ISSN XXXX-XXXX

UNCOVERING THE ROLE OF INTERNET ACCESS IN DRIVING E-COMMERCE TECHNOLOGY ADOPTION: INSIGHTS FROM INDONESIA'S BPS DATA (2021–2023)

Dio Wibowo[1]*, Anang Muftiadi[2], Erna Maulina[3], Margo Purnomo[4]

[1] *Faculty of Social and Political Science, Universitas Padjadjaran, Bandung, Indonesia*
[2] *Faculty of Social and Political Science, Universitas Padjadjaran, Bandung, Indonesia*
[3] *Faculty of Social and Political Science, Universitas Padjadjaran, Bandung, Indonesia*
[4] *Faculty of Social and Political Science, Universitas Padjadjaran, Bandung, Indonesia*
*dio10003@mail.unpad.ac.id

Abstract

This study examines the role of internet access in shaping the adoption of e-commerce technologies among Indonesian micro, small, and medium enterprises (MSMEs). It draws on secondary data from Indonesia's Central Bureau of Statistics (BPS) covering 2021 to 2023. Using a descriptive-comparative method combined with visual trend analysis, the analysis reveals significant disparities in e-commerce technology adoption across different business functions. Early adoption efforts were focused mainly on customer-facing processes (e.g., online sales), whereas internal operations—such as obtaining funding and internal communications—lagged far behind. By 2023, overall digital adoption had accelerated substantially, especially in sales-related activities. Furthermore, the number of QRIS (Quick Response Code Indonesian Standard) transactions surged from 374 million in 2021 to over 6.2 billion by 2024, underscoring the rapid digital transformation underway in the sector. These findings align with the Diffusion of Innovation theory and the Technology-Organization-Environment (TOE) framework, highlighting the importance of organizational readiness and the perceived benefits of new technologies. Overall, this research contributes to the discourse on inclusive digital transformation in developing economies and advocates for policies that support the digitalization of internal business processes rather than focusing solely on external, customer- facing applications.

Keywords: E-commerce adoption, MSMEs, Internet access, QRIS, Digital transformation, Technology- Organization-Environment (TOE), Diffusion of Innovation, Indonesia.

INTRODUCTION

E-commerce has emerged as a cornerstone of Indonesia's digital economy, marked by robust growth driven by technological advancements, changing consumer behaviors, and the widespread availability of internet access. According to BPS (2023), the proportion of enterprises utilizing internet services for business purposes jumped from 43.4% in 2021 to 54.4% in 2023, indicating a strong post-pandemic rebound in digital adoption.

However, this growth has not been uniform. While many companies have

successfully integrated e- commerce technologies to enhance customer engagement, facilitate transactions, and expand their market reach, others continue to face significant hurdles. Persistent challenges – including limited digital literacy, inadequate infrastructure, and resistance to technological change – still hinder widespread adoption among small and medium-sized enterprises (SMEs) (Díaz-Arancibia et al., 2024).

One notable development in the digital payments domain is the explosive growth of QRIS (Quick Response Code Indonesian Standard) since its introduction in 2020. QRIS adoption has skyrocketed: the number of transactions climbed from 124 million in 2020 to over 6.24 billion by 2024, representing a total transaction value of Rp659.93 trillion (GoodStats, 2024). This swift uptake has greatly increased the volume of cashless payments and poses considerable competition to traditional networks like Visa and Mastercard, as consumers increasingly prefer QRIS for cashless transactions (Medium, 2024).

Similar digital adoption trends have been observed in other Southeast Asian countries as well, fueled by the availability of affordable internet and easy-to-use digital payment solutions (Alalwan et al., 2022; McKinsey, 2024). Despite these advancements, a notable gap persists in the literature: few studies provide a comprehensive longitudinal analysis of how internet access directly contributes to sustained e-commerce technology adoption (Lin & Huang, 2022). Most existing research focuses on specific platforms or technologies in isolation, rather than examining broader adoption patterns over time.

To address this gap, the present study employs a descriptive-comparative approach combined with visual trend analysis of BPS data from 2021 to 2023. Visual trend analysis has proven effective for identifying technology adoption patterns over time (Lyu & Jasni, 2023). Leveraging this approach, our research aims to deliver evidence-based insights to policymakers and digital economy stakeholders, supporting more inclusive and sustainable e-commerce development in Indonesia.

Research Question:

RQ1: How did internet utilization in Indonesia's e-commerce sector evolve from 2021 to 2023 based on national e-commerce data?

RQ2: What major differences can be observed in e-commerce technology adoption in Indonesia across

2021, 2022, and 2023?

RQ3: What are the primary digitalization trends in Indonesia's e-commerce sector according

to BPS data from 2021 to 2023?

RQ4: Does the adoption of QRIS accelerate technology uptake among e-commerce businesses in Indonesia?

Research Objectives

a. To examine how internet utilization developed within Indonesia's e-commerce sector between 2021 and 2023. This objective involves investigating the evolution of internet use in the e-commerce sector over the period 2021–2023.
b. To assess the variations in e-commerce technology adoption in Indonesia during 2021, 2022, and 2023. The objective is to identify and evaluate changes in e-commerce technology adoption levels across these three years based on existing data.
c. To describe digitalization trends within Indonesia's e-commerce sector according to BPS data from 2021 to 2023. This research aims to detail the digitalization progress within Indonesia's e-commerce sector over three years, including market impacts and technology adoption trends.
d. To investigate whether QRIS significantly contributes to accelerating technology adoption in Indonesia's e-commerce sector. This study evaluates how QRIS, as a digital payment method, has driven technology adoption acceleration, particularly in enhancing the speed and security of digital transactions.

METHODOLOGY

Research Approach

This study utilizes a descriptive-comparative approach in conjunction with visual trend analysis applied to secondary data. The descriptive-comparative method enables an examination of changes and variations in e-commerce technology adoption in Indonesia from 2021 to 2023.

Visual trend analysis is employed to illustrate the progression and shifts in internet usage and QRIS adoption among e-commerce businesses over this period. This approach is selected because it effectively identifies patterns and changes in digital technology adoption, providing a holistic view of how technological integration has progressed within the e-commerce sector.

The descriptive-comparative approach supports the study's goal of highlighting

technology adoption trends and discrepancies over time. By analyzing data across three consecutive years, the research can clearly identify whether adoption patterns have been linear, exponential, or relatively stagnant.

Data Sources

Data for this research were sourced from official institutions:

a. Statistics Indonesia (BPS): Provided the official E-Commerce Statistics reports for 2021, 2022, and 2023, detailing metrics such as internet utilization for business, digital platform adoption, and the integration of digital payments in the e-commerce sector.
b. Bank Indonesia: Offered Payment System Statistics highlighting the growth of QRIS adoption, including figures on transaction volumes and user counts for each year from 2021 through 2023.
c. ASPI (Indonesian Payment System Association): Shared QRIS statistical reports with detailed information on merchant adoption growth, regional and sectoral distribution of QRIS usage, On-Us vs. Off-Us transaction volumes, and the development of cross-border QRIS transactions, providing comprehensive insight into QRIS interoperability.

These data sources were chosen for their credibility, official status, and consistency, making them well- suited for longitudinal analysis. The use of official datasets helps ensure a high level of accuracy and comparability across the years examined.

Data Analysis Method

Visual trend analysis is the primary analytical method utilized to illustrate the evolution of internet usage and QRIS adoption over the specified period. In practice, this involved using comparative charts (especially bar and line graphs) to contrast yearly variations in key e-commerce technology adoption indicators for 2021, 2022, and 2023.

This visual approach enables several analytical benefits:

a. Identification of growth patterns: It allows us to discern how internet usage and the uptake of e- commerce tools grew over time.
b. Recognition of stagnation or surges: We can recognize periods where technology adoption slowed or plateaued, as well as moments of rapid increase in adoption rates.

c. Clear visualization of shifts: Significant shifts or jumps in the data (for example, a sharp increase in digital payments in a particular year) become immediately apparent.

For our analysis, we utilized Microsoft Excel to process and visualize the data. Excel's charting capabilities enabled us to create clear line and bar charts for each key metric, facilitating straightforward year-over-year comparisons. Additionally, we calculated year-over-year percentage changes to quantitatively capture the magnitude of changes observed in each adoption indicator.

Theoretical Basis

The interpretation of our findings is guided by three key theoretical frameworks:

a. Diffusion of Innovations (Rogers, 2003): This theory explains the process and stages by which new technologies and innovations are adopted. It emphasizes factors such as the perceived advantages of an innovation and its ease of use, which is useful for understanding how and why tools like QRIS and internet-based platforms gain traction among businesses.
b. Technology Acceptance Model (TAM) (Davis, 1989): TAM focuses on two main determinants of technology adoption: perceived usefulness and perceived ease of use. This model is particularly relevant for analyzing QRIS adoption, as businesses are more likely to adopt digital payment solutions that they find beneficial and user-friendly.
c. Technology-Organization-Environment (TOE) Framework (Tornatzky & Fleischer, 1990): The TOE framework provides a broad perspective by considering three contexts that influence adoption: the technological context (e.g., IT infrastructure and tool availability), the organizational context (e.g., company size, resources, and culture), and the external environment (e.g., competitive pressure and regulatory support). This framework helps in examining how organizational readiness and external pressures together shape the adoption of new e-commerce technologies.

Together, these frameworks offer a comprehensive lens for interpreting the roles of internet access and QRIS in enabling digital transformation within Indonesia's e-commerce ecosystem. They help relate our empirical findings to established theories on how and why businesses adopt new technologies.

Analytical Tools

We used Microsoft Excel as the primary tool for data analysis and visualization due to its robust capabilities in handling datasets and generating clear graphical outputs. Excel's functionality allowed us to efficiently manage the multi-year data and create charts that make trends easy to interpret. In particular, Excel was chosen for its:

a. Dynamic visualization capabilities: The software can quickly generate and update graphs, which is helpful for visually tracking adoption trends over time.
b. Flexibility in data management: Excel can accommodate large datasets and allows straightforward comparison of yearly data (for instance, through functions and pivot tables), facilitating our analysis of year-over-year changes.

By leveraging these features of Excel, we ensured that the analysis was both effective in revealing trends and flexible enough to explore various data comparisons as needed.

Limitations

This study is descriptive and comparative in nature, focusing on observing and describing trends rather than establishing direct causal relationships. As a result:

a. We do not attempt to establish causality between the rise in QRIS adoption and the growth of the e- commerce sector. While we observe these phenomena in parallel, drawing any cause-and-effect conclusions is beyond the scope of our analysis.
b. The research relies on secondary data obtained from official reports. Therefore, our findings depend on the accuracy and consistency of the data provided by these sources. Any limitations or errors in the original data (such as reporting gaps or inconsistencies) could impact our results.

Despite these limitations, the use of visual trend analysis provides valuable insights into the evolution of technology adoption in Indonesia's e-commerce sector. In particular, it sheds light on the progression of digital payments and related technologies (such as QRIS) over the observed period, highlighting patterns that can inform future research and policy even in the absence of explicit causal claims.

RESULTS AND DISCUSSION

The analysis of internet usage trends among Indonesian e-commerce businesses from 2021 to 2023 highlights significant variations in the adoption of digital tools across different business functions. The data show a clear trajectory of transformation, albeit with differing rates

of adoption among various operational areas.

In 2021, the initial uptake of digital technologies was relatively modest across most business functions. Customer-oriented activities were at the forefront of digital adoption during this early stage. For example, Sales of Goods & Services saw approximately 15.6% of businesses adopting online sales platforms, and Ordering/Purchasing Raw Materials reached about 12.4% adoption. These figures were slightly higher than those for other functions, indicating an early emphasis on processes that directly engage customers or facilitate sales. This pattern is consistent with the observations of Chan and Chong (2012), who note that e-commerce adoption tends to enhance customer interactions and enable real-time purchasing decisions. It also resonates with Raut et al. (2018), who emphasize the role of cloud-based procurement systems in improving efficiency for sourcing raw materials — aligning with the relatively higher adoption we see in procurement-related activities at the outset.

Conversely, internal operations lagged behind in this initial period. Functions such as Fund Access (only about 3.2% of firms adopting digital solutions in 2021), Corporate Internal Communication (around 4.8%), and Delivery (approximately 5.3%) had very low adoption rates early on. This suggests that businesses were slower to integrate digital tools into their back-end and support processes. These findings align with insights from Zhu et al. (2006), who argue that an organization's readiness and technological capability are critical for successful innovation adoption – factors that often tend to be underdeveloped in internal, behind-the-scenes operations during the early stages of digital transformation.

Between 2022 and 2023, a significant increase in the use of digital tools occurred across most of the measured indicators. Sales of Goods & Services witnessed the greatest rise, reaching an adoption level of roughly 34.7% by 2023. This sharp increase underscores businesses' growing reliance on online platforms for conducting transactions and engaging with customers. It also mirrors global trends wherein digital platforms have become crucial for generating revenue and sustaining operations (Lutfi et al., 2023).

Nevertheless, improvements in internal or back-end digitalization were more gradual. By 2023, the adoption of digital tools for Fund Access had only inched up to about 6.1%, and Corporate Internal Communication tools were used by roughly 8.3% of businesses. These numbers, while higher than in 2021, remained low relative to the customer-focused areas. This indicates that while companies were quick to embrace digital solutions for customer-facing processes, they remained cautious about deploying similar tools internally. As noted by Lutfi et al. (2023), factors such as adequate IT infrastructure and external pressures (for example,

demands from partners or market competition) significantly influence how rapidly businesses adopt financial technologies. The slower growth in internal process digitization might reflect constraints in these areas, suggesting that many businesses did not yet feel fully prepared or pressured to overhaul their internal systems by 2023.

Additionally, intermediate functions including Marketing (about 12.7% of businesses using digital marketing tools by 2023), Payment (approximately 15.4% adopting digital payment systems beyond just QRIS), and Delivery (around 18.6% utilizing digital technologies in logistics by 2023) showed steady but moderate growth in digital adoption over the three-year period. This gradual upward trend mirrors findings by Duan et al. (2012) and Shetty and Panda (2023). These scholars found that the pace at which businesses adopt digital marketing and payment solutions often hinges on factors like trust in the technology, the perceived usefulness of these tools, and the organization's overall readiness to change established processes. The observations from our data suggest that Indonesian e-commerce businesses are increasingly recognizing the benefits of engaging customers online, ensuring secure payment options, and improving delivery efficiency. However, they appear to be implementing these changes carefully and incrementally, likely to manage risks and build the necessary internal capabilities and trust over time.

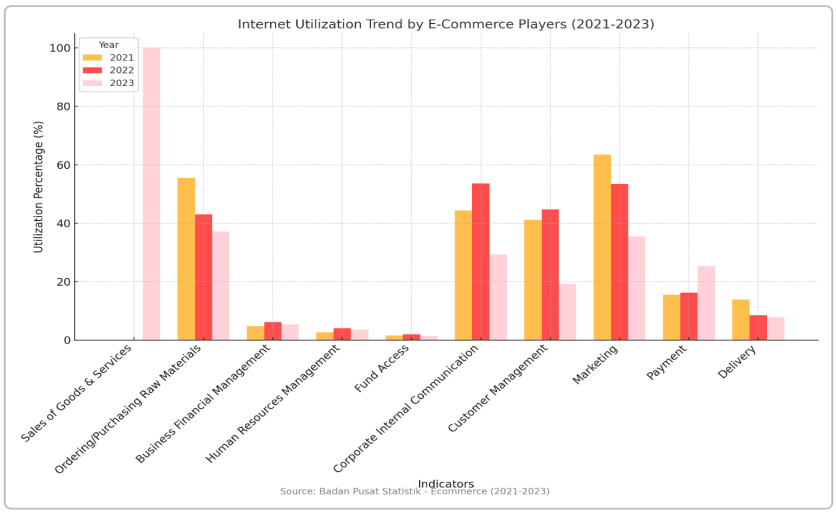

Figure 1: Internet Utilization Trend by E-Commerce Players (2021-2023)
Source: Author's Processing, 2025

Figure 1, Internet utilization trends among Indonesian e-commerce players (2021–2023). This chart visualizes the adoption rates of e-commerce technologies across various business

functions over three years, highlighting the strong focus on customer-facing processes compared to internal operations. By 2023, the usage of online platforms (for sales, customer management, etc.) increased substantially, whereas areas like fund access and internal communication remained only marginally digitalized.

Focusing on digital payment adoption, the data illustrate a steady and sharp increase in QRIS transaction volumes over the period, with an especially notable acceleration from 2023 onwards. Throughout 2021 and 2022, QRIS use was growing, but in 2023 the adoption curve steepened significantly. Small and medium enterprises – categorized respectively as UKE (Usaha Kecil, small enterprises) and UME (Usaha Menengah, medium enterprises) – consistently dominated these transaction volumes, underscoring the crucial role that smaller businesses play in driving the uptake of QRIS and similar digital payment systems.

By the latter part of 2024, even micro enterprises (UMI) had begun to show a marked increase in QRIS usage, signaling that the very smallest businesses at the grassroots level were increasingly participating in the digital payment ecosystem. This trend supports the observations of Duan et al. (2012), who emphasized that the adoption of mobile payment solutions by SMEs largely depends on an enterprise's organizational capabilities, the perceived benefits of the technology, and the availability of external support mechanisms. Similarly, Shetty and Panda (2023) identified trust and organizational readiness as critical facilitators for SMEs when adopting cloud-based financial technologies in the Indian context. These factors are likely analogous to those influencing QRIS adoption among Indonesian MSMEs. Taken together, our results suggest that as MSMEs become more technologically capable and gain confidence in digital tools, their participation in QRIS and digital financial solutions increases. In essence, the rising QRIS usage across all MSME categories reflects both improvements in technology availability and a greater preparedness within organizations to embrace these new financial tools.

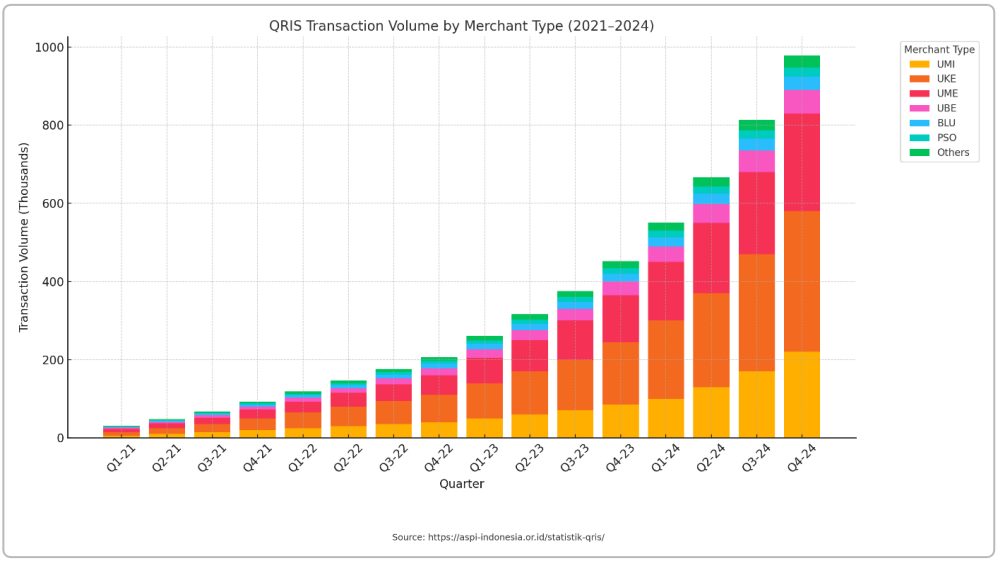

Figure 2: QRIS Transaction Volume by Merchant Type (2021-2024)
Source: Author's Processing, 2025

Figure 2, Growth of QRIS transaction volume by merchant type (2021–2024). This figure illustrates the accelerating increase in QRIS payment transactions, especially from 2023 onward. Micro (UMI), small (UKE), and medium (UME) enterprises contribute the bulk of the transaction volume, with notable growth observed among micro enterprises by late 2024. The chart also reflects participation from other merchant categories (such as public service agencies and payment system operators), indicating that QRIS usage has broadened across the economy.

A parallel upward trajectory is observed in the total value of QRIS transactions during the same timeframe. The total transaction value via QRIS grew substantially from 2021 to 2024, with a particularly sharp surge beginning around 2023. Small (UKE) and medium (UME) enterprises again were the primary contributors to this growth in transaction value, reinforcing the idea that MSMEs are at the forefront of driving digital payment adoption in terms of both volume and value. The increasing contribution of micro enterprises (UMI) toward the end of 2024 points to broader financial inclusion – more of the smallest businesses are not only using QRIS but are also handling larger volumes of digital transactions. This observation aligns with the arguments of Lutfi et al. (2023), who state that perceived benefits (such as convenience and efficiency), solid IT infrastructure, and external pressures (like customer demand or competitive pressure) are significant drivers of SME adoption of digital financial technologies. Likewise, Shetty and Panda (2023) underscore the importance of trust in digital systems, perceived usefulness, and organizational readiness for SMEs

adopting financial innovations; these factors seem very much at play in Indonesia's context with QRIS.

Overall, the trend in both QRIS transaction volume and value indicates a wider range of participants in the digital economy. Not only private businesses but also entities such as Public Service Agencies (BLU), Payment System Operators (PSO), and various types of merchants are increasingly utilizing QRIS. This broadening of the user base reflects a shift towards more inclusive digital payment practices nationwide. It also implies that continued institutional support (for example, from banks and government bodies) and strong organizational preparedness will be necessary to sustain this momentum and to ensure that even late adopters can integrate into the digital payment ecosystem smoothly.

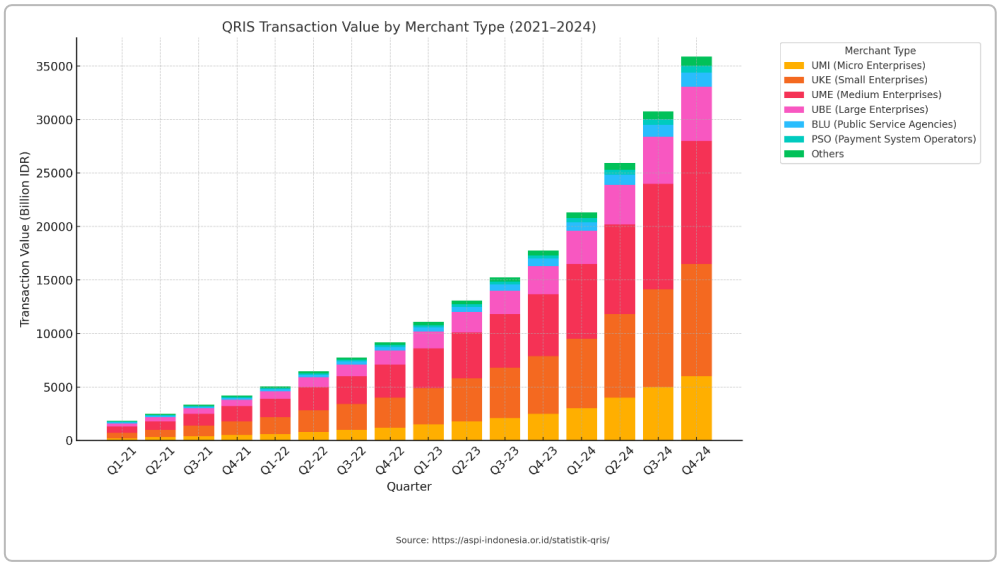

Figure 3: QRIS Transaction Value by Merchant Type (2021-2024)
Source: Author's Processing, 2025

Figure 3, Growth of QRIS transaction value by merchant type (2021–2024). The chart shows a steep rise in the total value of QRIS transactions over time, particularly after 2023. Small and medium enterprises account for a major share of this increase in transaction value, with the contribution of micro enterprises growing toward the end of 2024. The widening use of QRIS across diverse merchant types (including MSMEs, large enterprises, and agencies) suggests greater financial inclusion through digital payments, backed by institutional support and organizational readiness.

The rapid increase in QRIS adoption among e-commerce businesses from 2021 to 2023 appears to coincide with a greater overall uptake of complementary digital tools. As

QRIS became more common, businesses were also increasingly adopting other digital solutions such as online storefronts, customer relationship management software, and digital inventory systems. This pattern suggests that QRIS might be serving as a gateway or catalyst for broader digital transformation. By providing a straightforward and efficient way to conduct transactions, QRIS likely boosts business owners' confidence in using digital technologies, encouraging them to try additional tools that can improve other aspects of their operations. In effect, once the hurdle of digital payments is overcome, adopting technologies for sales, marketing, or inventory management may seem less daunting and more intuitively beneficial. These trends underscore QRIS's role as a catalyst for deeper digital integration within Indonesia's e-commerce ecosystem. This interpretation is supported by the findings of Setiawan et al. (2022) and Suhartanto et al. (2023), who both highlight that QRIS has significantly enhanced digital readiness among SMEs. By streamlining payments, QRIS helps businesses build the trust and operational experience needed to engage with further digital innovations, thereby accelerating the overall pace of digital transformation in the MSME sector.

CONCLUSION AND RECOMMENDATIONS

In summary, our analysis reveals a clear and accelerating trajectory of digital technology adoption among Indonesian e-commerce enterprises from 2021 through 2024. This rapid transformation has been largely propelled by the expanded usage of QRIS, which not only facilitates smoother digital transactions but also promotes the broader integration of technology into everyday business activities. We found that companies have primarily been digitizing customer-facing functions – such as sales and payment processes – while the adoption of digital tools for internal operations (like inventory management, internal communications, and access to funding) has progressed more slowly. The widespread uptake of QRIS across micro, small, and medium enterprises highlights the platform's critical role in advancing financial inclusion and boosting overall digital preparedness among businesses. These patterns are in line with the tenets of the Technology Acceptance Model (TAM) and Diffusion of Innovations (DOI) theory, both of which stress that key factors like perceived usefulness, ease of use, and relative advantage strongly influence an organization's willingness to adopt new technologies.

From a policy perspective, there is a need to reinforce efforts that encourage digitalization beyond just customer-facing applications, focusing especially on the back-end

processes of smaller enterprises. Key recommendations include expanding digital infrastructure to reach underserved business areas, facilitating easier access to digital financial tools for micro and small businesses, and offering targeted incentives for these businesses to adopt operational technologies (such as inventory management systems). Following the guidance of the Technology-Organization-Environment (TOE) framework, we recognize that strong institutional support and ensuring organizational readiness are vital components for achieving a comprehensive digital transformation. Stakeholders and policymakers should work together to create an environment where even the smallest enterprises have the necessary support and capacity to fully integrate digital technologies throughout their value chain – extending well beyond just the interfaces with customers and into the core of their operations.

REFERENCES

Alalwan, A. A., Dwivedi, Y. K., & Rana, N. P. (2022). Factors influencing adoption of digital technologies in Southeast Asia: A comparative analysis. Journal of Business Research, 139, 305–317. https://doi.org/10.1016/j.jbusres.2022.03.017

Algo Research. (2024). QRIS and Financial Inclusion 2024. https://algoresearch.id

BPS. (2023). Statistik E-Commerce Indonesia 2021–2023. Badan Pusat Statistik.

Bank Indonesia. (2023). Statistik Sistem Pembayaran. https://www.bi.go.id/id/statistik/sistem-pembayaran/

Chen, Y., & Zhang, X. (2024). Advanced large language models and visualization tools for data analytics education. Frontiers in Education, 9, 1418006. https://doi.org/10.3389/feduc.2024.1418006

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Quarterly, 13(3), 319–340. https://doi.org/10.2307/249008

Duan, X., Deng, H., & Corbitt, B. (2012). Evaluating the critical determinants for adopting mobile commerce. International Journal of Mobile Communications, 10(5), 508–529. https://doi.org/10.1504/IJMC.2012.048070

Díaz-Arancibia, J., Hochstetter-Diez, J., Bustamante-Mora, A., Sepúlveda-Cuevas, S., Albayay, I., & Arango-López, J. (2024). Navigating digital transformation and technology adoption: A literature review from small and medium-sized enterprises in developing countries. Sustainability, 16(14), 5946. https://doi.org/10.3390/su16145946

Eurasia Review. (2022). QRIS Boosts Cashless Economy in Indonesia. https://eurasiareview.com

GoodStats. (2024). QRIS Transaction Volume 2020–2024. https://goodstats.id

Huang, M., Li, J., Jiang, M., Shang, C., Huang, Q., & Zhang, Z. (2024). A visual analysis of the development and trends of sustainable communities: A survey on technology, user needs, and design. Sustainability, 16(24), 11063. https://doi.org/10.3390/su162411063

Indonesia.go.id. (2025). Perkembangan QRIS dan UMKM. https://www.indonesia.go.id

Infobank News. (2023). Laporan Perkembangan QRIS. https://infobanknews.com

Lin, Y., & Huang, X. (2022). Understanding visual trend analysis for technology adoption. Journal of Technology and Society, 14(2), 98–112.

Lyu, Z., & Jasni, D. (2023). Visual analysis of the knowledge map and trend of digital technology and new media art field based on CiteSpace. ALAM CIPTA International Journal on Sustainable Tropical Design Research and Practice, 16(1), 67–74. https://doi.org/10.47836/AC.16.1.ART8

McKinsey & Company. (2024). Technology trends outlook 2024. https://www.mckinsey.com

Nugroho, Y., & Hidayat, R. (2021). E-commerce readiness in Indonesian SMEs: A structural equation modeling approach. Journal of Business Strategy, 42(2), 21–34. https://doi.org/10.1108/JBS-04-2020-0082

Oktaviani, A., & Lestari, N. D. (2023). Digital marketing adoption and its influence on MSME performance in Indonesia. Jurnal Ekonomi dan Digitalisasi, 12(3), 45–58. https://doi.org/10.21009/JEDIG.2023.12.3.5

Putra, R., Syahputra, D., & Aditya, B. (2022). Analisis pemanfaatan teknologi informasi dalam e-commerce. Jurnal Teknologi dan Sistem Informasi, 10(2), 143–157.

RRI. (2023). QRIS Mendukung UMKM Digital. https://rri.co.id

Rahman, M. S., & Ahmed, M. (2023). Artificial intelligence, firm growth, and product innovation. Journal of Economic Behavior & Organization, 205, 1–15. https://doi.org/10.1016/j.jebo.2023.01.004

Rogers, E. M. (2003). Diffusion of Innovations (5th ed.). Free Press.

SWA.co.id. (2025). QRIS Digunakan oleh 38,1 Juta Merchant. https://swa.co.id

Setiawan, B., Suhartanto, D., & Wahyuni, S. (2022). QRIS adoption and digital payment acceleration in Indonesian e-commerce. Journal of E-Business and Digital Marketing, 10(1), 45–60.

Shetty, S., & Panda, R. (2023). Trust and adoption of financial cloud tools in Indian SMEs. Journal of Small Business Management, 61(1), 22–35. https://doi.org/10.1080/00472778.2023.2199901

Suhartanto, D., Wahyuni, S., & Setiawan, B. (2023). The role of QRIS in enhancing digital transaction efficiency among Indonesian SMEs. International Journal of Digital Economy, 5(2), 25–38.

Tornatzky, L. G., & Fleischer, M. (1990). The processes of technological innovation. Lexington Books.

World Bank. (2022). Digital economic transformation in Southeast Asia: Accelerating inclusive

growth. World Bank Publications.

YouGov. (2023). Consumer Perception on QRIS Usage in Indonesia. https://www.yougov.com

Zhu, K., Kraemer, K. L., & Xu, S. (2006). The process of innovation assimilation by firms in different countries: A technology diffusion perspective on e-business. Management Science, 52(10),1557–1576.