Adoption and Impact of POS Systems in Kolkata's Retail Sector: A Study on Digital Transformation, Challenges, and Opportunities

Sudipta Halder[1] and Shantanu P. Chakraborty*[2]

[1]Assistant Professor, Techno India School of Management Studies, *Kolkata, West Bengal, India*
[2]Assistant Professor, BRAINWARE UNIVERSITY, Research Scholar IISWBM, *Kolkata, West Bengal, India* spcy.cs@brainwareuniversity.ac.in

Abstract:

This study explores the adoption, utilization, and impact of Point-of-Sale (POS) systems within Kolkata's diverse retail sector amid ongoing digital transformation. As digital payment technologies reshape retail operations, POS systems have emerged as vital tools in enhancing operational efficiency, customer experience, and inventory control. However, the rate and effectiveness of adoption vary significantly across businesses, especially among small and medium-sized enterprises in emerging market environments. This research adopts a descriptive, quantitative approach using structured questionnaires, collecting responses from 385 retail businesses across major commercial zones in Kolkata. The findings reveal that while 41.8% of respondents have adopted POS systems within the last 1–5 years, many still face challenges such as limited digital literacy, high maintenance costs, and integration issues. Sector-specific adoption patterns were identified, with clothing stores, cafes, and multi-purpose outlets showing higher usage rates. The study uncovers a significant research gap in the localized understanding of POS implementation, particularly in terms of AI-enabled features, TAM-based theoretical perspectives, and the integration of transaction processing systems (TPS) with management information systems (MIS). The research contributes actionable insights for policy-makers, technology providers, and retail business owners, recommending strategies to improve digital readiness, reduce technical barriers, and enhance the strategic use of POS data in business decision-making.

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Keywords:

Point-of-Sale (POS), Retail Technology, Kolkata, Digital Transformation, Small Retailers, Transaction Processing Systems (TPS), Technology Acceptance Model (TAM), AI-enabled POS, Inventory Management, Customer Experience, Cashless Economy, Retail Efficiency.

1.Introduction

In recent years, significant technological advancements have been witnessed in the retail sector, with the adoption of digital payment systems being regarded as a transformative development. Among the most impactful tools in this digital transformation, the Point-of-Sale (POS) system has been recognized for its ability to revolutionize retail transactions by increasing efficiency, enhancing customer experience, and enabling improved inventory and financial management.Prior to the widespread implementation of POS systems, numerous operational challenges were faced by retail businesses in Kolkata. Manual transaction processing and bookkeeping were heavily relied upon in traditional setups, often resulting in delayed checkouts, inaccurate inventory tracking, and a lack of transparency in sales. Due to these limitations, the ability of businesses to scale and meet the evolving expectations of consumers in a dynamic market environment was hindered.

With the introduction of POS systems, retail operations have been significantly streamlined through the automation of sales tracking, real-time inventory updates, and the facilitation of diverse payment options including credit/debit cards, mobile wallets, and UPI. However, uniform adoption of POS technology has not been achieved. While the technology has been embraced by some retailers for its reliability and convenience, hesitations have been expressed by others due to high maintenance costs, technical malfunctions, and concerns related to data security.

Although improvements in transaction speed, inventory accuracy, and customer engagement have been reported in previous studies on digital retail tools, the focus has primarily been placed on developed or highly organized retail markets. Limited attention has been given to semi-urban or emerging market settings such as Kolkata, where retail businesses differ significantly in terms of scale, infrastructure, and technological readiness.

Despite the promising benefits of POS systems in enhancing operational efficiency and customer satisfaction, a critical gap has been identified in understanding the extent to which these systems are being effectively utilized in Kolkata’s retail sector. Specifically, limited digital literacy and

poor system integration have prevented many small and medium enterprises from fully exploiting the analytical and strategic capabilities offered by POS technologies.

In this study, the actual impact of POS adoption on retail operations in Kolkata will be examined. A mixed-method approach will be employed to evaluate gains in efficiency, improvements in customer service, and contributions to business growth. Barriers that hinder adoption and optimization of POS systems will also be identified. Through this research, a comprehensive analysis will be provided on the influence of POS systems on Kolkata's retail landscape. Actionable insights will be offered to enhance POS adoption and usage. Ultimately, a contribution will be made to the broader discourse on digital transformation within emerging market economies.

2.Literature Review

(Mohammad Shaker Ardakani, 2015) the findings show that the quality of service offered by companies providing electronic and online services is significantly different from that of traditional services. Factors such as time, access, and system performance are played a crucial role in the offering of these services. Rapid quality is considered essential in addressing customers' needs and expectations. By identifying key specifications, customer dissatisfaction can be addressed by companies, leading to improvements in service quality, customer retention, and profit boosting. Enhancements to point of sale (POS) networks can result in increased national productivity, public trust, and a decrease in the money supply, ultimately benefiting the economy. The aim of this research is to identify effective factors in electronic service quality and to test their relationship with customer satisfaction.

(Joydeep Mookerjee, 2022) this literature study were used to identify crucial elements. Business models are being transformed by technology, including e-payment, m-payment, billing and vendor systems, and inventory management. This digitally enabled commercial interaction involves all business transactions, including the purchasing and selling of products and services, and the transmission of data and payments electronically over the internet. Consumer behavior must be considered by retailers when retail technology is adopted, with an understanding of when, why, how, and where products are purchased or not purchased by individuals. The retail sector has been improved by technology through the offering of new strategies such as interactive displays, in-

store services, smart shelves, home delivery, brand optimization choices, supply chain optimization, and logistics automation. Consumer complaints and praise can be understood by retailers with the help of channels like wallets, POS data, and social media. Despite the success of large retailers, technology has been adopted more slowly by small retailers, especially those in the unorganized sector. In 2018, "Experiential Retail" became a buzzword in the industry, with accessibility, in-store features, consumer involvement through animation, and novel fusions of the real and virtual shopping worlds contributing to its prominence. The retail technology acceptance by small retailers in the Khidirpur market of Kolkata, West Bengal, India, is discussed in this paper.

(Donohue, 2003) the study is looked into to understand how ordering decisions in a multi-echelon supply chain are affected by point of sale (POS) data sharing. The focus is placed on how the "bullwhip effect," which raises order variability as one goes up the supply chain, might be lessened via POS data. According to theoretical research, it is suggested that when suppliers are unaware of the demand distribution beforehand, the bullwhip impact can be lessened by POS data. In stable businesses, the advantages of sharing POS data are found to be less evident. According to the study, it is noted that the exchange of POS data helps to lessen the order oscillation of upstream members, which is identified as one of the components of the bullwhip effect in a steady demand environment. According to the study, this improvement might be explained by the connection between demand line data and order decisions.

(Victor Santos, 2023) the paper focused on the substantial changes in the retail business have been brought about by digital transformation, with point-of-sale (POS) systems becoming more complex and smarter. Consumer data is evaluated and insightful product and service suggestions are provided by AI-powered point-of-sale (POS) systems using machine learning algorithms. Related products can also be recommended based on an analysis of a customer's past purchases by these systems. The shopping experience has been enhanced, and the range of goods and services offered has been increased thanks to the integration of point-of-sale (POS) systems with other technologies including mobile devices, the Internet of Things, and augmented reality.

(Hitesh Asrani, 2024) the findings show a comprehensive solution that combines hardware and software components to optimize sales operations in retail environments is provided by a Point of Sale (POS) system. A computer, peripherals like barcode scanners, cash registers, and card readers,

along with software for transaction processing, inventory management, and sales reporting are included in it. Sales recording, inventory tracking, customer purchase monitoring, and processing of various payment methods are essential functions performed by POS systems. Receipts or invoices are also generated by them, providing efficiency and accurate data for effective management. The significant evolution of POS systems from cash registers to sophisticated, integrated solutions has been noted, with front-end and back-end operations being integrated by modern systems. The popularity of mobile POS systems, which leverage tablets and smartphones, has further been boosted by their increasing usage.

(Ricky Johnny, 2024) In an era of digital transformation, a vital role is being played by point-of-sale (POS) systems in business operations. Historically, POS systems were regarded as simple devices by which cash transactions were recorded. Over time, these systems have been evolved into complex digital platforms capable of being used for the management of inventory, customer databases, and financial transactions. A vast amount of sensitive data is handled by POS systems, including credit card details, customer information, and transaction histories. Quantum encryption is recognized as a cutting-edge area of cryptography in which the principles of quantum mechanics are leveraged to create unbreakable encryption protocols. Point-of-sale (POS) systems are considered indispensable in the modern retail and service industries, as they are used to facilitate secure and seamless transactions between customers and businesses.

(Giovanna de Carvalho Oliveira, 2024)The choice of an operating system for Points of Sale (POS) in the retail sector is considered crucial for ensuring operational efficiency and cost control. According to Leal's (2020) theoretical framework, a complete solution is encompassed by the Point of Sale (POS) system. Business operations are automated, fiscal document issuance is integrated, inventory is managed, and payments are processed. It is highlighted by the study that POS systems based on Linux are being adopted, and such systems are regarded as viable alternatives for small retail businesses. Greater savings and operational flexibility are achieved by operating under limited budgets.

(J.O.JIMOH, 2023) A total transformation is required in cashless and e-payment policies for sustainable improvement in POS services in Nigeria. The study was conducted to model customers' perceptions toward POS machines. It was revealed through regression analysis that variables such as Internet, Completeness, Consistency, Observability, and Accuracy were found

to have a significant impact on customers' perceptions toward POS machines, while Location, Pricing, and Security were shown to have a non-significant impact. Positive high correlations among most variables were recorded through correlation analysis.

(Clodfelter, 2013) New technological advances are being seen as opportunities for retailers to better manage their firms and to enhance the shopping experience for customers, particularly at the point-of-sale (POS). Five technologies available at retail POS checkouts will be examined. Barcode scanning will be reexamined to determine whether increased productivity and pricing accuracy have been offered to both customers and retailers as initially promised. Electronic shelf tags (ESLs) will be presented and discussed as a method through which pricing accuracy at POS checkouts can be guaranteed. Barcode scanners are found to be the technology most often used at retail POS checkouts. The primary benefit offered by ESLs to retailers and customers is considered to be the elimination of pricing errors at the scanner by ensuring coordination between the prices displayed on store shelves and those stored in the POS checkout's price file. Another technological change occurring at the POS checkout is characterized by the placement of existing technology in the hands of shoppers rather than store employees. Self-checkouts are regarded as an outgrowth of experiments conducted by retailers to make the customer checkout process more efficient, while also enabling savings for the store.

(Light Frank A. A., 2023) Point-of-sale (POS) technology is referred to as hardware and software systems used by merchants for the processing of electronic payments. Initially, POS systems were limited to card swipe machines, but they have been evolved to support mobile wallets, QR codes, and contactless payments. In a cashless economy, the backbone for e-commerce, financial inclusion, and economic growth is provided by POS systems. The Nigerian banking sector, recognized as one of the largest in Africa, has been transformed over the past two decades. In 2010, the "Cashless Nigeria" policy was introduced by the Central Bank to encourage the adoption of electronic payments, including POS systems.

(Mukherjee, 2017) The evolution of retail automation, particularly in POS systems, is focused in the study, transitioning from traditional markets to data-driven systems. Efficiency, customer experience, and business intelligence are enhanced by these systems.

Transaction Processing Systems (TPS) for daily operations are emphasized in the article, with their data feeding into Management Information Systems (MIS) for analysis and optimization. Strategic

POS advantages, such as the tracking of customer preferences and automated purchasing, are discussed. Emerging technologies like mPOS and vending machines are also mentioned.

It is concluded by Mukherjee that POS automation is crucial for modern retailers, customer satisfaction, and competitive advantage, with a future trend towards self-service and greater integration being indicated.

(Hamza Salihu Umar, 2021) The effects of POS on the performance of small-scale businesses in Nigeria were investigated, and the evolution of the Nigerian payments system from a paper-based system was studied. A clear understanding of POS and substantial data were provided, and the continued measures post-2007 to increase electronic channel use towards a cash-lite society were examined. POS, introduced to further the cashless policy, was highlighted for its importance to retailers, and the determinants influencing its adoption were analysed using closed-ended questionnaires and secondary data presented in tables and percentages. Respondent demographics, ATM ownership, POS operation knowledge, bank charges, frequency of POS usage, and associated challenges were studied.

It was concluded that the importance of POS as an electronic transaction method cannot be overlooked, with network failure and power outages identified as the most challenging factors. Limited POS availability, network security, and POS unavailability at all merchant stores were revealed as challenges, and solutions were presented.

(Abraham, 2021) Kerala's Public Distribution System (PDS) is examined in this study, with its advanced network of wholesale and retail outlets being highlighted. The introduction of E-POS machines to enhance transparency and curb corruption in food grain distribution is also noted. Beneficiary opinions on the working, use, and limitations of E-POS machines are presented through five tables, offering an unbiased account.

The conclusion emphasizes E-POS as a significant breakthrough in improving PDS effectiveness in Kerala, while moderate consumer satisfaction with its implementation is noted.

(M. K. Lal, 2018) The benefits of point of sale (POS) system implementation for retailers/wholesalers in increasing market share and earnings are addressed. The reduction of IT infrastructure costs through business intelligence by eliminating redundant data extraction, and the decreased time for data suppliers and users through efficient data delivery are discussed. While

other authors have explored shopping list prediction, shared information value, and food sales' dietary quality, this paper focuses on the comparative utilization of POS data by retailers for improved supply chain management.

The research, involving interviews with over 30 retailers in central Madhya Pradesh using POS data, reveals that while some effectively leverage POS for supply chain management, many others lack the competence and integration to fully exploit its benefits.

(Titus Chukwuemezie Okeke, 2017) The evolution and significant changes in the Nigerian payments system due to new policies and environmental revolutions are shown. Studies underpinning customer behaviour toward e-payments and the introduction and challenges of the CBN cashless policy in Nigeria are also presented. The adapted TAM model for understanding innovation acceptance and the extended TAM model for studying m-Banking adoption in Kenya are mentioned. The importance of user security and safety in e-payments and new product diffusion theories highlighting consumer awareness are discussed. POS, an e-payment platform with a relatively low market share and volume in Nigeria according to CBN-ARSA reports, is examined for its adoption prediction by TAM with extensions. The SEM model and its fit indices are discussed, establishing that POS adoption has been significantly and positively impacted by PU and PEOU.

In conclusion, ATM dominance in market volume and value is shown. PU is significantly and positively impacted by consumer awareness, but the impact on PEOU is not significant, creating a path for further research on mediation and/or moderation impacts.

(The Impact of Point of Sale Systems on Small Business Efficiency and Customer Satisfaction., 2023) In this paper, it is discussed how efficiency, sales, and customer satisfaction in small businesses have been improved by POS systems. An improvement of 30% in efficiency was achieved, and customer satisfaction was increased due to faster service and personalized promotions. ROI within a year was realized by most businesses, demonstrating the profitability of POS adoption.

(Light Frank F. A., 2024) The study 'The Impact of POS Terminals on Cashless Policy Implementation in Nigeria' highlights how the use of POS terminals has been employed by

Nigeria's Central Bank to support a cashless policy since 2012. Benefits such as increased financial inclusion, e-commerce support, and economic growth have been noted. However, challenges such as infrastructure limitations and resistance from informal sectors have been encountered. Strategic reforms and better infrastructure are considered necessary.

(Nilesh Waghmare, 2020) A study was conducted by the authors to explore how restaurant operations have been streamlined by POS systems. Benefits such as real-time menu updates, automated billing, inventory tracking, and customer relationship management have been included. Decision-making has been enhanced through analytics, and theft has been prevented, contributing to operational efficiency and growth.

(Gupta, 2020) These studies focus on how billing accuracy, inventory control, and sales forecasting have been enhanced by the adoption of POS in Kolkata's retail stores. Better stock management and quicker decision-making have been enabled, supporting small retailers in competing with larger firms.

(Sen, 2019) It has been shown through research that the customer experience in Kolkata's retail sector has been improved by POS systems by reducing wait times and enabling CRM functionalities. Trust and retention have been increased through digital receipts and loyalty features, which are considered essential in a competitive urban retail market.

(Nasharuddin Zainala, 2024) The growing role of technology in retail, particularly through the integration of Point of Sale (POS) systems, Radio-Frequency Identification (RFID), and computer vision. Merging POS and RFID data enhances customer transaction analysis, allowing businesses to track movement patterns, optimize inventory, and personalize experiences. This study highlights that the developed an automated POS system using computer vision that quickly recognizes products and processes transactions. This improves efficiency and customer satisfaction, which is ideal for unmanned stores.

(Saikat Maitra, 2015) The transformation of labour identities in emerging retail industries, particularly in cities like Kolkata, has been shaped by neoliberal economic policies and shifting capital flows. Kolkata's economic shift, driven by liberalization, has led to new jobs but also new labour demands. Workers face a globalized work culture, highlighting their growing precarity.

(JYOTHI, 2024) The literature on organized retailing emphasizes the importance of various store attributes in shaping customer satisfaction. Factors such as store ambiance, product variety, pricing strategies, customer service, and convenience play a crucial role in enhancing the shopping experience. The shift from traditional retail to organized formats has been driven by changing consumer preferences, urbanization, and increased competition. Studies indicate that organized retail not only improves customer satisfaction but also contributes to economic growth by streamlining supply chains and creating employment opportunities. In emerging economies, modern retail formats have transformed shopping behaviours, fostering brand loyalty and repeat purchases. However, there is limited research on how local demographics and economic conditions influence consumer perceptions in Visakhapatnam. This study aims to fill that gap by analysing key store attributes and their impact on customer satisfaction in the city's organized retail sector.

(Getachew, 2018) The adoption of Point of Sale (POS) terminals has been increasing globally as customers prefer cashless transactions. Banks are required to provide efficient and technologically advanced POS services to meet customer expectations. Getachew (2018) highlights that customer satisfaction with POS services varies, with users appreciating aspects like user-friendliness and customer support. Non-users often perceive the service more positively than actual users, indicating a gap between expectations and real-time experiences. Additionally, improving infrastructure, outsourcing maintenance services, and exploring alternative networking and power solutions can contribute to a more seamless POS experience for customers.

(Pavan Kumar Hedge, 2024) The rapid advancement of digital payment technologies has revolutionized financial transactions, significantly altering consumer behavior and financial market operations worldwide. This study provides a systematic review of digital payment adoption, synthesizing existing research to identify key drivers and challenges. Digital payments help the economy and banks now, but the long-term effects are unknown. Things like internet access, rules, and trust matter. Cybersecurity is key as digital payments grow, consumer confidence, and seamless payment integration will be vital for ensuring widespread and sustainable adoption across diverse economic landscapes.

3.Research Gap:

1. Geographical Gap: There is a notable absence of research focusing on the adoption and impact of POS systems in retail shops in Kolkata and other metro cities in India. Previous studies have largely concentrated on larger or more generalized retail sectors, with no specific focus on small, urban retailers, particularly in emerging markets like Kolkata (Joydeep Mookerjee, 2022; Ricky Johnny, 2024).

2. Theoretical Gap (TAM Analysis): While the Technology Acceptance Model (TAM) has been widely used in understanding technology adoption, it has not been fully adapted to advanced POS technologies, especially in small-scale retail sectors. The existing studies primarily use TAM in traditional or basic POS systems, not addressing the complexities of AI-powered or integrated POS systems (Titus Chukwuemezie Okeke, 2017; Victor Santos, 2023).

3. Small Retailers' Problems: The challenges specific to small retailers, particularly in terms of budget constraints, lack of technical expertise, and infrastructure limitations, have not been sufficiently explored in the literature. Many studies overlook how these factors affect the adoption of modern POS technologies (J.O. Jimoh, 2023; Mukherjee, 2017).

4. AI-powered POS Systems: The application and acceptance of AI-powered POS systems, which offer advanced features like personalized customer experiences and machine learning-based insights, have not been thoroughly examined. These systems' role in enhancing retail operations and customer satisfaction remains underexplored (Victor Santos, 2023).

5. Integration of TPS and MIS: Although research highlights the benefits of POS systems for transaction processing (TPS) and management information systems (MIS), the integration of these systems with POS technology for improved decision-making and operational efficiency has not been adequately studied (Mukherjee, 2017; Donohue, 2003).

Scope and Objective :

1. To contribute actionable insights for policy-makers, technology providers, and retail business owners, recommending strategies to improve digital readiness,
2. To reduce technical barriers, and enhance the strategic use of POS data in business decision-making.

4.Research Methodology:

The study adopted a descriptive research design to examine the behaviour, perceptions, and challenges faced by retail shops in using POS machines or software in Kolkata's metropolitan region. The research was quantitative in nature, utilizing a structured, close-ended questionnaire to collect data. A simple convenience sampling technique was employed due to time-sensitive nature of the targeted Sample, which included retail shops (restaurants, café, clothing store, electronic store and many more categories) operating in Kolkata's urban areas. Retail shops of Kolkata metropolitan city including mani square, CC1 and CC2 , Axis mall , SEC V , Chinar Park , Esplanade and many more portions where we can easily find the most famous retail shops and the evaluation for them in using POS and how much they know about it As the total population of retail shops and POS using people or stores was unknown, the sample size was determined using the standard formula for an unknown population at a 95% confidence level, with a margin of error of 5% and maximum variability (p = 0.5), resulting in a minimum required sample size of approximately 384 respondents. Due to the unknown size of the total driver population in Kolkata, the required sample size was estimated using Cochran's formula (Cochran, 1977) for proportions in large or infinite populations. The formula is given as:

$$n_0 = \frac{Z^2.p.(1-p)}{e^2}$$

Where,

- n_0 = sample size
- Z = Z- value corresponding to the desired confidence level (1.96 for 95% confidence)
- P = estimated proportion of the population (assumed to be 0.5 for maximum variability)

- e = margin of error (0.05 or 5 %)

Substituting the values into the formula

$$n_0 = \frac{(1.96)^2 - 0.5\,.\,(1 - 0.5)}{(0.05)^2} = \frac{3.8416\,.\,0.25}{0.0025} = \frac{0.9604}{0.0025} = 384.16$$

Thus, a minimum of 384 responses were deemed necessary to achieve statistically significant results with 95% confidence and a 5% margin of error. Data collection was carried out using a close-ended questionnaire designed via Google Forms, ensuring uniformity in responses and ease of digital distribution. The form included demographic questions, service related experiences, behavioural tendencies, and satisfaction metrics. Following data collection, Microsoft Excel was employed for preliminary data processing, cleaning, tabulation, and chart generation, while Microsoft Word was used for drafting, compiling insights, and preparing the final report.

The primary data was collected through Google Forms and distributed both digitally and in person, wherever possible. Microsoft Excel was used for data organization, tabulation, and graphical analysis, while Microsoft Word supported the drafting and presentation of the research findings.

5.DATA ANALYSIS AND INTERPRETATION

5.1 KMO and Bartlett's Test

Table 1: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.699
Bartlett's Test of Sphericity	Approx. Chi-Square	619.128
	df	66
	Sig.	.000

5.2 Communalities

Table 2: Communalities

	Initial	Extraction
TypeofRetail	1.000	.421
DurationofUsageofPOS	1.000	.464
PreferenceofPOS	1.000	.515
Paymentmethodused	1.000	.375
SpeedofTransactionusing POS	1.000	.438
ErrosinTransaction	1.000	.543
POSTrackinginventorylev el	1.000	.625
POSSalesreport	1.000	.559
BenefitusingPOS	1.000	.803
ChallengesusingPOS	1.000	.358
TypeofPOSStore	1.000	.681
NameofthePOSSoftware	1.000	.739

Extraction Method: Principal Component Analysis.

5.3 Total Variance Explained

Table 3: Total Variance Explained

Compone nt	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.567	21.391	21.391	2.567	21.391	21.391	1.896	15.803	15.803
2	1.788	14.897	36.288	1.788	14.897	36.288	1.815	15.122	30.925
3	1.130	9.420	45.708	1.130	9.420	45.708	1.757	14.642	45.567
4	1.037	8.640	54.349	1.037	8.640	54.349	1.054	8.782	54.349
5	.963	8.021	62.370						
6	.839	6.991	69.361						
7	.808	6.732	76.093						
8	.724	6.034	82.128						
9	.650	5.421	87.548						
10	.595	4.960	92.508						
11	.491	4.094	96.601						
12	.408	3.399	100.000						

Extraction Method: Principal Component Analysis.

5.4 Component Matrix(a)

Table 4: Component Matrix

	Component			
	1	2	3	4
TypeofRetail	.214	-.360	-.178	.463
DurationofUsageofPOS	-.499	.058	.442	.128
PreferenceofPOS	.712	.057	-.057	-.030
Paymentmethodused	.410	.446	-.009	.090
SpeedofTransactionusing POS	-.480	-.247	.377	.062
ErrosinTransaction	-.079	-.528	-.505	-.046
POSTrackinginventorylev	.660	.296	.308	.085

el				
POSSalesreport	.660	.083	.316	.129
BenefitusingPOS	.155	-.057	.109	-.874
ChallengesusingPOS	-.505	.163	.274	.030
TypeofPOSStore	-.402	.706	-.138	.040
NameofthePOSSoftware	-.218	.700	-.450	-.009

Extraction Method: Principal Component Analysis.
a 4 components extracted.

5.5 Rotated Component Matrix(a)

Table 5: Rotated Component Matrix

	Component			
	1	2	3	4
TypeofRetail	-.050	-.222	-.290	-.535
DurationofUsageofPOS	-.031	.679	.032	-.022
PreferenceofPOS	.456	-.532	-.152	.021
Paymentmethodused	.496	-.243	.262	-.033
SpeedofTransactionusingPOS	-.215	.589	-.212	-.012
ErrosinTransaction	-.595	-.345	-.229	-.130
POSTrackinginventorylevel	.760	-.204	-.072	.017
POSSalesreport	.669	-.207	-.257	-.052
BenefitusingPOS	-.023	-.178	-.169	.862
ChallengesusingPOS	-.094	.557	.190	.052
TypeofPOSStore	.012	.237	.790	.028
NameofthePOSSoftware	-.051	-.117	.850	.008

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
a Rotation converged in 5 iterations.

5.6 Component Transformation Matrix

Table 6: Component Transformation Matrix

Component	1	2	3	4
1	.653	-.690	-.312	-.006
2	.486	.071	.861	.131
3	.551	.702	-.401	.208
4	.180	.164	.033	-.969

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

6.Interpretation of Factor Analysis Output (SPSS)

The factor analysis was conducted on 12 variables related to the use and perception of Point-of-Sale (POS) systems by 389 respondents. The goal was to identify latent constructs (factors) that group together correlated variables.

6.1 Sampling Adequacy and Suitability of Data

- **KMO Measure = 0.699**
  This value indicates **mediocre adequacy** for factor analysis (above 0.6 is acceptable). It suggests that the data is factorable.
- **Bartlett's Test of Sphericity**
  - Approx. Chi-Square = **619.128**, **df = 66**, **Sig. = .000**
    This test is **highly significant**, indicating that correlations between variables are sufficient for factor analysis.

6.2. Communalities

Communalities represent the proportion of each variable's variance that can be explained by the extracted components. Notable communalities include:

- **High Extraction Values**:
  - BenefitusingPOS = **0.803**
  - NameofthePOSSoftware = **0.739**
  - TypeofPOSStore = **0.681**
  - These variables are **well-explained** by the factor solution.
- **Low Extraction Values**:
  - ChallengesusingPOS = **0.358**
  - Paymentmethodused = **0.375**
    These variables are **less represented** in the factor model.

6.3. Total Variance Explained

- **Four components** had eigenvalues > 1 and were retained.
- Cumulative variance explained by the four components = **54.35%**, which is acceptable for social science research.

Table No 7 : Components

Component	% Variance Explained
1	21.39%
2	14.90%
3	9.42%
4	8.64%

6.4. Rotated Component Matrix (Varimax Rotation)

This table helps interpret which variables load strongly on which factor. Only high loadings (typically > 0.4) are considered meaningful.

Factor 1: POS Performance and Reporting

- High loadings:
  - POSTrackinginventorylevel = **0.760**
  - POSSalesreport = **0.669**
  - Paymentmethodused = **0.496**
  - PreferenceofPOS = **0.456**
- Interpretation: This factor captures **functionality and efficiency** of POS systems in **inventory and sales management**.

Factor 2: POS Experience and Challenges

- High loadings:
  - DurationofUsageofPOS = **0.679**
  - SpeedofTransactionusingPOS = **0.589**
  - ChallengesusingPOS = **0.557**
- Interpretation: Reflects **user experience and operational hurdles** in using POS systems over time.

Factor 3: POS Type and Software

- High loadings:
  - NameofthePOSSoftware = **0.850**
  - TypeofPOSStore = **0.790**
- Interpretation: Denotes **technical and contextual differentiation** of POS systems based on **store type and software used**.

Factor 4: Perceived Benefits

- High loading:
  - BenefitusingPOS = **0.862**
- Interpretation: Represents **positive outcomes** or **advantages perceived** by users from using POS systems.

6.5. Visual Output – Component Plot

- The plot in rotated space confirms distinct clustering of variables into the four factors.
- Variables are spread out along the axes of components 1, 2, and 3, supporting the multidimensional nature of POS usage perception.

7. Research and Findings:

This study investigates the impact of Point-of-Sale (POS) machines on retail shops in Kolkata, with a focus on transaction efficiency, customer preferences, inventory management, and operational challenges. Data was collected via a structured questionnaire distributed among diverse retail businesses, including pharmacies, electronics stores, clothing outlets, and grocery stores.

Sample Profile: The responses analyzed were from retailers with varying levels of experience using POS systems, ranging from less than 1 year to over 10 years. Most respondents reported using POS for 1–5 years.

This table helps interpret which variables load strongly on which factor. Only high loadings (typically > 0.4) are considered meaningful.

Factor 1: POS Performance and Reporting

- High loadings:
  - `POSTrackinginventorylevel` = **0.760**
  - `POSSalesreport` = **0.669**
  - `Paymentmethodused` = **0.496**
  - `PreferenceofPOS` = **0.456**
- Interpretation: This factor captures **functionality and efficiency** of POS systems in **inventory and sales management**.

Factor 2: POS Experience and Challenges

- High loadings:
  - `DurationofUsageofPOS` = **0.679**
  - `SpeedofTransactionusingPOS` = **0.589**
  - `ChallengesusingPOS` = **0.557**
- Interpretation: Reflects **user experience and operational hurdles** in using POS systems over time.

Factor 3: POS Type and Software

- High loadings:
  - `NameofthePOSSoftware` = **0.850**
  - `TypeofPOSStore` = **0.790**
- Interpretation: Denotes **technical and contextual differentiation** of POS systems based on **store type and software used**.

Factor 4: Perceived Benefits

- High loading:
  - `BenefitusingPOS` = **0.862**
- Interpretation: Represents **positive outcomes** or **advantages perceived** by users from using POS systems.

8. Findings:

1. Customer Preferences: A significant portion of customers prefer POS-based billing, with many responses indicating "Yes, always" or "Sometimes."

Manual billing is still preferred by a minority, particularly in less tech-savvy environments.

2. Payment Methods: UPI-based payments (Google Pay, PhonePe, Paytm) dominate across most businesses. Debit/Credit card payments are also common, especially in electronics and clothing stores. Cash usage remains relevant but secondary.

3. Transaction Efficiency: Over half of the retailers reported that POS machines significantly or moderately improved transaction speed.

A small portion observed no noticeable change, often correlating with shorter usage periods or poor infrastructure.

4. Error Reduction and Reliability: The majority of retailers experienced transaction errors rarely, indicating high system reliability. Some did report occasional issues, mostly linked to internet problems or technical glitches.

5. Inventory and Reporting: POS machines were rated as very or extremely helpful for inventory tracking by most users. Sales reporting features were appreciated, with many labeling them as somewhat to very detailed.

6. Benefits Experienced: Common benefits included faster transactions, better inventory management, and improved reporting. Enhanced business insights and reduced human error were frequently mentioned.

7. Challenges Faced: The main challenges identified were internet dependency, technical issues, and employee training difficulties. These indicate a need for better digital infrastructure and staff onboarding.

9.0 Conclusion: Impact of POS Machines on Retail Shops in Kolkata

The adoption of Point-of-Sale (POS) machines has significantly transformed retail operations in Kolkata. Retailers have experienced enhanced efficiency through faster checkouts, accurate inventory management, and streamlined sales processes. The integration of various payment methods, including UPI and mobile wallets, has improved customer convenience and satisfaction. Additionally, POS systems facilitate real-time data analytics, enabling retailers to make informed decisions and tailor marketing strategies effectively. Overall, POS machines have become indispensable tools for modern retail businesses in Kolkata, driving growth and improving customer experiences.

The factor analysis successfully extracted **four underlying factors** related to POS system use in retail:

1. **Performance and Reporting**
2. **User Experience and Operational Challenges**
3. **POS Type and Software**
4. **Perceived Benefits**

These factors collectively explain a reasonable amount of variance (54.35%) and offer meaningful groupings for further analysis, such as building composite scores or conducting regression models. The analysis indicates that POS software features, user experience, and perceived benefits play distinct and important roles in how retail businesses evaluate POS systems.

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