

Factors Shaping UPI Platform Adoption and Effective Utilization in Metro Cities: A Key to Success

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Abstract

The Unified Payments Interface (UPI) platform is poised to displace the cash economy in the nation. In view of this event, it is imperative to study this segment. Consequently the title of the thesis is “**Factors Shaping UPI Platform Adoption and Effective Utilization in Metro Cities: A Key to Success**” The study reviews the literature around technology adoption and primary data from the National Payments Corporation of India (NPCI) to identify the framework to be used. On careful consideration, Diffusion of Adoption theory is selected as the appropriate basis for thesis framework. Data collection via questionnaire administration through online survey on respondents from Metro cities and subsequent hypothesis testing led to identification of the factors of adoption of UPI technology among B2C consumers. In conclusion, the 3 factors of observability, minimal complexity, and relative advantage of UPI platforms impacts user's intention to use and also recommending it, thus validating the Metcalf's law.

Introduction

The Unified Payments Interface (UPI) platform is at the forefront of India's digital payment revolution. One of the greatest financial innovations in India since independence, the UPI is a fast real-time payment system established by the National Payments Corporation of India (NPCI) and controlled by the Reserve Bank of India (RBI). It is poised to displace the cash economy in the nation. The UPI was established in 2016 with the goal of advancing digital transactions and creating a cashless economy to bolster the battle against corruption and dirty money.

By means of smartphone applications like PhonePe, GPay, BHIM, PayTM, it facilitates instantaneous transactions between bank accounts. Additionally, bank-based UPI platforms are significantly impacting the UPI business.

EPW [article](#) by Sanjay Kumar Singh, Shivendra Sanjay Singh & Vijay Lakshmi Singh highlights that users of UPI only require a smartphone to conduct transactions up to <1 lakh per day; they do not need to carry cash or a card for any trade. Furthermore, there is no additional fee for making a UPI payment, in contrast to credit card purchases, which are free of charge. Peer-to-merchant (P2M) transactions using UPI have also surpassed the share of card and other payment methods by a significant margin. In 2021, there were 2.15 billion credit card transactions with a total value of 8.88 trillion, and 4.12 billion debit card transactions with a value of 7.42 trillion. Compared to 18% of UPI in retail digital payments in January 2022 (it was below 9% in 2020), credit card share was less than 2% in that same month.

According to (Sharma, R., & Mishra, R. (2014). A review of evolution of theories and models of technology adoption. *Indore Management Journal*, 6(2), 17-29) and (Alavi, S., Ahuja, V., & Medury, Y.

(2012). Metcalfe's law and operational, analytical and collaborative CRM-using online business communities for co-creation. Journal of Targeting, Measurement and Analysis for Marketing, 20, 35-45), in Metcalf's Law (Gilders, 1993), when more and more individuals accept an invention, its value increases for current users. The adoption curve accelerates as a consequence of each new user's beneficial impact on current users. When communities are established as a component of an enterprise strategy, the law emphasizes how crucial it is to assist the networks' expansion through the challenging early stages until a "critical mass" of participants is reached.

Communities developed through UPI platforms have successfully completed this stage.

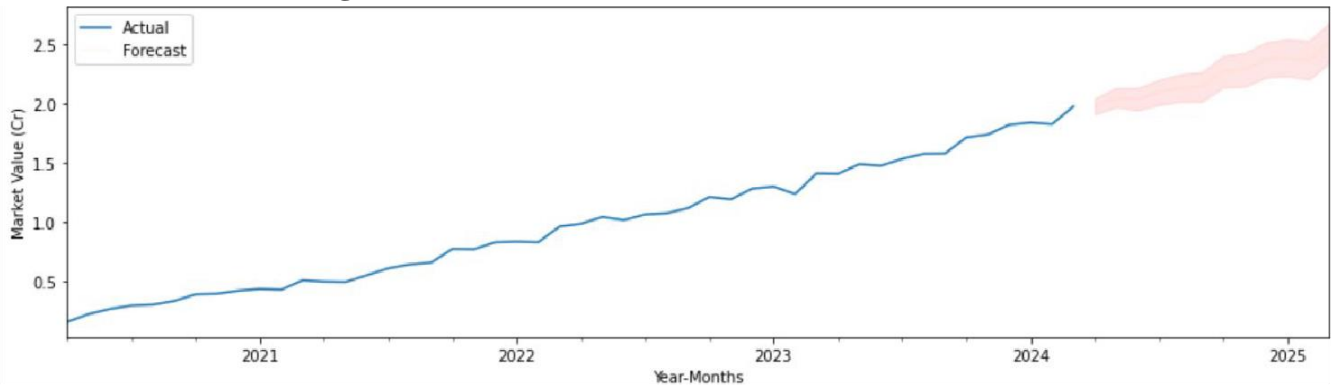
Exploratory Analysis

An initial analysis is conducted on the information gathered from the National Payments Corporation of India (NPCI) website in order to establish the foundation for the study. The data used covers the period from August 2022 to September 2023 in terms of both market volume (in millions) and market value (in millions).

Forecasting using Exponential Smoothing, Moving Average and SARIMA(Seasonal Autoregressive Integrated Moving Average) were used on the market volume (in millions) and market value (in millions). Since SARIMA method had the lowest MAPE(Mean Absolute Percentage Error), it was chosen as the appropriate tool for forecasting.

The results are as follows:

Market Value(Forecasting)

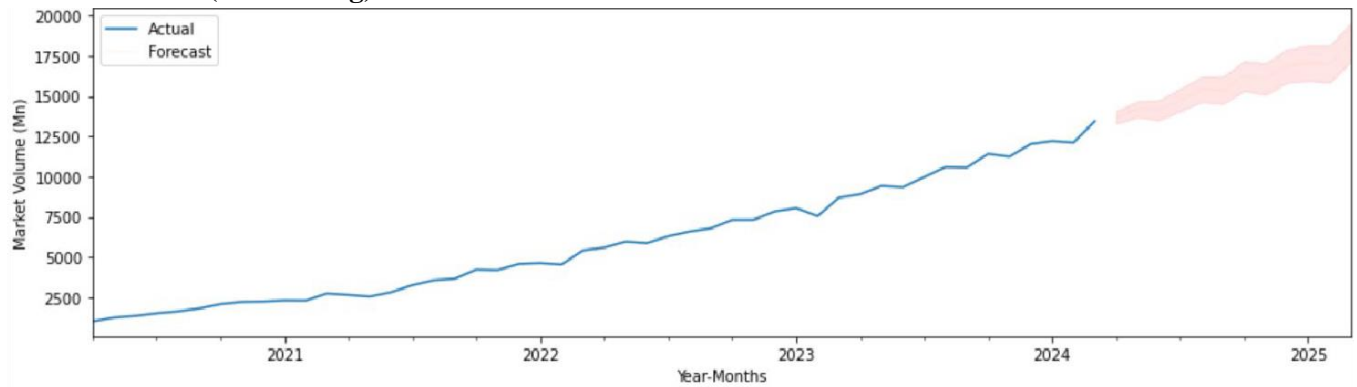


Data Source: National Payments Corporation of India(NPCI) **Figure 2.1 Forecast of UPI market based on Market Value**

	Test RMSE	Test Mape
TripleExponentialSmoothing	145681.347016	7.393376
2pointTrailingMovingAverage	39802.891467	2.002406
4pointTrailingMovingAverage	76306.476741	4.551645
6pointTrailingMovingAverage	116759.489415	7.233282
SARIMA	101187.888118	4.794584

Table 2.1 Summary of Model Evaluation on forecast models based on Market Value

Market Volume(Forecasting)



Data Source: National Payments Corporation of India(NPCI) **Figure 2.2 Forecast of UPI market based on Market Volume 2.4 Market Volume(Model Evaluation)**

	Test RMSE	Test Mape
TripleExponentialSmoothing	1700.747447	13.281452
2pointTrailingMovingAverage	299.837640	2.372692
4pointTrailingMovingAverage	574.903300	5.383042
6pointTrailingMovingAverage	884.925162	8.522617
SARIMA	691.669685	4.987214

Table 2.2 Summary of Model Evaluation on forecast models based on Market Volume

The reason for not shortlisting 2-point trailing moving average as the model of choice despite having the lowest MAPE is that the model is naïve and has a tendency of overfitting the data. Hence, the interpretation could mislead.

The goal of this research study is to determine the adoption determinants of UPI platforms in metro cities, although the NPCI data does not separately break down the metro/non-metro portion of the UPI market. Therefore, the study's data gathering scope will be limited to metro cities only.

As highlighted earlier in the preliminary analysis of NPCI data, it is being forecasted that UPI market in India will increase in the next 12-month period. Thus, it is imperative to identify the factors that influence the UPI adoption.

Phonepe & GooglePay Market Share Trend



Figure 3.1 Market share trend of Phonepe & GooglePay

The market shares of Phonepe and Google Pay over the period considered, i.e. April 2020 to March 2024 has witnessed Phonepe having overtaken Google Pay in December 2020. Since then Phonepe has

consistently maintained an average market share of 46.55%. In February 2024, Phonepe managed to corner more than half of the market share i.e. 50.74 %.

Considering the current competitive scenario, Phonepe & Google Pay combined command approximately 80% of the market share. The strategies being employed by these two players determine the manner in which the industry progresses.

Literature Review

The growth of businesses and the ease with which consumers may now access goods and services, whether through B2C or B2B channels, have made technology a vital instrument for facilitating the seamless and effective execution of business transactions and post-sale support. However, it is important to understand how to guarantee that the technology gets adopted, though simply introducing it is insufficient. Since the B2C market accounts for the majority of UPI platform usage, we will examine the literature on technology adoption from this angle.

Sharma, R., & Mishra, R. (2014). A review of evolution of theories and models of technology adoption. *Indore Management Journal*, 6(2), 17-29 in their study have reviewed the various theories on technology adoption. Some of the prominent theories highlighted are:

- Diffusion of Innovation Theory (Roger, 1960)
- Theory of Reasoned Action (Fishbein and Ajzen, 1975)
- Theory of Planned Behaviour (Ajzen, 1991)
- The Social Cognitive Theory (Bandura, 1986)
- Technical Adoption Model (Fred D Davis, 1989)
- The Model of PC Utilization (Thompson et. al. 1991)
- The Motivation Model (Davis et al., 1992)
- Extended TAM2 model (Venkatesh and Davis, 2000)
- Unified Theory of Acceptance and Use of Technology (Venkatesh, 2003)
- Model of Acceptance with Peer Support, (MAPS, Sykes et al., 2009)

After carefully examining the theories, it becomes clear that the Diffusion of Innovation Theory (Roger, 1960) is the most appropriate course of action for the current investigation. The rationale behind its application in the present investigation is elaborated upon below.

Justification for DOI usage

a) Sharma, R., & Mishra, R. (2014). A review of evolution of theories and models of technology adoption. *Indore Management Journal*, 6(2), 17-29 shows a comparative analysis of the constructs/ Determinants of Adoption of the various theories.

Table 4.1 Comparative analysis of the constructs/ Determinants of Adoption of the various theories
Instead of focusing on behavioral or psychological factors, the current study stresses the importance of investigating societal factors that influence people's adoption of technology. Because of this, we can only conclude that the right method is Diffusion of Innovation Theory (Roger, 1960) at the outset.

b) As per Sharma, R., & Mishra, R. (2014). A review of evolution of theories and models of technology adoption. *Indore Management Journal*, 6(2), 17-29, Diffusion of Innovation inherently follows the Metcalfe's law (Gilders 1993) which finds its background in the S-shaped curve of adoption which

was also called as the epidemic model of adoption.

Year	Theory/Model	Developed By	Constructs/ Determinants of adoption
1960	Diffusion of Innovation Theory	Everett Roger	The innovation, communication channels, time and social system.
1975	Theory of Reasoned Action	Ajzen and Fishbein	Behavioural intention, Attitude (A), and Subjective Norm.
1985	Theory of Planned Behaviour	Ajzen	Behavioural intention, Attitude (A), and Subjective Norm, Perceived Behavioural Control.
1986	Social Cognitive Theory	Bandura	Affect, anxiety.
1989	Technical Adoption	Fred D Davis	Perceived usefulness and perceived ease of use.
1991	The Model of PC Utilization	Thompson et al.	Job-fit, Complexity, Long-term consequences, Affect Towards Use, Social Factors, Facilitating Conditions.
1992	The Motivation Model	Davis et al.	Extrinsic motivation (such as perceived usefulness, perceived ease of use, and subjective norm) and intrinsic motivation (such as perceptions of pleasure and satisfaction).
2000	Extended TAM2 model	Venkatesh and Davis	Social influence processes (subjective norm, voluntariness and image) and cognitive instrumental processes (job relevance, output quality, result demonstrability and perceived ease of use).
2003	Unified Theory of Acceptance and Use of Technology (UTAUT)	Venkatesh et al.	Performance expectancy, effort expectancy, social influence and facilitating conditions.
2009	Model of Acceptance with Peer Support (MAPS)	Sykes et al.	Behavioural intention, System use, Facilitating conditions, Network density, Network centrality, Valued network centrality, Valued network density.

S-shaped curve, when studied in the context of Information Technology, gets a special significance and is called as Metcalfe's law (Gilders 1993). In this case, as more and more individuals adopt the innovation, it's worth increases for current communication system users. The adoption curve accelerates with each new user since they have a favourable impact on current system users.

Phenomenal growth of the Internet over last one and half decade is often interpreted by this law.

Diffusion of Innovation construct for current study

As per Zoubi, M., ALfaris, Y., Fraihat, B., Otoum, A., Nawasreh, M., & Alfandi, A. (2023). An extension of the diffusion of innovation theory for business intelligence adoption: A maturity perspective on project management. *Uncertain Supply Chain Management*, 11(2), 465-472, Roger (1995) contends that the diffusion and acceptance of new technologies depend on five main factors: observability, complexity, compatibility, trialability, and relative advantage. Tornatzky and Klein (1982) evaluated the Rogers' innovation characteristics and found that compatibility, relative advantage, and complexity had the strongest links with uptake across a wide variety of innovation strategies.

Since this study was conducted in a business-to-business (B2B) project management scenario, we are

attempting to apply the same theory in a business-to-consumer(B2C) situation.

To identify the relevant construct in a business-to-consumer(B2C), Shahid, M. (2022). Exploring the determinants of adoption of Unified Payment Interface (UPI) in India: A study based on diffusion of innovation theory. Digital Business, 2(2), 100040 is explored.

In this study Shahid, M. (2022), the determinants of UPI adoption are explored using all the 5 factors of Diffusion of Innovation: observability, complexity, compatibility, trialability, and relative advantage. The analysis comes to the conclusion that the important determinants are complexity, observability, and relative advantage. In a business-to-consumer context, compatibility and trialability are not supported.

Hence, we will use the 3 significant factors of **complexity, observability, and relative advantage** in the current study.

The literature that has been reviewed thus far has aimed to investigate the relationship among the Diffusion of Innovation (DOI) constructs. The impact of user’s background on the adoption of technology is an area yet to be explored. This research will introduce the user’s background as a construct.

Additionally, safety of the UPI platforms is also an area that must be investigated given the trust factor that need to be there in any financial transaction. Hence, the impact of the intention to use on the safety construct and thereafter safety’s impact on a user’s intention to recommend the UPI platform is being introduced in this research.

Proposed construct of the study

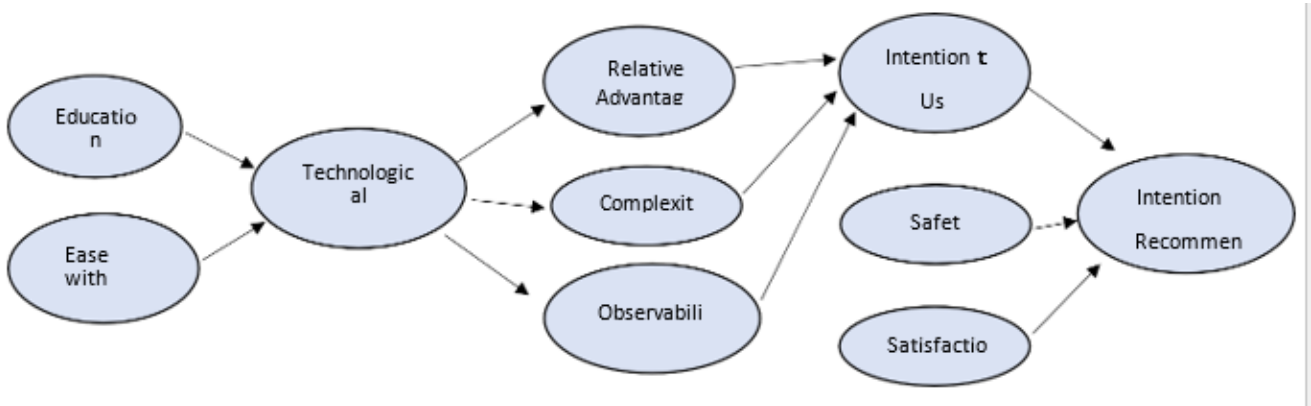


Figure 5.1 Proposed Model of the study

Intention to recommend is the backbone of Metcalf’s Law. In other words, the S-shaped curve finds it’s basis in the willingness of the satisfied users to recommend the usage further.

Hypothesis to be tested

H1: The education level has a positive impact on technological maturity.

H2: The ease with technology of respondents has a positive impact on technological maturity.

H3: The technological maturity has a positive impact on the relative advantage of the UPI platform. H4:

The technological maturity has a positive impact on complexity of the UPI platform.

H5: The technological maturity has a positive impact on observability of the UPI platform. H6: The

relative maturity has a positive impact on respondent’s intension to use.

H7: The complexity has a positive impact on respondent’s intension to use. H8: The observability has a

positive impact on respondent’s intension to use.

H9: Safety of the UPI platform has a positive impact on respondent’s intension to recommend the UPI platform.

H10: Intension to use has a positive impact on respondent’s intension to recommend the UPI platform.

H11: Satisfaction level of the respondent has a positive impact on the intension to recommend the UPI platform.

Questionnaire

Scale: 1 to 5(5: Highest score & 1: Lowest Score)

Parameter	Code	Question	1	2	3	4	5
Education Level	Education Level	My highest education qualification.	Below 10th standard	10th standard	12th standard	Graduation	Posters & Above
Ease with Technology	Ease with Technology	Number of years I have been using UPI	Never used	less than 1 year	1-3 years	3-5 years	More than 5 years
Relative Advantage	RA1	UPI has a number of advantages over other payment methods.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	RA2	UPI is more convenient than the cash payment method.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Complexity	CX1	Using UPI will makes simpler to purchase items.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	CX2	Using UPI is more convenient when making a purchase.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Observability	OB1	I have seen other people use UPI.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	OB2	I have observed a lot of people using UPI.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Intention to Use	IU1	I anticipate using UPI more frequently in the future.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	IU2	I plan to use UPI in the future.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Safety	SF1	I feel safe in using UPI for transactions.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree

	SF2	I am not afraid of my money unnecessarily getting deducted transacting on UPI.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Satisfaction	ST1	In general, I am pleased with the UPI.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
Intension to Recommend	IR1	I will suggest UPI to a friend.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
	IR2	If I have a positive experience with UPI, I will recommend it to my friends.	Strongly disagree	Disagree	Neutral	Agree	Strongly agree

Table 7.1 Questionnaire designed for the study

Description of the Survey Data

The survey has been administered via online mode through a google form. The respondent pool are professionals residing in metro cities of India. Survey responses were received from 26 respondents. The anonymity has been maintained of the survey respondents to maintain confidentiality and control any chances of bias in responses.

8.1 Data Description

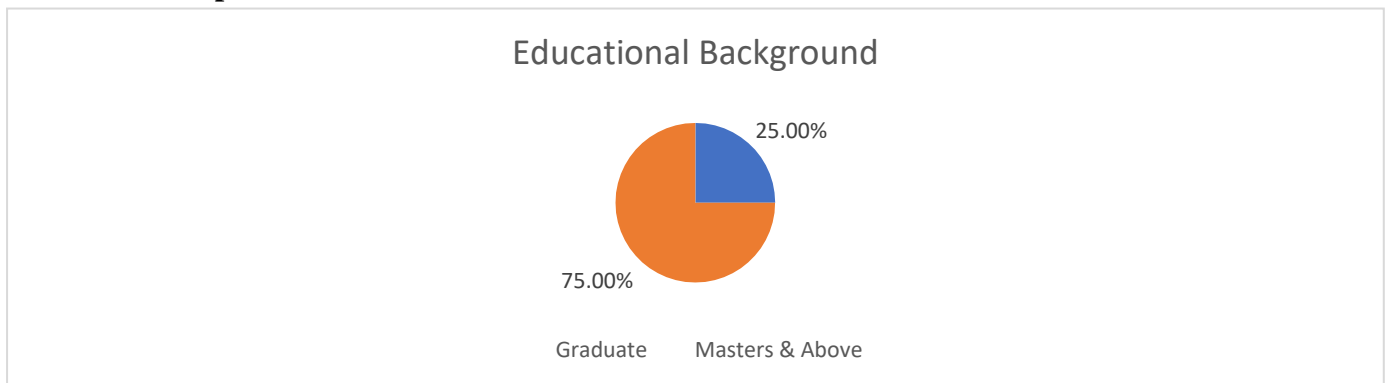


Figure 8.1 Education background of the survey respondents

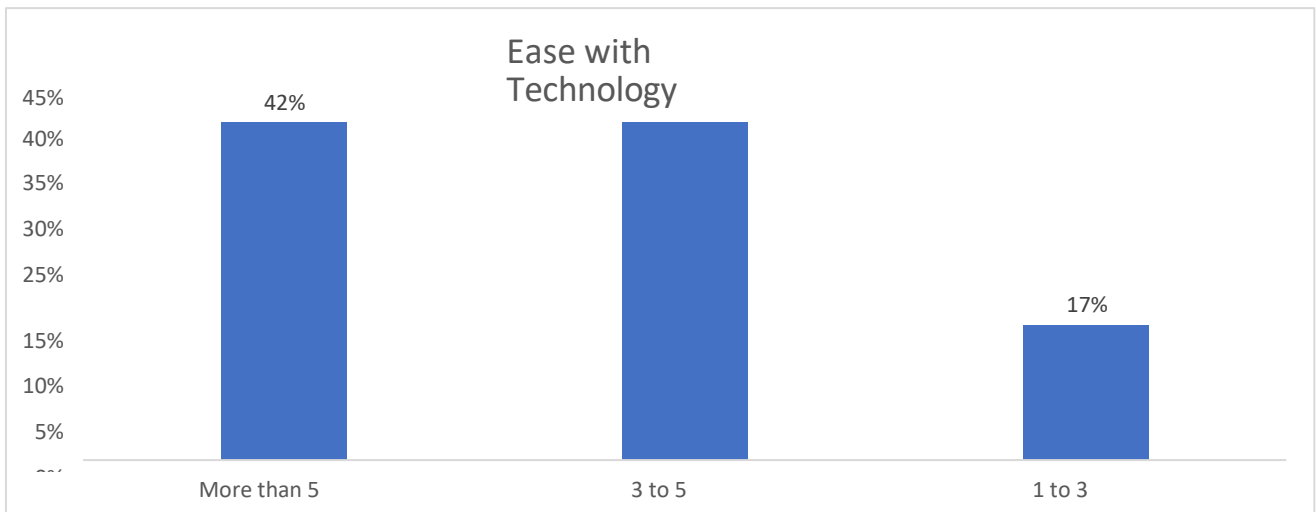


Figure 8.2 Technological Maturity of the survey respondents

75% of the survey respondents have a master’s degree while more than 80% of the respondents have been experienced UPI technology since the last 3 years. Considering that UPI has payment technology has gained momentum in the last 3 to 4 years only, it can be assumed that the respondents are early adopters.

Data Analysis

Data Preparation & Analysis Approach

In this study, the tool used for conducting the data analysis is Python. The method being used is Structured Equation Modelling (SEM). In order to validate the outcomes, Exploratory factor Analysis and Confirmatory Factor analysis are being used.

In order to fine tune the variable that are suitable to be included in the model, Commuality-Uniqueness analysis also conducted.

Commuality-Uniqueness of Variables

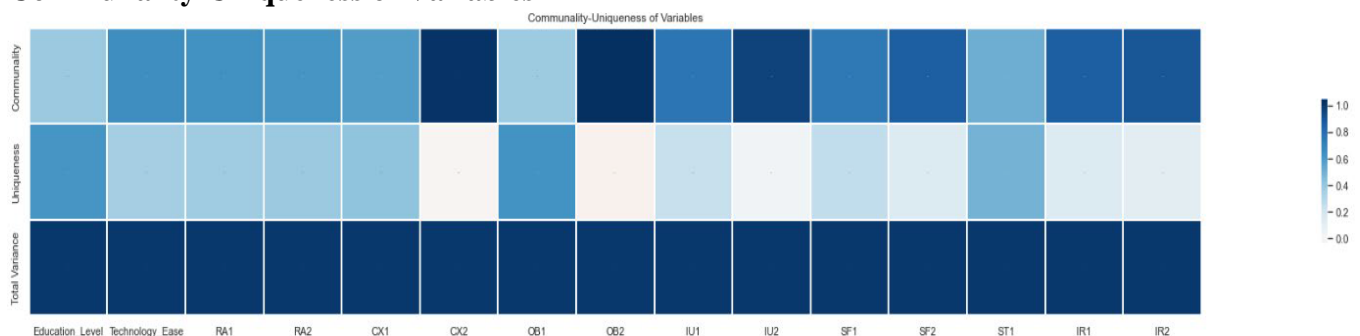


Figure 9.1 Commuality-Uniqueness of all the survey variables

As per the commuality-uniqueness shown above, variables which have a higher commuality are better suited to be included in further analysis.

Of all the variables in this study, the variables that have a higher commuality than uniqueness qualify for

inclusion for further analysis.

The following variables are found suitable to be included in the Structural Equation Modelling (SEM).

Parameter	Code	Question
Education Level	Education Level	My highest education qualification.
Ease with Technology	Ease with Technology	Number of years I have been using UPI
Relative Advantage	RA1	has a number of advantages over other payment methods.
Complexity	CX2	UPI is more convenient when making a purchase.
Observability	OB2	I have observed a lot of people using UPI.
Intention to Use	IU2	I plan to use UPI in the future.
Safety	SF2	I am not afraid of my money unnecessarily getting deducted transacting on UPI.
Satisfaction	ST1	In general, I am pleased with the UPI.
Intension to Recommend	IR1	I will suggest UPI to a friend.

Table 9.1 Variables shortlisted after Communnality-Uniqueness 9.3 Structural Equation Modelling (SEM)

	lval	op	rval	Estimate	Est. Std	Std. Err	z-value	p-value
0	Technological_Maturity	~	RA1	1.000000e+00	2.695482e+00	-	-	-
1	Technological_Maturity	~	CX2	1.000000e+00	8.678537e-01	-	-	-
2	Technological_Maturity	~	OB2	1.000000e+00	8.678537e-01	-	-	-
3	RA1	~	IU2	1.000000e+00	9.990767e-01	-	-	-
4	CX2	~	IU2	-3.193816e-01	-9.910569e-01	0.089767	-3.557899	0.000374
5	OB2	~	IU2	-3.193816e-01	-9.910569e-01	0.089767	-3.557899	0.000374
6	IU2	~	IR1	-3.519963e-01	-9.557795e-01	0.092131	-3.820594	0.000133
7	Education_Level	~	Technological_Maturity	1.000000e+00	4.043041e-01	-	-	-
8	Technology_Ease	~	Technological_Maturity	-3.399154e+00	-8.245827e-01	2.494811	-1.36249	0.173043
9	SF2	~	IR1	1.000000e+00	1.000000e+00	-	-	-
10	ST1	~	IR1	4.406931e-01	6.638468e-01	0.184395	2.38994	0.016851
11	CX2	~~	CX2	4.110615e-04	1.780620e-02	0.004408	0.093257	0.925699
12	IR1	~~	IR1	1.638900e+00	1.000000e+00	0.79614	2.058557	0.039537
13	IU2	~~	IU2	1.922458e-02	8.648558e-02	0.000575	33.423263	0.0
14	OB2	~~	OB2	4.110615e-04	1.780620e-02	0.004408	0.093257	0.925699
15	RA1	~~	RA1	4.110615e-04	1.845829e-03	0.004408	0.093257	0.925699
16	Technological_Maturity	~~	Technological_Maturity	4.110615e-04	1.341109e-02	0.004408	0.093257	0.925699
17	Education_Level	~~	Education_Level	1.568600e-01	8.365382e-01	0.066015	2.376118	0.017496
18	SF2	~~	SF2	7.254389e-15	4.426378e-15	0.431479	0.0	1.0
19	ST1	~~	ST1	4.039613e-01	5.593075e-01	0.184985	2.18375	0.028981
20	Technology_Ease	~~	Technology_Ease	1.667062e-01	3.200633e-01	0.197393	0.844539	0.398368

Table 9.2 Results of Structural Equation Modelling(SEM)

The table above shows the detailed outcome of the SEM analysis on the surveyed data.

Model

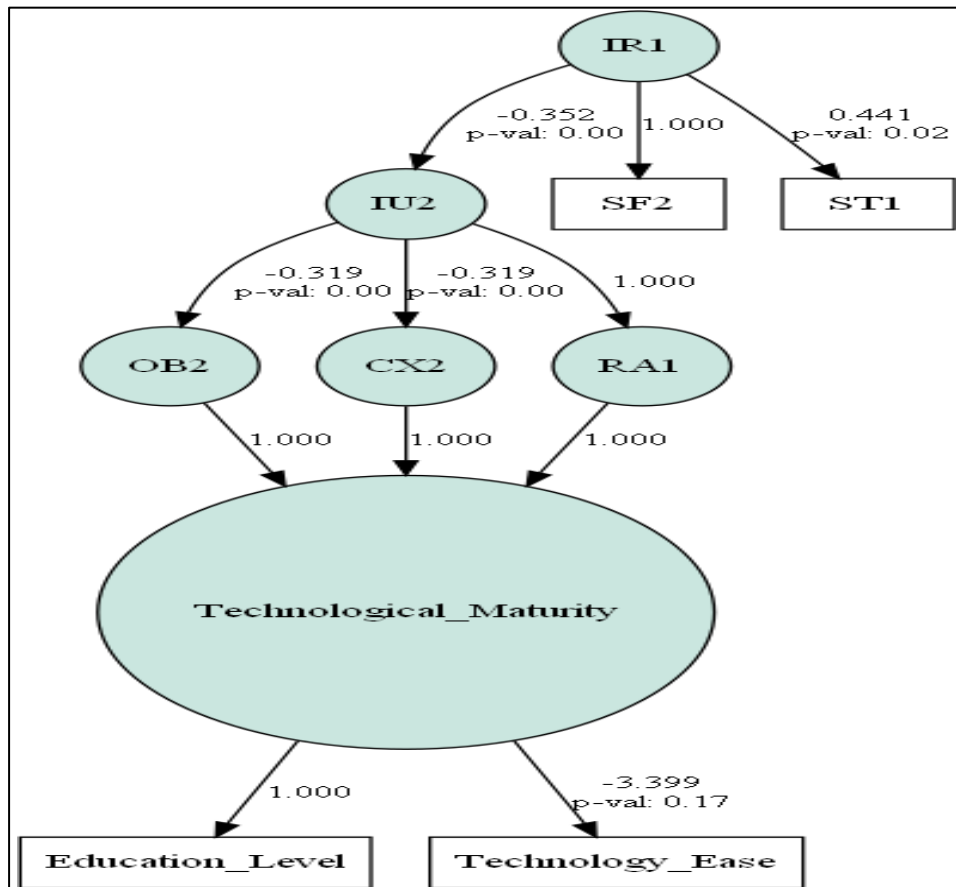


Figure 10.1 Model derived out of Structural Equation Modelling(SEM)

The model derived out of the Structural Equation Modelling depicts the validation of the framework envisaged.

Model’s Interpretation

Technological Maturity

We may conclude with certainty that the loading of Education Level has a beneficial effect on Technological Maturity. But there is no meaningful correlation between Technological Maturity and Ease of Use. In conclusion, one's general education level is more important than how long they have utilized UPI. The resulting technological maturity can also be applied to other B2C technologies.

Observability

In order to ascertain their purpose to use, observability is essential. If observability is perceived as "well organized," it has the potential to draw in additional clients. Dhir, A., Chen, G. M., & Chen, S. (2017). Why do we tag photographs on Facebook? Proposing a new gratifications scale. *New Media & Society*, 19(4), 502-521 explains that young consumers have a propensity to cultivate a favourable self-image among their peer group. The study shows support for the hypothesis that technological maturity has positive impact on observability. The Indian economy's transformation following demonetization in 2016 may be the cause of this. UPI is more popular among younger people as a means of payment. Government campaigns and UPI service provider ads, meanwhile, greatly increased public knowledge of the UPI

platform. In India, impression management may be another factor in the usage of UPI.

Complexity

The result of the study supports the hypothesis that technological maturity is positively associated with its low complexity. Consumers desire to pay swiftly with UPI and have their lives made easier. Users can make payments quickly and easily when there is less complication.

Relative Advantage

The study's findings have backed the hypothesis that technological maturity is positively associated with its relative maturity. Users perceived the UPI to have comparable advantages over other payment methods, particularly cash payment methods.

Intention to Use

All the 3 parameters of Relative Advantage, Complexity & Observability highlighted above have positive relation with Intention to use. Relative Advantage's relationship with Intention to use is the strongest among all the three.

Intention to Recommend

According to the study, there is a favourable correlation between participants' intentions to use and recommend. Similar observation have been found in another study, Oliveira, T., Thomas, M., Baptista, G., & Campos, F. (2016). Mobile payment: Understanding the determinants of customer adoption and intention to recommend the technology. *Computers in human behaviour*, 61, 404-414.

Safety

The perception of safety of the transactions made via UPI influences the users to recommend it in the social circle.

Satisfaction

Similarly, the satisfaction level a user has on usage of UPI also influences the users to recommend it in the social circle.

Metcalf's Law

These relationships form the basis of Metcalf's law that states the more users a technology or network has, the more attractive and valuable it becomes.

Hypothesis Results

S. No.	Hypothesis	Supported
1	H1: The education level has a positive impact on technological maturity.	Yes
2	H2: The ease with technology of respondents has a positive impact on technological maturity.	No
3	H3: The technological maturity has a positive impact on the relative advantage of the UPI platform.	Yes
4	H4: The technological maturity has a positive impact on complexity of the UPI platform.	Yes
5	H5: The technological maturity has a positive impact on observability of the UPI platform.	Yes
6	H6: The relative maturity has a positive impact on respondent’s intension to use.	Yes
7	H7: The complexity has a positive impact on respondent’s intension to use.	No
8	H8: The observability has a positive impact on respondent’s intension to use.	No
9	H9: Safety of the UPI platform has a positive impact on respondent’s intension to recommend the UPI platform.	Yes
10	H10: Intension to use has a positive impact on respondent’s intension to recommend the UPI platform.	No
11	H11: Satisfaction level of the respondent has a positive impact on the intension to recommend the UPI platform.	Yes

Table 10.1 Complete list of Hypothesis result

Conclusion

In Indian metropolises, the UPI payment ecosystem is becoming more widely accepted as it swiftly supplants more conventional payment methods. Since this information will allow the player to maintain their position in this rapidly changing industry, it has become essential to determine the elements that drive the adoption of a UPI platform. How simple it is for a user to comprehend and navigate UPI technology is based on a fundamental level of technological maturity that was created through their educational background. Through the concepts of observability, minimal complexity, and relative advantage, this technological maturity also serves as the foundation for a user's positive attitude. The trio of these 3 factors provides the user utility and ease of life by using this transformative technology. Put otherwise, the user's intention to use is increased. In accordance with Metcalf's law, each user who has personally experienced the value of this technology increases the intention for recommending it. In addition, the user's sense of security and satisfaction from using UPI increases their intention to make recommendations.

Limitations & Future Direction

Adoption in light of future technology advancements was not taken into account in this study. It may significantly affect how future users attempt to use UPI technology. Security is another issue that requires more examination because it's a concept that's still developing and needs more testing. Occasionally, the regulatory bodies release updated transaction security recommendations necessitating a renewed attempt

to study this factor..

We have chosen to use elements of the diffusion of innovation theory in order to comprehend participants' intended behavior toward UPI. Owing to certain restrictions, the study's findings cannot be applied to other contexts. Thus, more research should take into account a variety of additional aspects.

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