:2 (M/F) and the age of all the experts lies above 50 years.

The ISM process

The ISM technique is a distinguished method for detecting associations amid discrete individual elements that are of minimal significance until they are brought together to constitute a complicated problem. There could be several components that are assumed to be the reason of a particular issue, but examining them independently will result in a much less accurate representation of the situation than examining the aspects in direct and indirect interactions. This justifies the usage of ISM since it encourages experts to reconsider their pre-conceived notions and base their conclusions on the relationships between important barriers. Due to the study gap, it is unclear what connects these barriers or if they have any relationships. ISM model will provide an insight about the direct and indirect relationship among the barriers through empirical analysis of expert opinions.

The following are the steps involved in ISM technique:

Step 1: This step entails identifying various antecedents to be investigated for the problem. Various barriers to MPSs have been distinguished from the literature review in this paper. *Step 2:* Once the barriers have been identified, expert opinions on the contextual relationships among the identified barriers have been acquired. *Step 3:* Using the symbols A, B, C and D, construct an SSIM showing pair-wise relationships between different identified barriers. *Step 4:* This step develops the preparatory reachability matrix (PRM) from SSIM by

converting symbols into binary matrix after placing 0 and 1 accordingly, and checking of transitivity. In ISM, as per transitivity rule, if barrier X is related to barrier Y and Y is related to barrier Z, then X will essentially relate to Z. *Step 5:* Using the rule of transitivity, a conclusive reachability matrix (CRM) has been structured in this step. *Step 6:* The CRM level partitioning were completed in this step. *Step 7:* This step entails the creation of an ISM model.

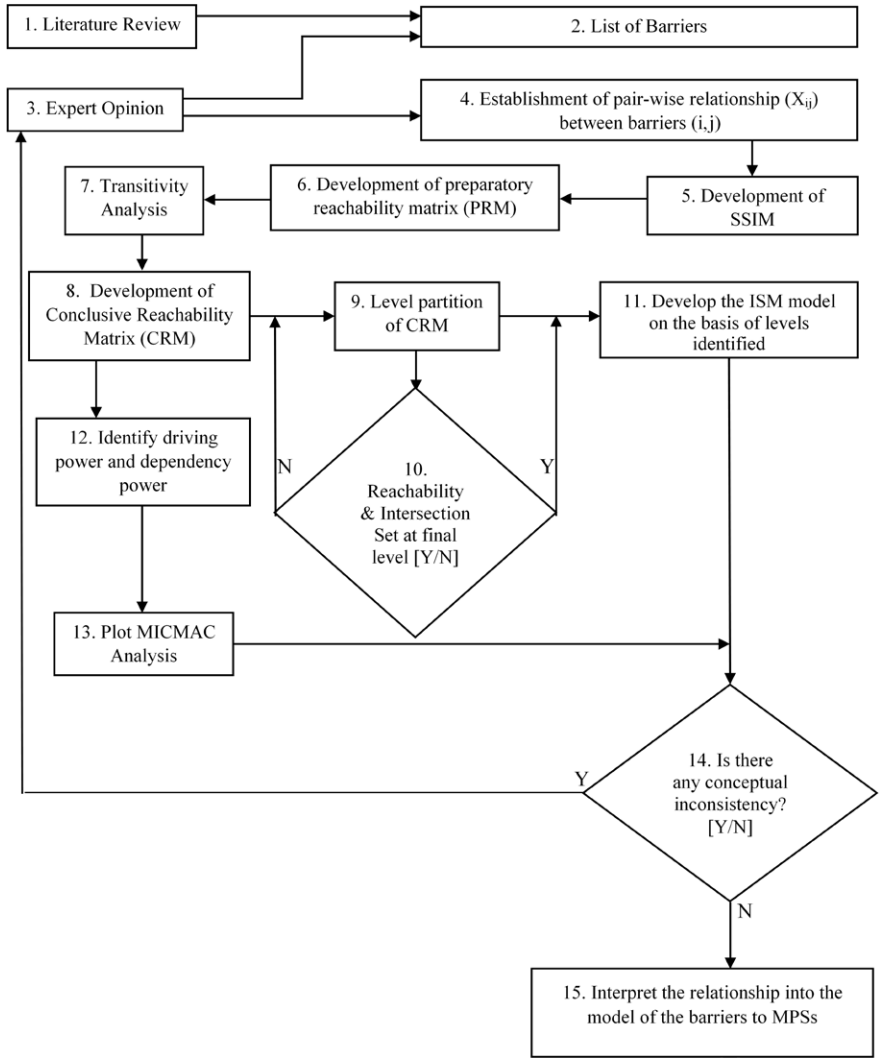

Figure 1. Flow chart for preparing the ISM model of barriers to MPSs adoption

For MICMAC (Matriced' Impacts Croise's Multiplication Appliquee an Classement) analysis, CRM is exercised for plotting the graph between dependence power and driving power and it is elucidated in further sections. All steps of ISM model are exhibited in a flow diagram in Figure 1 and deliberated in the following sections.

3. Data analysis and results

3.1. Structural self-interaction matrix (SSIM)

It demonstrates a step-by-step process that begins with the establishment of the IRT model and other barriers. SSIM has been created in accordance with this contextual relationship. The researcher assessed the matrix's variables and attempted to establish any interdependencies amongst them based according to their own perspective and the ISM ruling's boundaries. The linkages in this matrix are the result of one variable influencing another or vice versa, while some elements may have equal impact and others may have none (Gupta & Dhingra, 2022; Rana et al., 2019, 2022; Rafiq et al., 2021; Tamtam & Tourabi, 2021; Singh et al., 2018; Sahu & Singh, 2018; Maheshwari et al., 2018). The interactions between the variables are represented by the symbols 'i' & 'j' in the rows and columns, respectively. Table 1 shows the SSIM, with the symbols "A," "B," "C," and "D" denoting the relationship among each barrier (Al-Muftah et al., 2018; Janssen et al., 2018; Mangla et al., 2018; Singh et al., 2018; Sahu & Singh, 2018; Mishra et al., 2017; Dwivedi et al., 2017; Hughes et al., 2016).

The four symbols below designate the existence of an affiliation amid the two variables (i and j) and the consistent direction of the relationship.

– "A", refers to 'i' is a predictor of 'j';
– "B", refers to 'j' is a predictor of 'i';
– "C", refers to 'i' and 'j' are predictor of each other;
– "D", refers to 'i' and 'j' are no relation between them.

The development of SSIM can be easily understood by looking at the intersection point of 'i' and 'j' at usage barrier (b1) and tradition barrier (b4) in Table 1, where the experts have suggested an "A". Here, it can be interpreted as that b1 is a predictor of b4 or b1 directly influences b4. Likewise, the intersection of usage barrier (b1) and design constraint barrier (b8) has a "B", representing b8 is a predictor of b1. The method is continued until all cells are completed diagonally. Common intersecting cells i.e, b1:b1; b2:b2 are suggested to left alone because the multiplication of these cells is always equal to 1. The blank cells in the matrix denoting the replicating cells, which will be covered by the researcher on the basis of expert opinion.

Table 1. Structural self-interaction matrix (SSIM)

i/j	b8	b7	b6	b5	b4	b3	b2	b1
b1	B	C	B	C	A	B	A	–
b2	D	C	B	C	B	B	–	–
b3	C	D	C	D	D	–	–	–
b4	D	D	D	D	–	–	–	–
b5	C	A	B	–	–	–	–	–
b6	C	D	–	–	–	–	–	–
b7	D	–	–	–	–	–	–	–
b8	–	–	–	–	–	–	–	–

3.2. Preparatory reachability matrix (PRM)

The development of PRM is the next process in the ISM methodology. The data of the SSIM is replaced by the binary numbers according to the following criteria:

Rule 1: if the (i, j) in the SSIM is A, then the entry in (i, j) becomes 1 and the (j, i) turn out to be: 0;

Rule 2: if the (i, j) in the SSIM is B, then the entry in (i, j) turn into 0 and the (j, i) turn out to be: 1;

Rule 3: if the (i, j) in the SSIM is C, then the entry in both (i, j) and (j, i) turn into 1;

Rule 4: if the (i, j) in the SSIM is D, then the entry in both (i, j) and (j, i) becomes 0.

Based on the above rules PRM is then prepared and showed in Table 2 below.

Table 2. Preparatory reachability matrix (PRM)

i/j	b1	b2	b3	b4	b5	b6	b7	b8
b1	1	1	0	1	1	0	1	0
b2	0	1	0	0	1	0	1	0
b3	1	1	1	0	0	1	0	1
b4	0	1	0	1	0	0	0	0
b5	1	1	0	0	1	0	1	1
b6	1	1	1	0	1	1	0	1
b7	1	1	0	0	0	0	1	0
b8	1	0	1	0	1	1	0	1

3.3. Conclusive reachability matrix (CRM)

After the SSIM is converted into PRM, CRM is now prepared by applying transitivity rule. The transitivity rule has already been discussed in previous sections and shown as in Table 3 within the CRM, transitivity is denoted by 1^T. The steps to convert PRM into CRM are, *Step 1:* Start looking at PRM (row-wise) for '0' and stop when you find it. For instance, '0' at the intersection cell b1:b8 in row b1 (first row) in Table 2. *Step 2:* Now, keeping in mind the transitivity rule, look for '1' in the same row (ignoring common intersecting cells) and again stop once you find it. Like, '1' at intersection point b1:b2 in the same table. Here, the first part of transitivity rule comes in. *Step 3:* Next step is to look for second part of transitivity, which stated that if b1 is related to b2, then is there a possibility that b2 might relate to b8 to apply the transitive rule between b1 and b8. This can be analysed by looking for '1' at intersection point of row b2 and column b8 in the same table. If the intersection has '1' in it then the transitivity exists and '0' means no transitivity. Here, no transitivity exists in between b1 and b8, since '0' is put at b2:b8. *Step 4:* If no transitivity is found at first instance, *Step 2* is to be repeated again ignoring previously analysed '1' until any transitive link is found in the same row. For example, b1:b5 has '1' in row b1. *Step 5:* Step 3 is again taken into consideration in this step and it is to be repeated unless any transitive links are found. Here, since b5:b8 has '1' it means the transitivity exists between b1 and b8 (b1→b5→b8, thus b1 is in turn related to b8) as shown in Table 3 by putting 1^T.

Table 3. Conclusive reachability matrix (CRM)

i/j	b1	b2	b3	b4	b5	b6	b7	b8	Driving Power
b1	1	1	0	1	1	0	1	1^T	6
b2	1^T	1	0	0	1	0	1	1^T	5
b3	1	1	1	1^T	1^T	1	1^T	1	8
b4	0	1	0	1	1^T	0	1^T	0	4
b5	1	1	1^T	1^T	1	1^T	1	1	8
b6	1	1	1	1^T	1	1	1^T	1	8
b7	1	1	0	1^T	1^T	0	1	0	5
b8	1	1^T	1	1^T	1	1	1^T	1	8
Dependence Power	7	8	4	7	8	4	8	6	

3.4. Level partitioning

By evaluating the reachability and antecedent sets for each barrier, the CRM matrix has now been partitioned. The next stage is to create the reachability set (RS) and antecedent set (AS). The RS is comprised of the particular variable as well as the other variables that it is predictor of. Table 3 distinguishes these by using 1 and 1^T for each variable (i) across all rows (j). AS is comprised of the individual variable as well as any other variables that may contribute in its achievement. Table 3 demonstrates this by highlighting the occurrences of 1 and 1^T across all the columns (ie. 'j') that corresponds to each barrier (ie. 'i'). Intersection set (IS) of these RS and AS set are the final top-level variables in the matrix.

Table 4. Level partition – I

i	RS	AS	IS	Level
b1	1,2,4,5,7,8	1,2,3,5,6,7,8	1,2,5,7,8	
b2	1,2,5,7,8	1,2,3,4,5,6,7,8	1,2,5,7,8	I
b3	1,2,3,4,5,6,7,8	3,5,6,8	3,5,6,8	
b4	2,4,5,7	1,3,4,5,6,7,8	4,5,7	
b5	1,2,3,4,5,6,7,8	1,2,3,4,5,6,7,8	1,2,3,4,5,6,7,8	I
b6	1,2,3,4,5,6,7,8	3,5,6,8	3,5,6,8	
b7	1,2,4,5,7	1,2,3,4,5,6,7,8	1,2,4,5,7	I
b8	1,2,3,4,5,6,7,8	1,2,3,5,6,8	1,2,3,5,6,8	

The levels have been defined in the ISM hierarchy, where there is an exact match between RS and IS. 'I' (i.e. level 1) will be placed in front of the relevant barrier where there is a match found. Hence, the value barrier (b2), image barrier (b5) and visibility barrier (b7) are the matching barriers and are labelled as 'I' in Table 4. The level 'I' barriers are those barriers which will not allow other barriers beyond their individual level in the hierarchy (Singh et al., 2018, 2020; Sahu & Singh, 2018).

The same procedure is continued in level partition 'II' (Table 5) here, in this step the barriers delineated in level 'I' are eliminated from RS and IS. Tradition barrier (b4) is the only barrier which is labelled as 'II'. In the next table (Table 6), b1 (usage barrier) and b8 (design constraint barrier) are labelled as III. Remaining barriers, b3 (risk barrier) and b6 (privacy barrier) were outlined in level IV respectively (Table 7).

Table 5. Level partition – II

i	RS	AS	IS	Level
b1	1,4,8	1,3,6,8	1,8	
b3	1,3,4,6,8	3,6,8	3,6,8	
b4	4	1,3,4,6,8	4	II
b6	1,3,4,6,8	3,6,8	3,6,8	
b8	1,3,4,6,8	1,3,6,8	1,3,6,8	

Table 6. Level partition – III

i	RS	AS	IS	Level
b1	1,8	1,3,6,8	1,8	III
b3	1,3,6,8	3,6,8	3,6,8	
b6	1,3,6,8	3,6,8	3,6,8	
b8	1,3,6,8	1,3,6,8	1,3,6,8	III

Table 7. Level partition – IV

i	RS	AS	IS	Level
b3	3,6	3,6	3,6	IV
b6	3,6	3,6	3,6	IV

3.5. ISM modeling

ISM based model was developed with the help of CRM, as depicted in Figure 2. The arrow shows the relationship among the barrier between them. As identified in Table 4, top level consists of value barrier (b2), image barrier (b5) and visibility barrier (b7). The reason being the fact, that they have high driving and dependence power (Figure 3). Resulting, the barrier high dependency on the lower-level barriers to attain the results pertaining to MPSs adoption. The lower-level barriers b3 (risk barrier) and b6 (privacy barrier) have maximum driving power and minimal dependence power. Interestingly, risk barrier being one of the important constructs in IRT model, is placed at lower level in this study stating less dependence on other barriers and need to be driven.

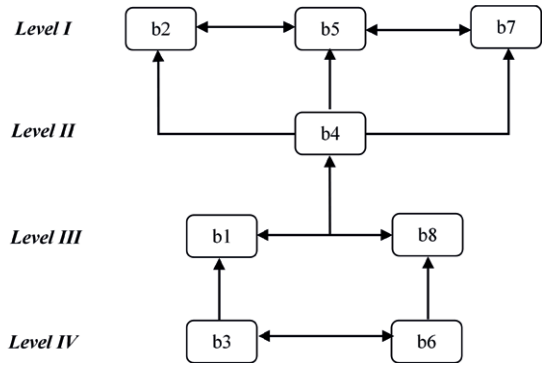

Figure 2. ISM model

3.6. MICMAC analysis

The objective of the MICMAC analysis is to classify variables on the basis of their drive power and dependence power. All pre-identified variables are plotted on a graph with the x-axis and y-axis reflecting the degree of dependence and degree of driving power respectively (Chander et al., 2013). In this research, establishment of dependence and driving powers that contribute to MPS adoption barriers were identified. Driving and dependence power were identified by the totaling of value '1' and '1^{T}' across each row (ie. 'i') and column (ie. 'j') of every barrier in the CRM table (Table 3). The sum of each row and column for each variable is used to establish the appropriate position for the variable's plot (Figure 3).

There are four quadrants in the MICMAC plot diagram, which denote the power of driving and dependence in various relationships among the variables. For instance, each quadrant indicates the power and dependence of the variable into it, over other variables, as well as how it fits into the ISM model. *Autonomous quadrant* (I): the variables of this quadrant have weak driving power along with weak dependence power. This means, the variables have a negligible influence over other variables, and they have very less linkages with them. *Dependent quadrant* (II): the variables in this quadrant have high dependency power but the driving power is low. These variables are generally influenced by others. *Linkage quadrant* (III): the variable of this quadrant have both high driving power and high dependence power. As a result, the variable is considered unbalanced, in which they provide a certain constant result. *Independent quadrant* (IV): this quadrant provides a strong driving power but a low dependence power, hence this quadrant is often more important.

Consistent with the outcomes of the MICMAC analysis, there are no barriers in quadrant I. The absenteeism of such barriers in the study demonstrates that all barriers have a substantial effect. As a result, the presence of any of the barriers highlighted in this study could be a crucial facilitator in understanding MPS adoption. Quadrant II contains a "tradition barrier", which has low driving power but high dependency power. Image barrier, design barrier, value barrier, visibility barrier, and usage barrier are all included in Quadrant III. With "privacy barrier" and "risk barrier", Quadrant IV has by far the most driving power.

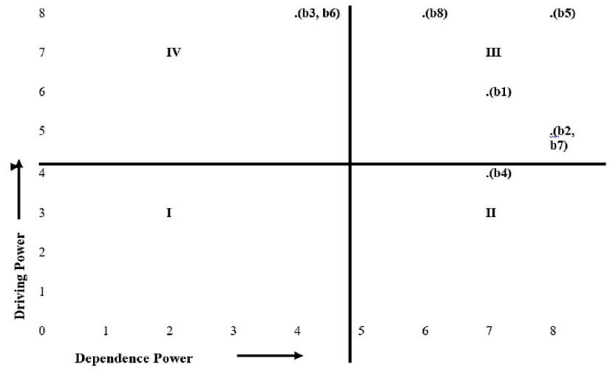

Figure 3. Driving and dependence power plot

4. Discussion

The drive of this study was to gain insights on the reason(s) as to why some consumers are reluctant to MPSs adoption, even during in this COVID-19 pandemic times. This qualitative study identified eight critical barriers including the five barriers of IRT (usage barrier, value barrier, risk barrier, tradition barrier and image barrier). The three-privacy barrier, visibility barrier and design constraint barrier emerged with IRT, and did not fall in the above categories of barriers. See annexure 1 for the related questionnaire prepared for the response from the experts. The questionnaire consists of demographic items in section I followed by barrier related items in section II. We have mentioned the sub-factor under each category of barrier, to brief and make the expert familiar about the concerned barrier.

The findings suggest that usage barriers are in level III and have high driving and high dependence power, which indicate that there are multiple MPSs options are available in Indian market but there is still lack of proper awareness, and training. The result is similar with the finding mentioned by RBI in the annual report 2021. In the Indian market, banks are partnering with global MPSs such as Google Pay, Amazon Pay, Paytm, PhonePe, and others, rather than providing exclusively their own banking options such as online and mobile banking. Although the above-mentioned contactless payment solutions do not demand any further investments from users, they do necessitate some training in areas such as QR codes, rewards, and mPIN (Mobile Banking Personal Identification Number) generation/change, which is a concern for users (Tiwari & Singh, 2019; Bryman, 2012). Not unexpectedly, respondents mentioned the importance of having a backup payment method (i.e. cash) and having numerous applications for different buying scenarios. Some of them also stated that they lacked knowledge of mobile payment options.

Furthermore, in terms of value barriers, it has a high driving and reliance power and belongs to the ISM model's level I. The findings, like those of other studies (Deloitte, 2019; Oliveira et al., 2016), show that people are not adopting MPSs due to a lack of utility and switching benefits. Cashbacks and other incentives were identified as possible value drivers for beginners to mobile payments. On the word of Arvidsson (2014), users feel that MPSs

should be fast, easy, and economical as card payment. The findings display that the value barrier is still a major barrier to mobile payment adoption. In the cash dominating country like India, where the debit and credit card are highly accepted there may be low benefits for MPSs. MPSs may provide more benefit to the users in exchange for their work in learning and becoming familiar to utilising this technology since they have low value barriers. Additionally, users may also avail the technological benefits of MPSs which further spur in the technological advancement of the country.

Risk barrier is one of the major concerns among the respondents. It is one of the key barriers which has high driving and low dependency power. In this study, the concern was lack of trust on the device, app, and/or payment technology. In previous studies also, trust has always been one of the major concerns in the technology adoption (Vinerean et al., 2022; Ramos de Luna et al., 2019; Singh et al., 2018; Sahu & Singh, 2018; Kerviler et al., 2016; Oliveira et al., 2016; Yang et al., 2015; Arvidsson, 2014; Mallat, 2007). According to the report of Opensignal (2021), the average internet connection speed in India is 8.1 Mb/s which is 85th rank worldwide. "Internet connection lost" is one of the major risks during mobile payment, especially in large value payment, due to which people are concerned about monetary loss, pending payment, dual payment etc. With this people feel tradition method of payment is more secure.

Tradition barrier is related to the old habits of a person. This is the only barrier which is on level II of ISM model and dependent quadrant, which means tradition barrier is very important barrier and it is highly influence by other users. People may use or not to use MPSs according to the spending habits and influencers around. During this study a common question was always raised by the respondents that, "why would I need to change, if I am comfortable with the tradition method?" It is in their habit to use cash first in place of thinking about any alternatives. Very few senior citizens, those are not using MPSs try to learn new technology, else are happy with their traditional mode of payment. Being comfortable in no-change obstruct the technology adoption of MPSs, similar with prior studies (Singh et al., 2018; Sahu & Singh, 2018; Chemingui & Ben lallouna, 2013).

Image barrier also matters, it has the equal and highest ratio of driving and dependence power in the MICMAC analysis. The findings support those of Arvidsson (2014), who emphasised the importance of the relationship between business to consumer (B2C) in the adoption of MPSs. The image of company and the country image is the representative of the new technology adoption behaviour.

Privacy barrier is also an important barrier of technology adoption, which has high driving power. People are concerned about what global IT corporations may do with their personal data, and the management of personal information by third-party suppliers (other than one's own bank) are important problems to consider. Security concern has always been a major concern on technology adoption (Sahu & Singh, 2018).

Visibility barrier arises when the payment methods are not available to use. It is due to the merchants of that locality not using it. Results shows that it is quadrant III in MICMAC plot and level I in the model, which represents the importance of this barrier in MPSs context. Mallat (2007) has written extensively about the less merchant acceptance of MPSs. This fear is likely to fade, with the mass adoption of mobile payments. The current study also revealed

that other people's acceptance is crucial for adoption. New users always take suggestion about the technology from their family, friend and peer group. Therefore, MPSs platform providers may be more attentive to the improvement of visibility, so as to facilitate the willingness of the potential users to adopt the MPSs platform. The government may also offer resources and regulations to make adoption simpler and clearer. This is due to the fact that an individual's attitude, moral obligations to his or her country and society, and support from various mobile payment service providers and vendors would have a high impact on their intention to continue using mobile payment services when they are strongly motivated by mandatory government regulation (eg. the demonetisation regulation) (Verma et al., 2019).

Likewise, other barriers, design constraints of the device are also one of the main concern for people. The result is concurring with the previous study (Sahu & Singh, 2018). It is in quadrant III, which means this barrier has high impact with other barriers of the study. Design constrains are involved when the mobile is not compatible with the systems, along with fear of low battery life, possibility of theft etc.

Conclusions, limitations and future research direction

The MPSs is one of the most cost-effective, convenient, and digitally enabled technology in the digital world. It acts as an enabler to achieve the objective of zero physical cash transactions. Traditional payment services should be replaced by MPSs, as adoption of this technology is likely to increase in most countries, with some emerging economies potentially showing a leapfrog development from cash to mobile pay (Boden et al., 2020). During COVID-19, government suggested to adopt MPSs in routine transactions to avoid the transmit of virus as well as to maintain the transparency during the transaction. Therefore, marketers look for a positive growth in the area of MPSs. However, as per the central government report, the adoption rate is very low which is not expected by the government. Hence, a study was required to identify the reason behind the slow adoption rate of MPSs.

With the help of review of literature, and interviews of experts, this study identified a set of total 8 barriers of adoption of MPSs in which 5 barriers were commonly used barriers of well-known IRT model, that could prohibit India from adopting MPSs technology. This research applied ISM and MICMAC methods to derive interplay among the factors and present a structured model. Subsequently, identification of the pairs of barriers (i, j) was made possible through the development of a contextual relationship among these 8 barriers. The application of ISM resulted in a final hierarchal model which divided all the barriers into four different levels and developed an interconnection among them, allowing users, researchers, and policymakers to better grasp the notion and become acquainted with the interactions that can lead to adoption failure. With the help of ISM this research is able to provide both direct and indirect links between the barriers in context with MPSs.

The findings emphasise the unpredictability of variables in terms of their influence on one another, their interactions, and themselves. It demonstrates the necessity of looking at data as a whole afore at individual barriers. On the MICMAC plot diagram in Figure 3, each variable's driving power and dependent power has been identified and assigned to a separate quadrant. As a result of the variables' location, the majority of them have a high driving and

dependency power. High driving power means, high amount of influence over key factors. The barriers with the high driving and dependent power are found at the top (level I) of the ISM model (Figure 2), implying that they will be impacted and influenced if any of the related elements in the lower levels are impeding adoption. Therefore, level I barriers essentially be properly addressed if both the driving and dependant powers are high. In conclusion, the novelty of this research work is threefold. First, it surfaces three new factors – privacy barrier, visibility barrier and design constraints barrier into the extant of IRT. Second, it brings a new conceptual model towards the barrier of technology adoption. Finally, few strategies are recommended for the barriers of adoption of MPSs with ISM methodology.

There are few flaws in this study as well. First, this study is concentrated on MPSs barriers which are obtained from the IRT model. Researcher can identify more barrier through extensive literature review in the area of technology adoption. The ISM technique could be used to develop a framework for MPSs adoption in the future. Second, only Indian academics working in higher education were selected as expert and were requested to complete the survey, therefore, there could be a possibility of bias and may have narrowed the scope of the findings to a single industry. In future, additional comparisons might be done and the results could be more thorough if the study was conducted in other locations or sectors. Furthermore, since the ISM methodology was used in this study, the result is not statistically validated. Hence, the scholars may explore empirical methods such as SEM to test the model to reduce bias (Chowdhury et al., 2019). Third, the strength of the links between the factors is not clear, and a fuzzy MICMAC analysis could have been employed to find out the strength of such inter-relationship (Venkatesh et al., 2015). Fourth, MPSs user behaviors could also vary across countries; therefore, it is worth testing this model across geography. This may provide different findings in the future research.

Author contributions

Naveen Kumar Singh: Conceptualization, Supervision, Investigation, Methodology, Resources, Data Collection, Validation, Writing – original draft, Writing – review & editing. Pragati Singh: Writing – original draft, Writing – review & editing.

Disclosure statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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APPENDIX

Section I

Please select any one option in the questions below. Please write 'Y' (Yes) in front of specific column.

1. What is your education qualification?

(a) Postgraduate		
(b) Doctorate		
(c) Any other		

2. What is your total teaching experience?

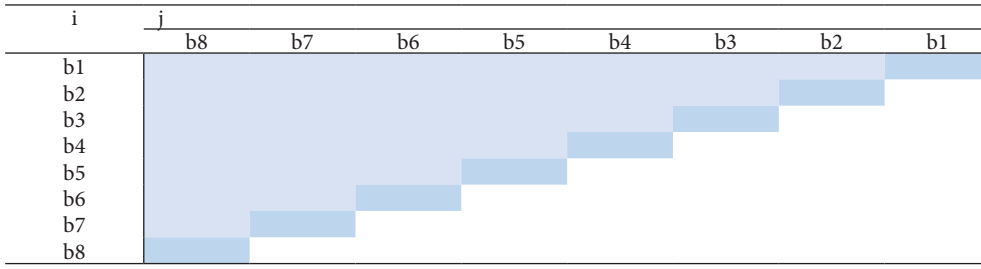
(a) 10–15yrs		
(b) 11–0 yrs		
(c) >20 yrs		

3. How many employees working in your organization?

(a) <50 Employees		
(b) 51–250 Employees		
(c) >250 Employees		

Section II

4. Relationships between the barriers of MPSs adoption.



Sub-factors of the barriers

Usage barriers	– Lack of knowledge of the technology – Alternate payment options are easier than payment through mobile phone – Multiple apps required for different merchants
Value barriers	– Lack of benefits over other options available in the market – No switching benefits – I am looking for a big offer/incentive/reward to start using
Risk barriers	– Mobile payment is not function proper at all the time – Lack of trust on the device/app/payment technology – Fear of monetary loss during the transaction – Alternate payment options available in the market are more secure – Poor connectivity of the internet
Tradition barriers	– Why would I need to change, if I am comfortable with the tradition method? – I don't want to learn/effort for new technology
Image barriers	– The company/country of technology providing is not good – Third party, except banks are not trustworthy – Others are not happy or getting threat by the use of technology
Privacy concern barrier	– Risk of unauthorized access of my personal information – Fear of leakage of information I am putting on third party app
Visibility barrier	– I can't see anyone using the technology in my locality – Nobody is taking initiatives to start using the new technology – Merchants are not accepting the new technology of payment
Design constraints barrier	– My phone is not compatible to use any mobile payment app – The mobile payment app isn't easy to learn