

Original Article

# Examining the Availability of Digital Technologies and Analysis of the Preferences with Neural Network Analysis

M. Karthik Ram<sup>1</sup>, S. Selvabaskar<sup>2</sup>

<sup>1,2</sup>School of Management, SASTRA Deemed to be University, Tamil Nadu, India

<sup>3</sup>Corresponding Author: [karthikram@sastra.ac.in](mailto:karthikram@sastra.ac.in)

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**Abstract** - This study aims to examine the availability of digital technologies and analyse their preference with Artificial Neural Network Analysis among small & medium retailers. This study identified new digital technologies which are emerged in this domain, and the technologies are Barcode, Quick Response code, Digital payments, and Electronic Data Interchange. Further, this study identified nine major constructs which have measured the influence through neural network analysis. Artificial Neural Network analysis aimed to map the most important determinant in this study. Further, it measures the most important determinant in this research. From that analysis, this study found that the most important determinant is Digital infrastructure, consumer readiness and availability of new digital technologies.

**Keywords** - Barcode, Quick response code, Digital Technologies, and Electronic Data Interchange.

## 1. Introduction

The retail industry has significantly transformed in recent years due to technological advancements and the widespread use of digital technologies in various categories. This transformation is driven by various factors, including customer demand, digital infrastructure, government policies, increasing awareness, and the impact of the pandemic. The initial outbreak of COVID-19 resulted in the closure of more than 600,000 retail businesses, causing permanent damage to their operations. The second wave of COVID-19 created an unprecedented challenge for retailers and reduced the supply of retail goods across several categories. The confederation of all Indian traders estimated a retail business loss of 4.25 lakh crore during the second wave of COVID. This has led to the rise in digital sales channels and further affects offline retailers, especially unorganised retailers. Unorganised retail is a form of low-cost retailing dominating the Indian retail industry. Unorganised retailers face several challenges and cannot manage their procurement efficiently during these difficult times. In addition, unorganised retailers face several challenges in their supply chain management, such as long process cycles, shipment damage, cost, tampered goods, procurement bypass, poor supplier relationships, lack of technology, difficulty tracking, and the like. Further, it significantly affects the unorganised retailers' business and customer loyalty and retention.

### 1.1. Availability of Digital Technologies

#### 1.1.1. Bar Code Reader

Barcode Reader is one of the most important digital technology which is used to monitor the inventory of shops. Barcodes assist the users in tracking the inventory records in real time. It also assists retailers in recording their inventories, which will assist the users in calculating the

demand of their shops. Barcoding is an IT tool used for automated data capture. It is a faster and more accurate method than manual data entry, which can be time-consuming and prone to errors and inaccuracies. Barcoding provides 100% accuracy and captures data within microseconds. In addition to product attributes, barcodes can store other information, such as batch numbers and manufacturing or expiry dates.

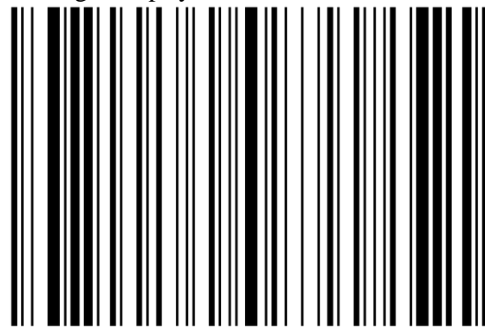


Fig. 1 Bar Code

#### 1.1.2. RFID:- (Radio Frequency Identification)

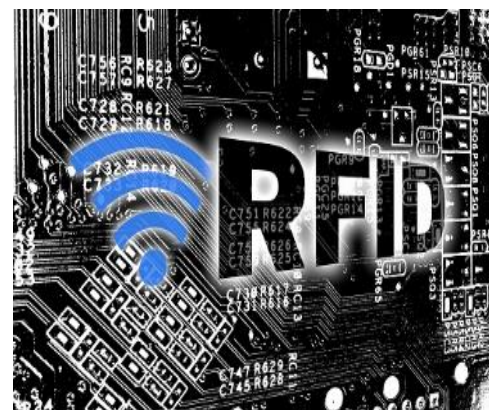


Fig. 2 RFID



Radio Frequency Identification (RFID) is an Internet of Things (IoT) based technology commonly used in the transportation industry. However, many organisations are now utilising RFID to safeguard their inventory against theft, damage, and obsolescence. By using RFID, end-users can track their inventory in real-time and obtain complete data on a specific stock, enabling retailers to implement a push strategy to sell products quickly. Unlike barcodes, RFID tags permit the reading, writing, transmitting, storing, and updating of data. While barcodes and RFID tags have many similarities, the main difference lies in the level of technology utilised. Barcodes use optical laser or imaging technology to scan a printed label, whereas RFID employs radio frequency technology to scan or interrogate a semiconductor tag. RFID is also useful for retailers to reduce losses and maximise profits.

### 1.1.3. Electronic Data Interchange (EDI)

Electronic data interchange (EDI) is the process of using computer systems to exchange business information through standard interfaces. It refers to the electronic exchange of business data between organisations without requiring the key information. Sometimes, the term EDI has also been referred to as Electronic Document Interchange because it involves the exchange of electronic documents between organisations. Database administration involves using systems to organise, manage, search, and retrieve data. This data can include information on products, customers, vendors, suppliers, or any combination of these. With just a simple purchase at a retail store, a retailer can gather a wealth of information about their products and customers.



Fig. 3 EDI



Fig. 4 Digital Payments

### 1.1.4. Digital Payments

Digital payments in India started their penetration after launching the “Digital India” programme. Further, its penetration accelerated due to its innovation and constant push from the Government side. In addition, digital payments are also adopted by small retailers due to their constant innovation. The recent voice-based verification in digital payments technology faces a huge welcome across small retailers. In addition, the costless QR Code technology is also available for unorganised retailers. Small retailers also adopt the costless QR code technology.

### 1.1.5. Mobile Applications

Mobile applications are a new form of technology available for small and medium retailers. Several mobile applications offer multiple business functions in retail, and some of them support supply chain management, accounts, bills, receipts, payments & settlements, communication, and the like. Mobile applications are considerably available. However, the penetration of such technology is very limited.



Fig. 5 Mobile Applications

## 2. Related Literature

Awareness means a certain degree of familiarity with a particular technology among the users. It has been mentioned as "a degree of technological awareness and creates a positive belief about the technology which influences the adoption process" [1]. Awareness was considered a primary factor influencing the intention to adopt mobile advertising [2]. A lack of awareness of technologies would create ambiguity, anxiety, and unawareness about available technologies' usage and benefits. Hence, it will affect the penetration of digital technologies. Sudhir et al. [3] stated that a lack of awareness hindered the adoption of mobile phones among Indian consumers. Further, awareness positively impacts technology adoption [4].

Availability means checking the degree of Mobile payments technology available in the market for merchants. After smartphones and the google play store were introduced, applications created a digital space for several small businesses. Nathalie et al. [5] studied the adoption of SST (self-service technology) in a retail context. In this study, the researcher assessed the availability of barcodes, automatic vending machines, and automatic checkout in a retail context. Further, in this research, the availability of technology positively influenced technology adoption.

Enjoyment is a sub-construct of PEOU. Enjoyment is the degree to which 'the degree of using a technology is perceived to be enjoyable.' Researchers identified that Enjoyment drives users to adopt E-commerce technology [6]. While using technology creates Enjoyment among individuals, it also measures the service quality of the technology [7].

Perceived ubiquity refers to unrestricted access to technology by users at any time and from any location [8]. The continuous development of digital technologies, play store applications, Internet accessories, and services led to the penetration of digital technologies among merchants. Mobile phones' ubiquity shares information across all platforms, enhancing service accessibility among customers [9].

Businesses aim to ensure that the advantages of implementing new ideas are proportional to the expenses involved in implementing them. Tornatzky and Klein [10] state that technologies perceived to be low in charge are more likely to be adopted. Suhaiza Zailani et al. [11] found cost-effectiveness to be an essential variable in the context of supply chain performance.

Entrepreneurial motivation refers to the process of transforming an entrepreneur into an influential business person. It encouraged entrepreneurs to put their best efforts into their businesses to achieve their entrepreneurial goals. Entrepreneurial motivation acts as a moderating variable between Entrepreneurial intention and Behaviour, and it also found significance between Entrepreneurial intention and Entrepreneurial Behaviour [12].

Zhu et al. [13] study consumer readiness as related to consumer willingness to use technologies in their purchase. Consumer willingness measures their desire to access online shopping, Internet-associated technologies, and internet infrastructures amongst public users and focuses on the diffusion of personal computers, mobiles, laptops, and palmtops.

Digital infrastructure plays a crucial role in unorganised retailers' technology adoption. Small businesses need digital infrastructure to run their ventures, and only they will be able to succeed in their business. They do not have corporate funds and technology support like an organised retailer. The government needs to create a digital infrastructure to create technology adoption among unorganised retailers. Through that, It can make a societal benefit. The role of the digital infrastructure stimulates the shift of Internet penetration. Government attempts to create a digital environment to thrive the retailer's willingness to invest in retail technologies [14].

Digital technology acceptance provides greater convenience for the unorganised retailer, which assists the retailers in attracting new customers & retain existing customers in their business. Thus, this study wants to assess the digital technology preferences factors through Neural Network analysis.

**Table 1. Result Summary of ANN – Analysis of Artificial Neural Network**

Values		
Training	Sum of Squares Error	32.575
	Relative Error	.334
Testing	Sum of Squares Error	5.512
	Relative Error	.452
Dependent Variable: MTA		

(Source: Primary Data) (Compiled from: SPSS 25)

**2.1. Novelty of this Research**

Existing studies mostly concentrated on assessing organised retailers' impact on unorganised retailers. Further, several studies concentrated on measuring the impacts of organised retailers' technology adoption. However, unorganised retailers' technology adoption is not covered. Thus, this study identified this research gap and identified technology acceptance variables from existing theories, which is a pioneer attempt to measure the adoption factors among unorganised retailers.

**3. Materials and Methods**

**3.1. Research Methodology**

The objective of this study is to assess the willingness of unorganised retailers to adopt business-to-business technology. The study formulates a research model by drawing from multiple technology adoption and social theories. Additionally, a carefully crafted questionnaire is designed to evaluate the readiness of retailers and measure their behavioral intention to adopt business-to-business technology. The study collects data from 245 unorganised retailers as part of the sample size.

**3.2. Research Objectives**

- To identify the availability of digital technologies for small retailers
- To identify the small retailers' technology adoption preference.

**3.3. Neural Network Analysis**

ANN is incorporated in this study to complement the prediction of PLS-SEM findings and highlight each independent variable's importance. ANN has a higher forecast and considers the significance of PLS-SEM results because of the linear or non-linear assessment capabilities. ANN analysis gives more attention to the dependent variable, i.e., Mobile payments technology adoption; Thus, there will be one deep ANN model. The ANN model is developed on one output neuron and several input neurons, such as Awareness, Availability, Ubiquity, Enjoyment, cost-effectiveness, entrepreneurial motivation, consumer readiness, and digital infrastructure. To analyse one output neuron, this study deployed seven hidden layers of deep ANN in this study. The model summary of ANN is presented in table 1

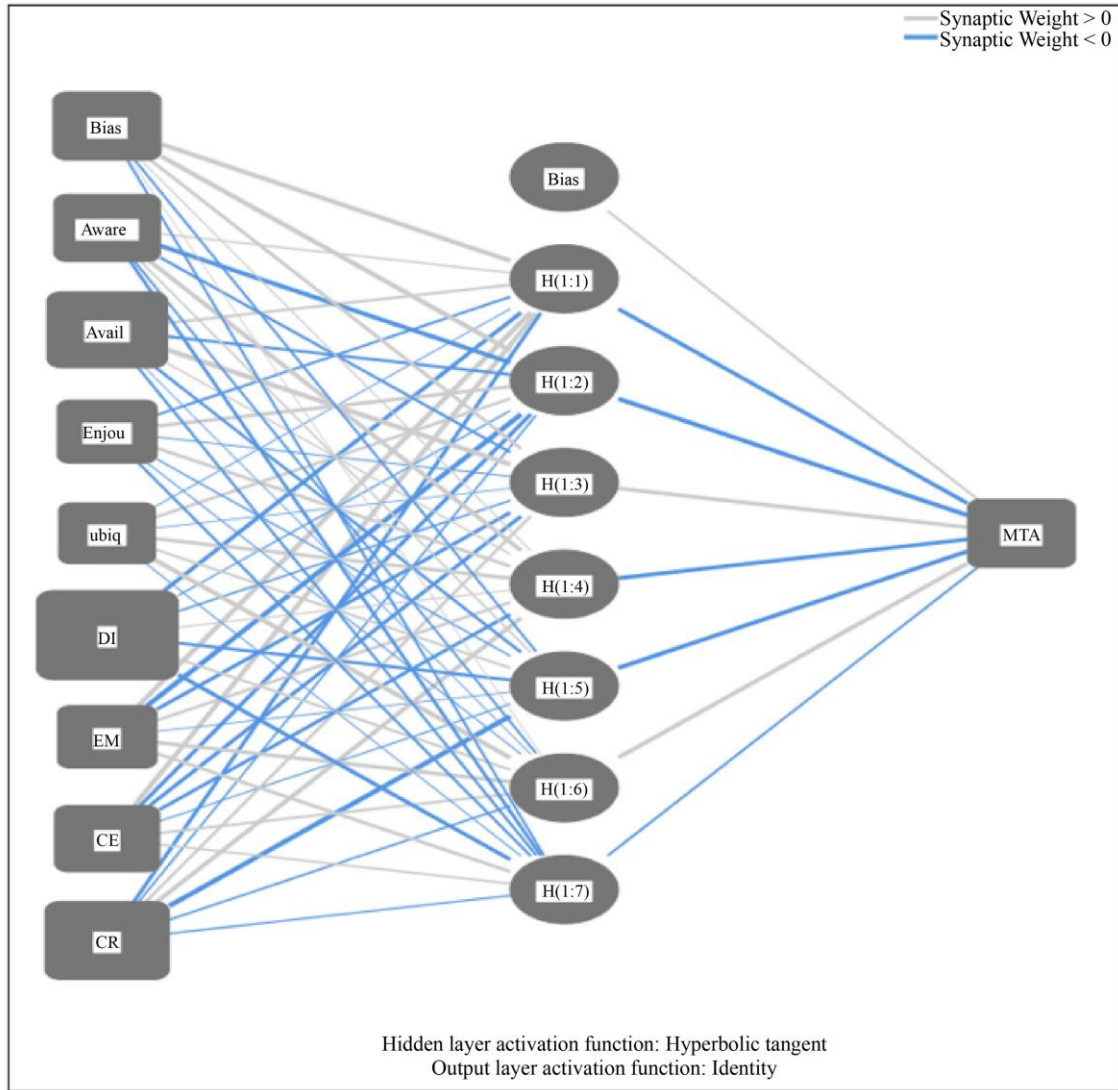


Fig. 6 ANN - Artificial Neural Network Analysis

In order to prevent the model from overfitting, eight-fold cross-validation was carried out. During this process, 70% of the data was used for training the neural network, while the remaining 30% was used to determine the accuracy of the ANN model's predictions. Table 1 displays the ANN model results for training and testing, with relative error and ranges between 0.334 and 0.452. The sum of squares error for the model during training was 32.575, while during testing, it was 5.512. By ensuring that the relative error was low, the ANN analysis increased the prediction power of the model. Therefore, the network model is reliable and effectively captures the relationship between the independent and dependent variables.

**3.4. Adoption**

Artificial Neural Network analysis was calculated using the multi-layer perception technique, as shown in figure 6. The regression values extracted from this technique are also high, and the R square value is (0.510), which has a 51.0% predictable power. Consumer readiness, Digital Infrastructure, Availability, Entrepreneurial motivation, and Enjoyment enhance the regression values and positively influence the dependent variables.

Table 2. Importance of Independent Variables

IV -Independent Variables	Score	Normalised Score
Awareness	0.108	47.9%
Availability	0.155	69.0%
Enjoyment	0.086	38.1%
Ubiquity	0.075	33.2%
Digital Infrastructure	0.225	100.0%
Entrepreneurial Motivation	0.083	36.9%
Cost-Effectiveness	0.102	45.5%
Consumer Readiness	0.167	74.1%

(Source: Primary Data) (Compiled from: SPSS 25)

Table 2 shows that, generally, variables related to Mobile payments technology adoption and Digital



infrastructure have the most significant effect on Mobile payments technology adoption among the merchants when compared to technology and organisation constructs.

This study compiled the normalised importance value using the importance values divided by the highest important values and expressed in percentage. This study measured the normalised importance of independent variables in ANN analysis. This study found that Digital Infrastructure is the most important independent variable, and consumer readiness is the second crucial independent variable in this ANN analysis. Its normalised importance is 74.1%.

Followed by availability is the third most essential independent variable to measure Mobile payments technology adoption, and it has 69.0% of normalised importance. The least crucial independent variable is ubiquity, which has 33.2% of normalised importance in this ANN analysis. These findings are exciting and noteworthy; Mobile payments technology adoption has higher consumer readiness and digital infrastructure, influencing Mobile payments technology adoption among the merchants.

Further, the Availability of Mobile Payments and entrepreneurial motivation will positively impact Mobile payments technology adoption among merchants. A limitation of this ANN analysis is that it would not show the relationship's direction between dependent and independent variables. However, the SEM addressed that, which showed the positive relationship between antecedents and their consequents.

## References

- [1] M. Sirajul Islam, and Ake Gronlund, "Factors Influencing the Adoption of Mobile Phones Among the Farmers in Bangladesh: Theories and Practices," *International Journal on Advances in ICT for Emerging Regions*, vol. 4, no. 1, pp. 4-14, 2011. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [2] Mohammad Naved Khan, and Kamaal Allil, "Determinants of Mobile Advertising Adoption: A Cross-country Comparison of India and Syria," *International Journal of mobile marketing*, vol. 5, no. 1, 41-59, 2010. [[Google Scholar](#)] [[Publisher link](#)]
- [3] K. M. P. a. I. T. Sudhir, "Mobile banking in India: Barriers and adoption triggers. Mobile Banking Experience the Freedom., 18 11 2012. [Online]. Available: <https://som.yale.edu/sites/default/files/files/Mbanking%20report-Final.pdf>
- [4] Amit Shankar, and Pooj A Kumari, "Factors Affecting Mobile Banking Adoption Behavior in India," *Journal of Internet Banking and Commerce*, vol. 21, no. 1, 1-24, 2016. [[Google Scholar](#)] [[Publisher link](#)]
- [5] Nathalie T.M. Demoulin, and Souad Djelassi, "An Integrated Model of Self-service Technology (SST) Usage in a Retail Context," *International Journal of Retail & Distribution Management*, vol. 44, no. 5, pp. 540-559, 2016. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [6] K.M. Elliott, Mark Hall, and J. Meng, "Consumers' Intention to use Self-scanning: The Role of Technology Readiness and Perceptions toward Self-service Technology," *Academy of Marketing Studies Journal*, vol. 17, no. 1, pp. 129-143, 2013. [[Google Scholar](#)] [[Publisher link](#)]
- [7] Fatma Demirci Orel, and Ali Kara, "Supermarket Self-checkout Service Quality, Customer Satisfaction, and Loyalty: Empirical Evidence from an Emerging Market," *Journal of Retailing and Consumer Services*, vol. 21, no. 2, pp. 118-129, 2014. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [8] Vess Johnson et al., "Limitations to the Rapid Adoption of M-payment Services: Understanding the Impact of Privacy Risk on M-Payment Services," *Computers in Human Behavior*, vol. 79, pp. 111-122, 2018. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [9] Lara Srivastava, "Japan's Ubiquitous Mobile Information Society," *Emerald Group Publishing Limited*, vol. 6, no. 4, pp. 234-251, 2004. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [10] Louis G. Tornatzky, and Katherine J. Klein, "Innovation Characteristics and Innovation Adoption-implementation: A Meta-analysis of Findings," *IEEE Transactions on Engineering Management*, vol. EM-29, no. 1, pp. 28-45, 1982. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]

## 3.5. Practical Implications

This study considered only people who adopt digital technologies in their businesses. To penetrate digital technologies, service providers need to be in personal contact with their customers. Further, unorganised retailers need exclusive personalised services for their retail shops so that they will be able to face the competition, which also ensures their survival.

Unorganised retailers have thought that digital technologies would deliver the common product in their business, resulting in increasing competition. Further, new digital technologies (AR, VR) would exclude small retailers from their business, affecting the unorganised retailer's business to a greater extent.

## 4. Discussion

Technology acceptance brings numerous benefits to unorganised retailers, including increased trade volume and business flexibility. The rise of digital disruption has spurred development in various retail sectors, leading to the widespread adoption of digital technologies by small and medium-sized unorganised retail businesses. It is crucial to identify the determinants of their adoption and address any barriers hindering their progress. Furthermore, adopting digital technologies in e-commerce platforms has given rise to a new business model called "Quick Commerce" (Q-Commerce). Ultimately, integrating digital technologies supports the stakeholders involved in unorganised retail businesses and helps small and medium-sized enterprises thrive in this competitive market.

- [11] Premkumar Rjagobal, and Suhaiza Zailani, "The Effects of Information Quality on Supply Chain Performance: New Evidence from Malaysia," *Information Quality Management: Theory and Applications*, 2007. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [12] Muhammad Zubair Alam, Shazia Kousar, and Ch. Abdul Rehman, "Role of Entrepreneurial Motivation on Entrepreneurial Intentions and Behaviour: Theory of Planned Behaviour Extension on Engineering Students in Pakistan," *Journal of Global Entrepreneurship Research*, 2019. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [13] Zhu Kevin, Kenneth L. Kraemer, and Sean Xu, "A Cross-country Study of e-Business Adoption using the Technology-Organization-Environment Framework," *Proceedings of the International Conference on Information Systems (ICIS 2002 Proceedings)*, pp. 15-18, 2002. [[Google Scholar](#)] [[Publisher link](#)]
- [14] Stephen Nabareseh et al., "A Comparative Study of Consumers' Readiness for Internet Shopping in Two African Emerging Economies: Some Preliminary Findings," *Mediterranean Journal of social science*, vol. 5, no. 23, pp. 1882-1889, 2014. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [15] Fatma Kınış, and Cem Tanova, "Can I Trust My Phone to Replace My Wallet? The Determinants of E-Wallet Adoption in North Cyprus," *Journal of Theoretical and Applied Electronic Commerce*, vol. 17, no. 4, pp. 1696-1715, 2022. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [16] Pauline W.J. Van Esterik-Plasmeijer, and W. Fred Van Raaij, "Banking System Trust, Bank Trust, and Bank Loyalty," *International Journal of Bank Marketing*, vol. 35, no. 1, pp. 97-111, 2017. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [17] Joaquin Aldás-Manzano et al., "The Role of Consumer Innovativeness and Perceived Risk in Online Banking Usage," *International Journal of Bank Marketing*, vol. 27, no. 1, pp. 53-75, 2009. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [18] Carlos Flavian, Miguel Guinaliu, and Eduardo Torres, "The Influence of Corporate Image on Consumer Trust: A Comparative Analysis in Traditional Versus Internet Banking," *Internet Research*, vol. 15, no. 4, pp. 447-470, 2005. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [19] T. Ravikumar, and N. Prakash, "Determinants of Adoption of Digital Payment Services Among Small Fixed Retail Stores in Bangalore, India," *International Journal of Business Innovation and Research*, vol. 28, no. 3, pp. 319-346, 2022. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [20] Jianli Xie et al., "Understanding FinTech Platform Adoption: Impacts of Perceived Value and Perceived Risk," *Journal of Theoretical and Applied Electronic Commerce Research*, vol. 16, no. 5, pp. 1893-1911, 2021. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [21] Ritu Agarwal, and Jayesh Prasad, "A Conceptual and Operational Definition of Personal Innovativeness in the Domain of Information Technology," *Information Systems Research*, vol. 9, no. 2, pp. 101-215, 1998. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [22] William Lewis, Ritu Agarwal, and V. Sambamurthy, "Sources of Influence on Beliefs about Information Technology Use: An Empirical Study of Knowledge Workers," *MIS Quarterly*, vol. 27, no. 4, pp. 657-679, 2003. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [23] June Lu et al., "Technology Acceptance Model for Wireless Internet," *Journal of Internet Research*, vol. 13, no. 3, pp. 206-222, 2003. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [24] Lucy Gitau, and David Nzuki, "Analysis of Determinants of M-Commerce Adoption by Online Consumers," *International Journal of Business, Humanities and Technology*, vol. 4, no. 3, 2014. [[Google Scholar](#)] [[Publisher link](#)]
- [25] Aminul Islam et al., "The Adoption of Mobile Commerce Service Among Employed Mobile Phone Users in Bangladesh: Self-Efficacy as a Moderator," *International Business Research*, vol. 4, no. 2, 2011. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [26] Khaled M.S. Faqih, and Mohammad-Issa Riad Mousa Jaradat, "Assessing the Moderating Effect of Gender Differences and Individualism-Collectivism at Individual-level on the Adoption of Mobile Commerce Technology: TAM3 Perspective," *Journal of Retailing and Consumer Services*, vol. 22, pp. 37-52, 2015. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [27] Amit Shankar, "Factors Affecting Mobile Banking Adoption Behavior in India," *Journal of Internet Banking and Commerce*, 2016. [[Google Scholar](#)] [[Publisher link](#)]
- [28] Geoffrey Harvey Tanakinjal, "Exploring Technical Knowledge, Perceived Risk and The Innovative Characteristics in the Adoption of Mobile Marketing," *International Journal of Contemporary Research*, vol. 2, no. 8, pp. 69-80, 2012. [[Google Scholar](#)] [[Publisher link](#)]
- [29] S. K. H. M. Scott WR, *Institutional Theory: Contributing to a Theoretical Research Program*, in *Great Minds in Management: The Process of Theory Development*, Oxford, UK:: Oxford university press, 2005.
- [30] Rosli Mohamad, and Noor Azizi Ismail, "Electronic Commerce Adoption in SME: The Trend of Prior Studies," *Journal of internet bank and commerce*, vol. 14, no. 2, 2009. [[Google Scholar](#)] [[Publisher link](#)]
- [31] Chechan Liao, Jain-Liang Chen, and David C. Yen, "Theory of Planning Behavior (TPB) and Customer Satisfaction in the Continued use of e-service: An Integrated Model," *Computers in Human Behaviour*, vol. 23, no. 6, pp. 2804-2822, 2007. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]
- [32] Jorg Henseler, Christian M. Ringle, and Marko Sarstedt, "A New Criterion for Assessing Discriminant Validity in Variance-based Structural Equation Modeling," *Journal of the Academy of Marketing Science*, pp. 115-135, 2015. [[CrossRef](#)] [[Google Scholar](#)] [[Publisher link](#)]