Critical Success Factors of the Digital Payment Infrastructure for Developing Economies

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Abstract. This paper studies the Critical Success Factors' (CSFs) for the adoption of Digital Payment System in India. There are few studies about the literature on CSFs for the adoption of the digital payment system in the Indian context. This study is an attempt to cover this gap. In this study, we reviewed the theories for adoption model at the individual level used in Information System (IS) and discussed four technology model including "Technology Acceptance Model" (TAM). Ten factors have been identified with extensive literature review and review of selected models namely; Perceived Ease of Use, Perceived functional benefits, Awareness, Availability of Resources, Government as a policy maker, Performance Expectancy, Social Influence, Price Value, Experience & Habit, and Risk-taking ability. An expert from academic industry has been taken as a reviewer or consultant of the selected variables. The CSFs may ensure that they are the predictors and the important factors for adoption of digital payments system in India. The study mainly uses the deductive approach to consider the primary and secondary sources of data. The analyses of these models take into account through Interpretive Structural Modeling (ISM) methodology and develop a model for effective adoption of Digital Payment System in India. The paper also makes future recommendations for further research studies.

Keywords: Technology Acceptance Model (TAM)
Interpretive Structural Modeling (ISM) · Digital Payment System
Critical Success Factor (CSF)

1 Introduction

"Digital Payment will acquire around 15% of the total GDP", estimated by the Boston Consulting Group (BCG) in their report Digital Payment 2020. The report also estimated that around 90% of the customer will acquire digital payment for their daily (online and offline both) transactions. Payment plays an important part in country's major decisions like; monetary policy, fiscal policy, financial sector and economic

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development [20, 42]. It is one of the important issues and having substantial changes policies in across the world. In traditional stage, barter system was used to fulfil the need [1] through the exchange of one good with other required goods, like livestock, crop, food etc. But in the modern era of the digital payment system, which is totally different from the traditional way of exchange of goods; here the transactions are made by using digital currencies with the help of an electronic medium. Digital Payment refers to the set of rules & regulations, procedures, method, medium (i.e. mobile phones, computers, laptops etc.), processes and interbank funds transfer systems which accelerate the circulation of money in the country or currency area [22]. The study conducted to fulfill the objective of research, the objectives are:

- To carry-out a comprehensive literature review on adoption of Digital Payment.
- To identify the Critical Success Factors (CSFs) for effective adoption of Digital Payment System in India.
- To develop a model for effective adoption of Digital Payment System using Interpretive Structural Modeling (ISM) Methodology.
- To develop a set of recommendations for effective adoption of Digital Payment System in the developing economies like India.

The structure of this paper is as shown – Sect. 2 is literature review of the related study including identification of CSFs on the basis of adopted theories and related literature, it also provides the background, history of digital payment system; Sect. 3 is the explanation of related theories and methodology of the study; Sect. 4 discussed the identification of variable affecting adoption of digital payment system and research model development; Sect. 5 presented the study's finding and result with the help of Interpretive Structural Modeling (ISM) methods. Section 6 discusses the findings and brief conclusion of the study; Sect. 7 is the last section of the study provides the future recommendation and its limitation and probably potential direction for future studies on adoption of Digital Payment System.

2 Review of Literature

Cashless transactions were introduced in the early 1950s and become "ready money" to the users, which reduce the risk of an individual like, handling of cash, theft by pickpocket etc. and national risk like, corruption, black money, stockiest etc. During the 1990s' cashless transactions become more popular with the popularity of e-Banking in developed countries. Late 2010, digital methods of payment became more popular in across the world. At the earlier stage, online modes of payment like Paypal, Plastic cards, Mobile wallet systems, e-Banking etc. helped the users to make a digital transaction. Different types of payment system existed before the emergence of digital payment system in India. People deposited money manually at the bank branch, sahukar, jewelers, etc. and the banking system operations were done on paper/files manually, which lead to a slow transaction, more chance of errors, maintenance and keeping of register. The process of maintaining, ledger posting, and keeping of register without using any single machine called "Book Keeping". Hardly one computer

present at one whole branch which helps to cover some sort of manual work in the branch, more the one computer are like "triton among the minnows".

The worldwide propagation of the Internet led to the birth of e-Commerce, which further allows the electronic transfer in a technological environment. The growth of e-Commerce depends on its speed, digitalisation, accessibility, and availability. The internet provides the facility to make quick decision making in business activities, like advertising, auction, negotiation, ordering, paying for merchandise and sourcing [43]. E-Commerce allows the companies to reach potential customers from one corner to another corner of the world. But the problem in global transaction system is the lack of standard finance system in an open electronic market. E-Commerce requires authentication, non-repudiation, trust, and security for successful implementation of technology [17] and for this purpose Digital signature is one of the best examples of Internet authentication and non-repudiation [11]. Moving against the drawback of digital payment like overflow of currency, black money, corruption, terror funding etc. provides the transparency in the flow of currency and an easy way to track money anywhere and anytime. There are various methods to make digital transaction in India (Cashless India) including, Internet Banking, Banking Cards, Unified Payments Interface (UPI), Unstructured Supplementary Service Data (USSD), Aadhar Enabled Payment System (AEPS), Mobile Wallets, Bank Pre-Paid Cards, Point of Sale (POS), Mobile Banking, and Micro ATMs. The government of India started Digital India Program to promote digital transaction, digital literacy, awareness, use of internet etc. which transforms India into a digitally empowered society and digital friendly economy. A program like "Digital India" provides an intensified impetus for future progress for electronic governance and would promote not only growth but also provides e-Services, e-Product, e-Devices, digital manufacturing, and job creation. E-Governance and Service on Demand is an important component in Digital India Program of Government of India. It offers seamlessly integrated, real-time online services, to Indian citizen with a platform for the digital mode of financial transactions. The program "Digital India" started by the government of India (GOI), encouraged and supported by the other private as well as public organisations of the country and contributing their effort to make India cashless.

Ministry of Electronic and Information Technology (MeitY), Government of India envisages internet and mobile-enabled information and services access anytime, anywhere in the whole country, especially in the semi-urban, rural and remote part of India (GOI). MeitY further envisages common e-Government infrastructure that offers end-to-end online transfer experience for the Indian citizen, business and other governmental functions like, accessing various government information to Indian citizens, Payment gateway interface etc. After the implementation of e-payment methods, people can use digital payment methods for numerous purposes such as, online shopping, bill payment, fund transfer, etc. According to a local study, the level of technology continues to rise; fears continue to rise as well. According to Johnson [19], Fear of commercial failure or loss of competitive advantages is "driving high levels of innovation among commercial firms, information systems suppliers and financial institutions".

3 Research Methodology

The use of Information Technology (IT) in the workplace remains a core concern of Information Systems (IS) research and practice of the Government. The troubling problem of information technology is underutilized systems, in place of impressive advances in hardware and software capabilities [38]. Less use of installed systems has become major factor underlying the "productivity paradox" surrounding uninspiring returns from organisational investments in IT [32]. Adoption is a primary decision made by a user to interact with the technology [40]. A number of studies have been investigated for the adoption of new technology in developed countries [36] but very few in developing countries [5]. In this study, we studied various theories for IT adoption models at the individual level used in IS literature and discuss in prominent models used in this study. The models used for the study are: Technology Acceptance Model (TAM) [13], Unified Theory of Acceptance and Use of Technology (UTAUT) [39], The Theory of Reasoned Action (TRA) [16], and The Theory of Planned Behaviour (TPB) [2] because these models are the only ones that are at the individual level. The Diffusion of Innovation (DOI) [30] and Technology–Organization–Environment framework (TOE) [6] are at the firm level. The DOI and TOE are not discussed further because these are not the part of our study, rest of the theories are discussed in the following sub-sections.

3.1 Technology Acceptance Model (TAM)

According to Davis [13, 14], this model develops the intention to use the IS, which influences the individuals' decision of actual usage of the technology. This model derived two beliefs Perceives Usefulness (PU) & Perceived Ease of Use (PEU), which intended use of a technology. This is broadly studied and accepted model in technology adoption [35] and according to this model ease of use has also been found to be an important constraint of intention to use new technology [25].

Perceived Ease of Use (PEU). It is the degree to which user believes that it would be free of efforts by using a particular system [13]. There is lots of research which provides evidence of the significant effect of ease of use on intention to use [13, 21, 23, 26, 34]. Among the potential adopters of software, PEU has a positive effect on intention to adopt [21]. Similarly, according to Guriting and Ndubisi [18], bank customers are likely to use online banking and other banking services when the technology easy to use; and [23], for online trading system PEU was correlated with intention toward the use of the online trading system. PEU has a significant effect the development of initial willingness to use of Internet Banking [27]. Thus PEU predicts the acceptance of technology with end users' beliefs on technology [14, 38].

Perceived Usefulness (PU). It is the degree to which user believes that with the help of the technological system, it would help to enhance performance and productivity in the workplace.

3.2 Unified Theory of Acceptance and Use of Technology (UTAUT)

There are five behavioral intentions in this model [39]:

Performance Expectancy. It is a degree to which user believes that the system will help to gain his/her performance.

Effort Expectancy. It is a degree in which user believes the ease of use of the technology.

Social Influence. It is the reaction, impact, of the society for the use of new technology by the individual.

Facilitating Condition. It is the belief of the individual that the organization and technical infrastructure exist to support the individual.

Behavioral Intention. It is the individuals' subjective probability of performance. There are four moderate determinants of the individual in this model: gender, age, experience, and voluntariness of use.

3.3 The Theory of Reasoned Action (TRA)

TRA derived from the study of human attitude and behavior. TRA posits the antecedents of behavior are users' intention and the strength of the persons' intention to carry out that certain behavior corresponds with the likelihood of the behavior taking place. The following three antecedents are derived from this model are:

Attitude. It means the intention to use the technology.

Subjective Norms. It is the perception that the persons who are important to the individual perform the questionable behavior, and

Behavioral Intention. It is a belief that performing behavior lead to a specific outcome. TRA finds its origin in the field of social psychology. It defines the link between intentions, behavioral beliefs, social norms, personal attitude, and behavior of an individual. According to Ajzen & Fishbein [4], an individuals' behavior is identified by its behavioral intention to performance. This intention is further identified by the individuals' behavioral attitudes, traits, and subjective norms towards the behavior. [16] also claims that there are some other factors which are known as external variables, influence the behavior only in an indirect way by influencing the attitude or subjective norms. The variables like; characteristics of the task, types of development implementation, political influences, organizational structure etc. [14].

3.4 The Theory of Planned Behavior (TPB)

TPB expands the area of pure volitional control identified by TRA [2]. It is a social-psychological model which is extensively in the domain of IS for predicting, examining and explaining the human behavior [15]. According to this model, the actual behavior is driven by users' intentions that are influenced by factors related to personal, social and

environmental. TPB examines and predicts users' intention and behavior in situations where the individual user might lack control over their own behavior [2, 6, 37]. TPB supply more information to explain human behavior, so it can be said that it is more powerful and superior than the other technology adoption models predicting and explaining human behavior [24, 33, 34].

4 Variable Which Affects the Adoption of Digital Payment System

On the basis on above models adopted for the study and extensive review of literature in the area of technology adoption, there are following Critical Success Factors' were identified to develop a model for effective adoption of digital payment in India. There are a number of studies that have investigated adoption of technology in developed countries [36] but very few or no studies that have been focused in developing countries [5] and also no standard model has been given by any of them for use in developing countries. For instance, there is no dominating method for digital payment system in India. To develop a model for effective adoption of digital payment system a few factors are identified, such as:

Perceived Ease of Use. It refers to the degree of effort required to adopt the digital payment methods in place of traditional methods. The more complex process needed the more efforts to adopt the technology and vice versa [13, 14].

Perceived Functional Benefits. Functional benefits provide the advantages of adoption of new technology to the user and the society [29].

Availability of Resources. It includes medium or device, methods, availability of the Internet, software, ICT with additional features like access of use, speed, and cost of internet [29].

Performance Expectancy. User adopts any new technology with this belief that the new technology will help him/her to gain in the performance and productivity, reduce cost, and save time providing overall growth to the individual as well as the society [39, 41].

Government as Policy Maker. Policy makers should be context specific, sensitive, and have the strongest impact on the user. It requires coordination with the other private or public institutions to make a strategy for implementation of innovative technology system.

Awareness. It consists the users' knowledge, education, and consciousness of digital payment system including its characteristics, functionality, advantages and disadvantages [29].

Social Influence. This consists of mouth to mouth publicity of the individual to use digital payment adoption methods. In this factor, users insist and help others to use the technology [39, 41].

Price Value. Price refers to the charges or commission of the services avail by the user to use the technology. So the charge taken by the government to the user should be low [41].

Experience & Habit. Past experience provides the platform to adopt new technology. It reflects the learning and past behaviors of the technology [41].

Risk Taking Ability. Risk plays an important role in the adoption of any new technology. Hence, the government should provide belief to the user that organizational and technological infrastructure exists to help the user.

A research model (Fig. 1) is proposed to validate the hypotheses. The model will be validated in a future study with the help of effective statistical tools and methods.

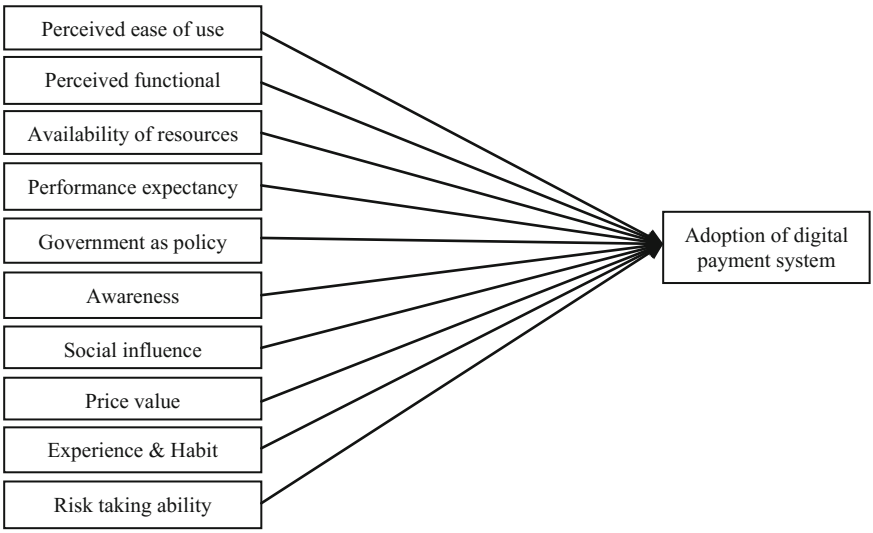

Fig. 1. Research model of the study

The proposed research model provided ten effective critical factors based on the existing theories and literature review. We will implement these CSFs in our further studies which will be related to consumer perception of adoption of the digital payment system. Structural Equation Modeling (SEM) will be used as a technique of analysis which provides a comprehensive model (Fig. 2) indication the hierarchy of variables and linkage of variables from each other. SEM-based analysis generally having two stages, first; Measurement Model and second; Structural Model. Measurement Model aims to identify constructs variables that fit to analyse the further studies. In getting fit variables Confirmatory test Factor Analysis (CFA) will be used. While on the other hand, Structural Model aims to identify a model which is feasible with the help of Goodness of Fit (GoF) test. To test the suitability of the model the statistical method will be used, namely; Goodness of Fit Index (GFI), Adjusted Goodness of Fit Index (AGFI), Root Mean Squares error of Approximation (RMSEA), Chi-Square test (X^2), and Root Mean Squares Residual (RMSR). To test the reliability, AMOS application will be used in SEM as a composite measure of reliability. If the value of Construct Reliability (CR) will be ≥ 0.70, then the construct will be deemed as good reliability.

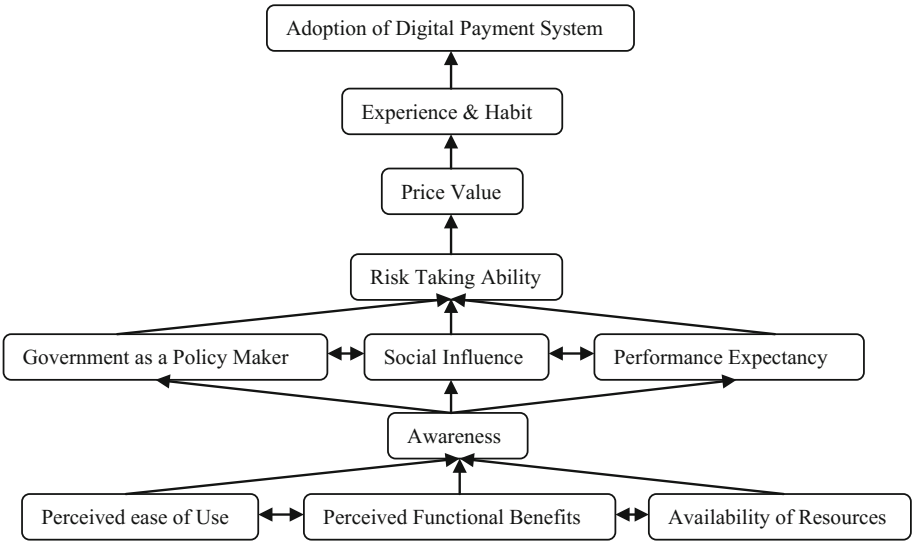

Fig. 2. Model for adoption of digital payment system

For this purpose, data will be collected through online as well as offline survey method with the help of a questionnaire. The target respondent will be individual customers who are directly related to procurement procedure.

5 Model Development Through Interpretive Structural Modeling (ISM)

ISM model enables the researchers to establish a relationship among the identified critical success factors with the help of a formal structure [10]. It is an interactive learning process which determines an interdisciplinary direction and provides level which shows the priority among the CSFs. With the help of literature review and a formal interview with academic experts of the related domain, a model has been developed using ISM methodology. This model is used to interpret the relationship and direction between the variables, to a better understanding of interdependency [31]. Hence, ISM modeling is used to develop an effective model for adoption of the digital payment system. There are several steps followed to develop the model [12]:

- Identified CSFs with the help of extensive literature review and expert opinion (Fig. 1).
- For pair-wise relationship, Structural Self-Interaction Matrix (SSIM) has been developed through expert advice and interviews.
- Reachability Matrix has been developed with the help of SSIM to check the transitive matrix (Table 1).

- To check the relationship from another axis, Antecend Set has been developed with the help of SSIM (Table 2*).

Table 1. Reachability matrix

Factors (j) (i)	11	10	9	8	7	6	5	4	3	2	1
1	1	0	1	1	0	1	0	1	0	1	1
2	1	1	1	1	0	1	0	1	1	1	1
3	1	1	0	1	1	0	0	0	1	0	1
4	1	0	0	0	0	1	1	1	0	1	1
5	1	0	0	1	1	0	1	0	1	0	0
6	0	1	1	1	1	1	0	0	0	1	1
7	1	0	1	1	1	1	1	0	0	1	1
8	0	1	1	1	0	1	1	0	0	0	0
9	1	1	1	0	0	0	1	0	0	0	0
10	1	1	0	1	0	1	1	0	0	1	0
11	1	0	0	0	0	0	0	0	0	0	0

- Development of Intersecting set from the factors which are intersecting between Reachability matrix and Antecend Set (Table 2*).

Table 2. Reachability, antecend, and intersection set and level of factors

Sl no	Reachability set	Antecend set	Intersection set	Level
1	1, 2, 4, 6, 8, 9, 11	1, 2, 3, 4, 6, 7	1, 2, 4, 6	VII
2	1, 2, 3, 4, 6, 8, 9, 10, 11	1, 2, 4, 6, 7, 10	1, 2, 4, 6, 10	VII
3	1, 3, 7, 8, 10, 11	2, 3, 5	3	VI
4	1, 2, 4, 5, 6, 11	1, 2, 4	1, 2, 4	VII
5	3, 5, 7, 8, 11	4, 5, 7, 8, 9, 10	5, 7, 8	V
6	1, 2, 6, 7, 8, 9, 10	1, 2, 4, 6, 7, 8, 10	1, 2, 6, 7, 8, 10	V
7	1, 2, 5, 6, 7, 8, 9, 11	3, 5, 6, 7	5, 6, 7	V
8	5, 6, 8, 9, 10	1, 2, 3, 5, 6, 7, 8, 10	5, 6, 8, 10	III
9	5, 9, 10, 11	1, 2, 6, 7, 8, 9	9	II
10	2, 5, 6, 8, 10, 11	2, 3, 6, 8, 9, 10	2, 6, 8, 10	IV
11	11	1, 2, 3, 4, 5, 7, 9, 10, 11	11	I

- Based on the Intersecting set a hierarchal graph has been drawn by removing transitive relationship (Fig. 2).

*Table 2 included both the sets.

We followed these following steps to prepare the SSIM as well as Reachability Matrix (Table 2) to construct the ISM model (Fig. 2):

1. If (i) is the predictor of (j) then (i, j) cell entry in the SSIM is A, then the equivalent (i, j) entry in the Reachability Matrix becomes 1 and the (j, i) cell entry become 0;
2. If (j) is a predictor of (i) then (i, j) cell entry in the SSIM is B, then the equivalent (i, j) entry in the Reachability Matrix becomes 0 and the (j, i) cell entry become 1;
3. If (i) and (j) are both predictors of each other then (i, j) cell entry in the SSIM is C, then the equivalent (i, j) and (j, i) both entries in the Reachability Matrix becomes 1;
4. If (i) and (j) both are not a predictor of each other then (i, j) cell entry in the SSIM is D, then the equivalent (i, j) and (j, i) both entry in the Reachability Matrix becomes 0;

Table 1 highlights the completed matrix when all the cell references have been converted to the binary format (i.e., 0 and 1) as the rules of ISM followed by Reachability Set, Antecend Set, and Intersection Set.

Table 2 identifies all ten critical success factors influencing the adoption of digital payment system. Table 2 also shows the Reachability Set and Antecend Set which help the researcher to categories the factor into different levels (i.e. from I to VII). These levels help the researcher to develop a model (Fig. 2) for a better understanding of interdependency on each other.

Developed ISM model represents the relationship between the selected CSFs in both direct and indirect way. All the factors are divided into seven different levels starting from bottom to top. Hence, the Model (Fig. 2) shows bottom-up approach where the factors at the bottom are the predicators of its upper factor/s. Like, Perceived ease of use, Perceived functional benefits & Availability of Resources (Level VII) are interdependent on each other and, are directly predictor of Awareness. These three factors (Perceived ease of use, Perceived functional benefits & Availability of Resources) are also indirectly predictor of rest of the other factors. Similarly, Awareness (Level VI) is directly predictor of factors; Government as a policy-maker, Social Influence, and Performance Expectancy (Level V) and so on. At the end of the hierarchy Adoption of Digital Payment System (Level I) is the immediate predictor of Experience and Habit (Level II). Therefore, this model provides an easy and clear hierarchal direction among the selected CSFs of Digital Payment System.

6 Discussion and Conclusion

With the help of TAM, UTAUT, TRA and TBP model including extensive literature review, there are ten CSFs were defined, which are responsible for the effective adoption of Digital Payment System. ISM provides the category-wise level from the identified CSFs, which shows the degree of importance of factors among all the CSFs. The objective of the study is to identify the CSFs for effective adoption of a digital payment system in India and the findings confirm that all the CSFs are related to Digital Payment System in India. The government of India and online transactions facility provider such as Banks, Non-Banking Financial Corporation (NBFC), Mobile Wallets, Payment Banks etc. should continually enhance their financial services with attractive offers, discounts, digital literacy, and awareness. It is observed that there are factors

which are also responsible for digital payment system [8, 28] like lack of trust, internet connectivity, awareness, and training etc. According to Böhle [9], digital payment methods should prove themselves to be convenient, secure and effective to cover the greater market in comparison with physical cash. In the rapidly growing economy where Perceived ease of use, Perceived functional benefits, and availability of resources have high impact on the digital payment system, similarly on the other side, Experience and Habit have a low impact on the adoption of Digital Payment System in India. The main contribution of this study includes an attempt to identify the significant variable using TAM, UTAUT, TRA, and TPB for successful adoption of the digital payment system in India.

7 Recommendations and Limitations

Finally, it would be useful to suggest the direction of the future research in the area of Digital Payment System. The technology adoption in the other sectors may slightly differ from the Digital Payment sector. This study used limited literature. This problem could be resolved in the next phase of the study where larger data will be utilised by the researchers. This study serves as a pre-cursor for the current digital payment system in India. In future, this study can incorporate more research and experts. The result may vary from country to country, at different location, environment etc. The present model has neither been approved by any governing body nor statistically, tested and validated. Thus, the model is required to be statistically tested and verified using different approaches like SEM, Confirmatory Factor Analysis (CAF) etc. Researchers can continue this study using analysis like MICMAC analysis. Very little research is available that focuses on the platform of adoption of digital payment and no research is available on the interaction among the factors using ISM. The present ISM based model help the managers and policy makers to understand the relationship between the variables.

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