

Bridging the digital divide: A thematic analysis of digital technology adoption and sustainable entrepreneurship among women-led MSMEs in North India

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Abstract

Digital technologies are widely regarded as enablers of entrepreneurship and business sustainability, yet qualitative evidence on how women entrepreneurs actually experience digital transformation in emerging economies remains limited. This study examines how digital technologies shape the sustainability of women-led micro, small and medium enterprises (MSMEs) in North India, drawing on the Technology Acceptance Model (TAM) extended with a digital inclusion perspective. Using a qualitative design, semi-structured interviews were conducted with 25 women entrepreneurs across Delhi, Uttar Pradesh, Haryana, Punjab, and Rajasthan, and the data were analysed using Braun and Clarke's reflexive thematic analysis. Four interconnected themes emerged: digital empowerment of business operations, market expansion through digital platforms, entrepreneurial autonomy, and persistent barriers to technology adoption. Findings show that digital technologies improve operational efficiency, strengthen customer engagement, expand market access, and enhance entrepreneurial autonomy, while inadequate infrastructure, limited digital capabilities, and socio-cultural constraints continue to restrict their full benefits. The study extends TAM by demonstrating that women entrepreneurs' technology adoption depends not only on perceived usefulness and ease of use but also on digital infrastructure, capabilities, and socio-cultural support. The findings contribute to the literature on digital entrepreneurship, women's entrepreneurship, and technology adoption, and offer practical implications for policymakers and entrepreneurship support organisations seeking to strengthen digital inclusion and promote sustainable, women-led enterprise development.

Keywords: Digital Entrepreneurship, Women Entrepreneurs, Sustainable Business, MSMEs, Digital Inclusion, Technology Acceptance Model, Digital Transformation, Thematic Analysis

JEL Classification: O33, O15, L26

1. Introduction

Women entrepreneurship has emerged as an important driver of economic development, innovation, and social transformation across both developed and developing economies (De vita., et.al., 2014; Hechavarria, D., et.al., 2019; Sajjad, M., et.al., 2020). Women-owned enterprises contribute to employment generation, poverty reduction, household welfare, and inclusive economic growth while strengthening the resilience of local economies (Minniti & Naudé, 2010; Jennings & Brush, 2013). In recent years, governments and international development agencies have increasingly recognised that supporting women entrepreneurs is essential for achieving sustainable development, gender equality, and inclusive economic participation (Kabeer, N. 2012; Olarewaju, T., & Fernando, J. 2020; Barrachina Fernández, M., et.al., 2021; Inkumsah, S. G. 2024). Nevertheless, despite their growing contribution to national economies, women entrepreneurs continue to face structural constraints, including limited access to finance, restricted business networks, inadequate institutional support, and persistent socio-cultural barriers that influence entrepreneurial opportunities and business growth (Roomi, M. A., & Parrott, G. 2008; Niethammer, C. 2013; Panda, S. 2018; Kamberidou, I. 2020; Agrawal, R., et.al., 2023; Irene, B., et.al., 2025).

The rapid advancement of digital technologies has fundamentally transformed entrepreneurial ecosystems by creating new opportunities for business creation, innovation, and market expansion (Elia, G., et.al., 2020; Autio, E., et.al., 2023). Digital payment systems, social media platforms, e-commerce marketplaces, cloud-based applications, and mobile business solutions have enabled micro, small and medium enterprises (MSMEs) to reduce transaction costs, improve customer engagement, and expand beyond traditional geographical boundaries (Bagale, G. S., et.al., 2021). Consequently, digital technologies are increasingly viewed as strategic resources that enhance entrepreneurial competitiveness and long-term business sustainability (Nambisan, 2017; Autio et al., 2018; Sahut et al., 2021). The transformative potential of digital technologies is particularly significant for women entrepreneurs (Suseno, Y., & Abbott, L. 2021; Salamzadeh, A., et.al., 2024). Digital platforms enable women-owned businesses to overcome several traditional barriers by facilitating flexible work arrangements, improving financial inclusion, strengthening customer relationships, and expanding access to regional and global markets (Ahmed, H., et.al., 2026). Social media marketing, digital payment systems, and online marketplaces have reduced dependence on physical business infrastructure and created alternative pathways for entrepreneurial growth (Sundararajan, A. 2014; Mahesh, K. M., et.al., 2022; Minarni, E. 2025). Recent studies further suggest that digital technologies can strengthen women's entrepreneurial agency by improving business visibility, increasing financial independence, and expanding opportunities for innovation in resource-constrained environments (Kambiri, D. 2025; Doargajudhur, M., 2026; Ghouse, S. M., & McElwee, G. 2026)..

Despite these opportunities, digital transformation has not benefited all women entrepreneurs equally (Dy, A. M., et.al.,2017; Kamberidou, I. 2020). Significant disparities remain in access to digital infrastructure, internet connectivity, digital literacy, technological skills, and institutional support (Robinson, L.,et.al., 2020; Rydzewski, P. 2025; Raihan, M. M., et.,al 2025). These inequalities are particularly evident in developing economies, where socio-cultural norms, family expectations, and resource constraints continue to influence technology adoption among women entrepreneurs (Hilbert, 2011; OECD, 2021). Recent evidence also indicates that although digital platforms have lowered several barriers to entrepreneurship, women entrepreneurs operating in informal and resource-constrained settings continue to experience challenges related to digital capabilities, platform access, and socio-cultural acceptance.

From a theoretical perspective, the Technology Acceptance Model (TAM) has been widely applied to explain individuals' adoption of digital technologies based on perceived usefulness and perceived ease of use (Davis, 1989; Taherdoost, H. 2018; Granić, A. 2023; Badda, A. 2025). While TAM provides a robust explanation of technology acceptance, it pays relatively limited attention to broader contextual influences that shape technology adoption in entrepreneurial environments (Putro, A. K., & Takahashi, Y. 2024; Rahimi, R. A., & Oh, G. S. 2025; Redondo-Rodríguez, M. D., et.al., 2026). For women entrepreneurs, decisions regarding digital technology adoption are influenced not only by perceptions of technological usefulness but also by digital literacy, infrastructure availability, institutional support, family expectations, and prevailing gender norms (Orser, B., et.al., 2019; Khoo, C., et.al., 2024) Consequently, relying exclusively on TAM may not fully explain how women entrepreneurs engage with digital technologies within diverse socio-economic contexts.

Although research on digital entrepreneurship has expanded considerably, an important explanatory problem remains unresolved. Existing studies have demonstrated that digital technologies can improve operational efficiency, customer engagement, market access and entrepreneurial flexibility. However, access to digital technologies does not necessarily ensure that entrepreneurs can use them meaningfully or convert them into sustained business outcomes. Women entrepreneurs may use smartphones, digital-payment systems and social-media platforms while continuing to experience limitations associated with connectivity, digital competence, affordability, institutional support and socio-cultural expectations.

This distinction between digital access and the capability to derive business value from digital technologies is particularly important in emerging economies. Technology-adoption research has largely concentrated on the factors influencing acceptance, behavioural intention or initial use. Such approaches provide valuable explanations of why individuals adopt technologies but offer comparatively limited understanding of what happens after adoption. In particular, insufficient attention has been given to how women entrepreneurs integrate digital technologies into everyday business practices, develop the capabilities required to use them strategically and negotiate the

social and infrastructural conditions that shape their use. The link between digitalisation and women's entrepreneurial agency is also not fully comprehended. Digital technologies can enable transactional processes, build customer relationships and help grow markets, but can have a wider impact on operational performance. Digital technologies can provide women with the potential of financial autonomy, confidence and entrepreneurial agency by making them more self-reliant in making payments, communicating directly with customers and controlling business decisions.

However, these benefits may not be fully achieved across the board, due to the embeddedness of women's capabilities in family relations, local infrastructure, institutional settings and gender norms. These are particularly relevant in the North Indian context of metropolitan and semi-urban entrepreneurial ecosystems where there is a significant variation in the availability of digital infrastructure and business support and technological capabilities. Women-owned businesses in such contexts can face a variety of technological opportunities and contextual constraints. These experiences can then be used to better understand the process of translating digital access to meaningful entrepreneurial outcomes in the context of digital inclusion inequality. Based on this, the main conclusion of this study is that having access to digital technologies does not given a sustainable entrepreneurial outcome. Digital technologies offer opportunities for women entrepreneurs to enhance transaction management, gain access to geographically remote consumers, enhance financial control and gain greater independence in business decision making. The potential of these opportunities to translate into viable and enduring business opportunities, however, does rely on the digital skills of the entrepreneurs and the infrastructure, institutional and socio-cultural environments where their businesses operate.

This research aims to investigate the integration of digital technologies in everyday work practices of women entrepreneurs in North India and how they translate the access to digital technologies into operational capabilities, participation in markets, entrepreneurial agency and sustainable business results. This study also investigates the role of infrastructural restrictions, institutional support, digital competence and socio-cultural contexts as facilitators or barriers of this process.

The study addresses the following research questions:

RQ1: How do women entrepreneurs integrate digital technologies into the everyday operational and market practices of their enterprises?

RQ2: How does the use of digital technologies shape women entrepreneurs' business capabilities, financial control and entrepreneurial agency?

RQ3: How do infrastructural, institutional and socio-cultural conditions enable or constrain the conversion of digital access into sustainable business outcomes?

This study has three contributions. First, it moves away from the focus on access and first use of technologies towards the process of women entrepreneurs using digital technologies to become effective business users. Second, it looks at outcome of operations and entrepreneurial agency side

by side, and how digitalisation can affect transaction management, customer relationships, financial control, confidence and decision-making autonomy. Third, it illustrates the contextual constraints of only being able to conceptualize digital entrepreneurship with regards to individual perceptions of usefulness and ease of use. The study contributes to the understanding of digital entrepreneurship in women-led businesses in emerging economies, by focusing on the characteristics of connectivity, digital competence, institutional support and socio-cultural support.

2. Literature Review

The digital transformation has revolutionized entrepreneurship by providing them with the opportunity to use new technologies, optimize operations, and reach new markets. Digital technologies offer opportunities for women entrepreneurs to mitigate traditional constraints on access to finance, access to markets and business management and contribute to the long term sustainability of their businesses. As a result, in the last decade or so, various studies have been conducted concerning digital entrepreneurship, women entrepreneurship and business sustainability. The literature, however, is disjointed, especially when it comes to the lived reality of and the use of digital technologies by female entrepreneurs in emerging economies. To build the theoretical underpinning of the present study, this literature review critically analyzes the literature on digital transformation and entrepreneurship, digital technologies and women entrepreneurship, business sustainability, the Technology Acceptance Model (TAM) and digital inclusion. The review ends by establishing the research gap and the rationale for the current qualitative study.

2.1 Digital Transformation and Entrepreneurship

Digital transformation has radically transformed the entrepreneurial ecosystem, transforming the way businesses create value, engage with customers and compete in increasingly digital markets. Digital technologies are no longer just instruments for doing work; they are strategic resources that can help the entrepreneur innovate, become more efficient and create new business models. Cloud computing, mobile technologies, social media, digital payment and ecommerce have helped reduce barriers to entry for new businesses and enabled small businesses to challenge their traditional geographical boundaries (Nambisan, 2017; Autio et al., 2018; Elia et al., 2020). Digital transformation is especially crucial for micro, small and medium enterprises (MSMEs), as they typically have limited financial and human resources. Digital technologies can help MSMEs automate repetitive business tasks, cut transaction expenses, enhance customer interactions and make better decisions using real-time data. Past research indicates that MSMEs that are more digital tend to be more responsive to market shifts and more likely to create novel products and services than those with a more traditional business approach (Sahut et al., 2021; OECD, 2021).

Recent studies also have suggested that digital transformation should be considered as an ongoing organisational competence and not as an individual technology. To enhance competitiveness and future sustainability, entrepreneurs are increasingly using a range of digital tools, such as digital

payment systems, social media marketing, customer relationship management applications and e-commerce platforms, to set up an ecosystem of their businesses. In this context, digital technologies have a role in business development, both in the short term, by augmenting operational efficiency, and in the long term, by facilitating sustainable business development by creating greater market responsiveness, customer engagement, and organisational learning (Nambisan et al., 2019).

The benefits of the digital transformation are not the same for all businesses and are not evenly shared. The challenge of financial resources, digital infrastructure, technical expertise and organisational readiness are common bottlenecks for MSMEs. In developing economies, these challenges can be more pronounced as there is varying institutional support and digital infrastructure throughout the country. Successful digital transformation, therefore, requires not only the availability of digital technologies but also on a wider segment of the entrepreneurial ecosystem that enables the effective adoption and utilization of digital technologies.

2.2 Digital Technologies and Women Entrepreneurship

The study of women entrepreneurship has been increasingly gaining academic focus due to its role in economic development, jobs creation, innovation and social inclusion. Women entrepreneurs are contributing towards household income, employment generation in the local area & national economic development. However, women entrepreneurs face an open challenge in the form of structural barriers which hinder their entrepreneurial capacity. These barriers are often faced by entrepreneurs, such as lack of financial resources, lack of business networks, lack of mobility, institutional discrimination and the continued existence of gender stereotypes that impact entrepreneurial decision making and business performance (Jennings & Brush, 2013; Minniti & Naudé, 2010; Franzke et al., 2022).

Technologies are increasingly important vehicles for overcoming many of these barriers, particularly digital technologies. Women entrepreneurs can use digital payment systems, e-commerce platforms, social media applications, mobile business solutions, and cloud-based technologies to run businesses that are more flexible, efficient, and accessible, allowing them to reach a broader audience and enhance their overall business operations. Unlike traditional business models, which rely on physical facilities and geographical proximity, digital platforms allow women entrepreneurs to directly engage with customers, market products online, conduct financial transactions digitally, and join larger entrepreneurial networks (Nambisan, 2017; Sahut et al., 2021). There are several studies which have shown that women's entrepreneurial empowerment with the use of digital technologies leads to improvement in financial independence, better customer engagement, better business visibility and innovation opportunities. Besides this, digital platforms also provide women entrepreneurs greater temporal and spatial flexibility to pursue entrepreneurial activities along with family responsibilities (Gochhait, S., et.al., 2025; Sowmya, B., & Pai, R.). 2025). Digital entrepreneurship, therefore, is now seen not just as a way to enhance

business performance but as a way to contribute to women's economic empowerment and social inclusion, as well (Suseno, Y., & Abbott, L.). 2021; Rizvi, S. A. A., et.al., 2025; Kar, P., et.al., 2025).

In spite of these opportunities, one could argue in recent literature that digital technologies are not enough to solve structural inequalities that are faced by women entrepreneurs (Martinez Dy, A., et.al., 2018; Dy, A. M., et.al., 2025). Digital access does not equate with digital participation and/or business growth (Dezuanni, M., et.al., 2017; Enriquez, R., et.al., 2025). Digital literacy, affordability of digital technologies, accessibility of the Internet, online safety, institutional support, and socio-cultural expectations remain important issues that women entrepreneurs face (Khoo, C., et.al., 2024). The limitations are especially significant in developing countries where gender norms and resource constraints persist and continue to shape entrepreneurship behaviour (Emon, M. M. H. & Nipa, M. N. 2024). Recent systematic reviews thus suggest to look at digital entrepreneurship as part of a larger digital inclusion perspective, and not just as technology adoption. Yet another key insight gained from recent scholarship is that the research about women and digital entrepreneurship is scattered (Alhajri, A., & Aloud, M.). 2024; Deng, W., et.al., 2025). The existing literature has focused on digital marketing, financial technologies, platform entrepreneurship and technology adoption separately, and there is limited research that has tried to synthesize these points to build an understanding of the experiences of women entrepreneurs. (Nuraisyiah, Azis, M., & Hasan, M.) 2025; Salamzadeh, A., et.al., 2026; Portuguese-Castro, M., & Ramirez-Lozano, J. P. 2026). Moreover, most of the empirical studies use a quantitative survey design that will be able to determine the determinants of technology use, but will not be able to provide insights into how women entrepreneurs interpret, negotiate, and incorporate digital technologies in their daily work. (Annu, Kashyap, A. K., et.al., 2026). Qualitative evidence regarding the interaction between digital technologies, entrepreneurial agency, and business sustainability is still rather limited, especially when it comes to emerging economies.

The Indian context is particularly relevant in terms of extending this literature. While the policy initiatives like Digital India, growth of Unified Payments Interface (UPI) and the mushrooming of smartphone usage has helped create a momentum in digital adoption among MSMEs, there are still significant regional disparities in digital infrastructure, digital competency and institutional support. The technology opportunities as well as the socio-cultural barriers faced by women-led MSMEs in semi-urban areas are special and less reflected in the existing international literature. These experiences are hence critical indicators of the role digital technologies play in enhancing entrepreneurial empowerment and sustainable business development in resource-limited environments. Overall, the body of work is proof that digital technologies have significant potential to contribute to the transformation of women entrepreneurship. However, existing knowledge is still disjointed on how women entrepreneurs connect digital technologies to their daily business operations and how they deal with contextual challenges of the digital world, such as social-cultural expectations, infrastructure and digital inclusion. To fill this gap, more

qualitative evidence that explains the impact of digital technologies not only on the adoption of digital technologies, but also on entrepreneurial empowerment and business sustainability is needed. To address this need, this study aims to delve into the lived experiences of women entrepreneurs in the context of MSMEs in North India. Today, sustainability is an important goal for business and organisations are increasingly aiming to deliver positive social and environmental value alongside economic performance over time (Hart, S. L., & Milstein, M. B. 2003; Laszlo, C. 2013; Camilleri, M. A. 2017). Business sustainability, in the entrepreneurial context, is not just about achieving financial survival, but also involves the capacity of businesses to stay competitive, adjust to changes in their environment, reinforce relationships with stakeholders and create long-term value for society (DiBella, J., et.al., 2023; Christodoulou, I. P., et.al., 2025). However, sustainability is a critical issue for micro, small and medium enterprises (MSMEs) as they tend to be more susceptible to market uncertainty and external shocks (Eggers, F.). 2020; Naradda Gamage, S. K., et.al., 2020). As a result, the capacity to incorporate novel technologies into the business is now one of the key factors that influence the sustainable growth of entrepreneurship (Carayannis, E. G., et.al., 2026). Operational efficiency, innovation, cost reduction and data-driven decision making are just some of the ways in which digital technologies have emerged as important enablers of sustainable business models (Martínez-Peláez, R., et.al., 2023; Florek-Paszkowska, A. & Ujwary-Gil, A.). (2025). The adoption of digital payment systems, cloud computing, artificial intelligence, e-commerce, social media marketing, and business analytics allows businesses to better manage resources and reach customers while enhancing their resilience (Hokmabadi, H., et.al., 2024). Digital technologies are not only being used as operational tools but are increasingly becoming strategic assets to enable ongoing sustainable value creation through constant innovation and better stakeholder engagement (Martínez-Peláez, R., et.al., 2023).

New research indicates that digital transformation has a variety of ways to improve sustainability (Florek-Paszkowska, A. & Ujwary-Gil, A.). 2025). In the first place digital technologies facilitates economic sustainability by boosting productivity, reducing operating expenses, making the financial situation more transparent and opening up new regional and international markets (Dahlman, C., Mealy, S., & Wermelinger, M.). 2016). Secondly, digital platforms play a role in bolstering social sustainability by enhancing customer relationships, advancing financial inclusion, enabling knowledge sharing and providing opportunities for the creation of entrepreneurship among disadvantaged groups (Salampasis, D., & Mention, A. L.). 2018; Nyamboga, T. O. 2026).

Thirdly, digital innovations can help create environmental sustainability by cutting down on paper-based transactions, optimizing logistics, and enabling virtual business operations, and improving resource efficiency (Saqib, Z. A., & Qin, L. 2024; Saqib, Z. A., & Qin, L. 2024; Šateikiene, D., & Kovalevskaja, J. 2026; Pereira, E. T., et.al., 2026). These multidimensional benefits demonstrate that digital transformation has become an important pathway through which MSMEs pursue long-term sustainable growth.

Digital technologies provide sustainability gains not just by enhancing business performance, but also in other ways that are relevant to women entrepreneurs (Salamzadeh, A., et.al., 2024; Salamzadeh, A., et.al., 2026). Digital platforms can help women-led businesses counteract mobility limitations, enhance the financial autonomy of women entrepreneurs, expand customer base, and increase access to entrepreneurial ecosystems (Ahmed, H., et.al., 2026). Modern information and communication technologies such as social media, digital financial services and e-commerce enable women entrepreneurs to engage more actively in formal economic activities while carrying out their businesses and family duties. Therefore, digital transformation is not only crucial for the sustainability of businesses, but it is also important for the empowerment of entrepreneurs, financial independence, and social inclusion.

However, the link between digital transformation and business sustainability is still complicated. Digital technologies can only be successfully integrated if there are a number of contextual factors such as digital literacy, managerial capability, organizational readiness, technological infrastructure and institutional support. Research shows that not all companies using digital technologies can ensure sustainable results, and that sustainability gains can be achieved by adopting technologies together with the right managerial skills, strategic focus and enabling entrepreneurial contexts. Correspondingly, management digital literacy has been found to be a key factor in the success of SMEs in the structural implementation of technological investments and creating sustainable organizational performance.

Although there is increasing volume of literature connecting sustainable business development and digital transformation, there are few limitations. Most of the current research focusses on organisational or technological aspects of sustainability and very little attention is paid to the experience of women entrepreneurs on sustainability in the context of digital transformation. Moreover, there has been limited research to understand the impact of digital technologies on economic resilience, entrepreneurial autonomy, and sustainability of businesses in the long term of MSMEs businessmen and women in different regional settings, with quantitative studies dominating the existing literature. To overcome these, there is a need for qualitative evidence that could provide an explanation for a lived experience in which digital technologies affect sustainable entrepreneurship. This study makes a contribution to this growing field by exploring the perspectives and practices of women entrepreneurs in North India who are using digital technologies to enhance their business sustainability while facing contextual challenges of infrastructure, digital skills and socio-cultural norms.

The fast development of digital technologies has led to a considerable volume of research investigating factors that affect the adoption of technologies in entrepreneurial and organizational contexts (Molinillo, S., & Japutra, A. 2017). In the last 30 years, several theories have emerged to account for individuals' and organizations' choices of adopting and using new technology (Yadegari, M., Mohammadi, S., & Masoumi, A. H.). 2024). . The most common models are the

Technology Acceptance Model (TAM), Diffusion of Innovation (DOI) Theory, the Unified Theory of Acceptance and Use of Technology (UTAUT), and the Technology Organization Environment (TOE) framework. While these theories have contributed greatly to research in the field of technology adoption, they have different focuses on technology adoption behaviour and conceptual drawbacks in the context of women entrepreneurship.

One of the most relevant models that has been proposed to explain technology adoption is the technology acceptance model (TAM) proposed by (Davis, 1989). TAM suggests that two cognitive beliefs namely perceived usefulness (PU) and perceived ease of use (PEOU) dominate users' behavioural intention to accept a technology. Perceived usefulness is defined as an individual's expectation that the use of a technology will improve task performance, and perceived ease of use is defined as the ease of task performance if the technology is used. The simplicity of its design and its high predictive power makes it applicable to numerous studies on digital payment systems, e-commerce adoption, social media marketing and digital entrepreneurship. Studies in recent years have still validated the role of perceived usefulness and ease of use as key factors in entrepreneurs' and small business' decisions to adopt digital technologies.

TAM has received criticism for being largely based on cognitive perceptions of the individual, with relatively little attention paid to the wider context (Davies, R., & Harty, C. 2013; Badda, A. 2025). Besides usefulness and ease of use, other factors that can influence the adoption of technology among entrepreneurs should be considered, such as institutional support, digital infrastructure, financial resources, cultural norms, and social relationships (Díaz-Arancibia, J., et.al., 2024). The contextual factors are especially significant for women entrepreneurs working in developing economies where entrepreneurial activities are often pursued in situations of resource scarcity and gender-specific institutional disadvantage. It might therefore be misleading to assume that using TAM alone is enough to take into consideration the complicated process by which women entrepreneurs adopt and use digital technologies in their businesses.

Technology adoption is a social process and the Diffusion of Innovation (DOI) Theory (Rogers, 2003) provides an explanation for the spread of the technology over time, among individuals and organizations. According to the theory proposed by DOI, the adoption decision is affected by five characteristics of innovation: relative advantage, compatibility, complexity, trialability, and observability. Whereas, DOI explicitly acknowledges the roles of communication channels, peer influence and social systems in technology diffusion process. However, DOI makes explicit the roles of communication channels, peer influence and social systems in the process of technology diffusion. The application of DOI has been used to explore the adoption of digital innovations in entrepreneurial ecosystems in previous studies, with success. Yet, DOI very much presupposes that opportunities to access innovations are similar across potential adopters, offering few accounts of structural inequalities related to gender, digital literacy or institutional support. These



constraints limit its scope to capture the experience of women entrepreneurs in unequal socio-economic circumstances.

The Unified Theory of Acceptance and Use of Technology (UTAUT) builds on previous technology adoption models and incorporates elements of eight well-known behavioural theories. Based on the theoretical work of Venkatesh et al., (2003), UTAUT posits that performance expectancy, effort expectancy, social influence, and facilitating conditions have a direct relationship with technology usage behaviour. UTAUT has a more general explanation of the reasons for using IT, as it includes the social environments and organisational support. As a result, a large number of research studies that have investigated digital entrepreneurship, electronic commerce, and mobile technology adoption have also utilized UTAUT. Yet despite the inclusion of social influence and facilitating conditions, UTAUT still focuses on individual technology acceptance, and offers only moderate attention to the wider entrepreneurial ecosystems, institutional contexts and gendered socio-cultural contexts which influence women's entrepreneurial experiences.

An alternative organizational view is offered by the Technology–Organization–Environment (TOE) framework which proposes that technology adoption is determined by the characteristics of the technology, organizational readiness and external environmental characteristics (Tornatzky & Fleischer, 1990). In the context of MSMEs, TOE has been used extensively to capture the notion of digital transformation by capturing the importance of managerial capability, availability of resources, competitive pressure, government support and technological infrastructure. TOE, however, mainly explains choices in adoption of the organisations and provides relatively little insight into the behavioural and psychological processes that affect an individual entrepreneur's technology acceptance. An assessment of these theories shows that none of these theories adequately explains digital technology adoption by the women entrepreneurs. These theories complement each other: TAM provides an explanation of individual cognitive assessment of the digital technologies, DOI focuses on the diffusion of innovations in social systems, UTAUT incorporates social influence and facilitating conditions, while TOE points to readiness of the organisation and the environment. But none of these theories can explain the phenomenon in its entirety. More recent studies on digital entrepreneurship also find the current body of research on technology adoption to be of a theoretical nature that is somewhat disjointed and needs more contextual, organisational and behavioural lenses to be included.

Therefore, the present study uses the Technology Acceptance Model (TAM) as the main theoretical framework as it has already been used to explain the attitudes of women entrepreneurs towards the digital technologies evaluated based on their perceived usefulness and ease of use. Concurrently, to acknowledge the restrictions of TAM, the study also includes digital inclusion as a supplementary approach to identify contextual factors that can relate to digital literacy, infrastructure availability, institutional support and socio-cultural factors. Combining these

viewpoints can help develop a holistic understanding of the uptake of digital technologies by women entrepreneurs and the role of these technologies in promoting entrepreneurial empowerment and business sustainability in women-led MSMEs in North India.

Table 1. Comparison of Major Technology Adoption Theories

Theory	Key Constructs	Strengths	Limitations	Relevance to the Present Study
Technology Acceptance Model (TAM) (Davis, 1989)	Perceived usefulness, perceived ease of use	Simple, widely validated, explains individual technology adoption behaviour	Focuses primarily on individual perceptions and gives limited attention to contextual and environmental influences	Provides the primary theoretical foundation for understanding how women entrepreneurs perceive and adopt digital technologies in their businesses.
Diffusion of Innovation (DOI) (Rogers, 2003)	Relative advantage, compatibility, complexity, trialability, observability	Explains how innovations spread through social systems and over time	Places less emphasis on individual behavioural intentions and organisational context	Helps explain how digital technologies diffuse among women entrepreneurs and MSMEs.
Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003)	Performance expectancy, effort expectancy, social influence, facilitating conditions	Integrates several technology adoption theories and includes social and facilitating factors	Complex model requiring multiple constructs and moderators; developed largely in organisational settings	Highlights the influence of social support and facilitating conditions relevant to women entrepreneurs' digital technology adoption.

Technology– Organization– Environment (TOE) (Tornatzky & Fleischer, 1990)	Technological context, organisational context, environmental context	Explains technology adoption at the organisational level by considering internal and external environments	Focuses on organisational adoption rather than individual decision-making	Supports understanding of how infrastructure, institutional support, and environmental conditions influence digital technology adoption among MSMEs.
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Source: Developed by the authors based on Davis (1989), Rogers (2003), Tornatzky and Fleischer (1990), and Venkatesh et al. (2003).

Table 1 summarises the major technology adoption theories frequently applied in entrepreneurship and information systems research. Although each framework provides valuable insights into technology adoption, the Technology Acceptance Model (TAM) was selected as the principal theoretical foundation for this study because of its ability to explain individual technology adoption through perceived usefulness and perceived ease of use. However, given the qualitative nature of this research and the contextual realities of women-led MSMEs in North India, the study also recognises that technology adoption is influenced by broader dimensions of digital inclusion, including digital infrastructure, digital capabilities, institutional support, and socio-cultural factors. Consequently, the present study adopts TAM as its primary theoretical lens while drawing on complementary insights from DOI, UTAUT, and TOE to provide a more comprehensive understanding of digital technology adoption among women entrepreneurs.

2.3 Research Gap and Conceptual Positioning

Previous studies have shown that digital technologies have emerged as enablers to address the challenges of entrepreneurial development, such as enhancing operational efficiency, enabling innovation and increasing market access for MSMEs. Digital platforms, digital payment systems, e-commerce and social media have also been noted as tools that boost entrepreneurial performance and foster women's economic inclusion, as found in previous research. However, careful analysis of literature shows that there are some issues which are yet to be resolved and which are still hindering the understanding of digital technology adoption among the women entrepreneurs. First, from a methodological point of view, the literature is still dominated by the quantitative research designs. Most of the empirical work is based on questionnaires and statistical modelling of the determinants of technology adoption, entrepreneurial intention or business performance. While



these studies give insights into relationships between variables, they give only limited insights into women entrepreneurs' direct experiences of digital transformation in their daily business practices. Thus, there is a lack of qualitative evidence that would help explain how women make sense of, negotiate, and incorporate digital technologies into their entrepreneurial careers (Jennings & Brush, 2013; Paul et al., 2023). Second, there is a theoretical fragmentation in the existing technology adoption research. It is evident that the Technology Acceptance Model (TAM), Diffusion of Innovation (DOI) Theory, the UTAUT and the Technology–Organization–Environment (TOE) framework have all made significant contributions to the understanding of the adoption of digital technologies. Most of these models, however, look at adoption behaviour, organisational or technological aspects in isolation. Few studies have brought these perspectives together to investigate the relationship between individual perceptions and contextual factors like access to digital infrastructure, institutional support and socio-cultural norms and expectations. This restriction is especially applicable in women entrepreneurs situated in resource poor entrepreneurial ecosystems. Thirdly, the linkage between digital transformation and business sustainability in women-led MSMEs is still under-researched. Existing literature focuses mainly on the operational efficiency, innovation capability, or business performance of digital technologies and relatively few have addressed the role digital technologies play in creating the long-term sustainability of women's businesses. Entrepreneurial resilience, continuous innovation, customer relationships, social inclusion and the ability to adapt to different business contexts are all factors that make up business sustainability besides the financial aspect. Therefore, more qualitative work is needed to gain insights into women entrepreneurs' perceptions of the role of digital technologies in their sustainable business development. Next, there are significant limitations in the current literature. Much of the evidence available comes from developed economies or metropolitan entrepreneurial ecosystems and conditions there vary considerably from what is found in many emerging economies. The entrepreneurial landscape is differentiated from state to state in India in terms of infrastructure, digital readiness, institutional support, etc., and what is expected of them in terms of socio-cultural aspects. Women entrepreneurs in semi-urban areas may face a set of barriers and opportunities that are not explored in the international literature. Last, the last few years have seen a series of systematic reviews that identify a gap for more in-depth and rich qualitative evidence to explain women's realities of digital entrepreneurship. While digital technologies have increasingly been acknowledged as means to improve financial inclusion, entrepreneurial empowerment and business growth, relatively little is known about the processes by which women entrepreneurs take up, adapt, and continued to use digital technologies across different regional contexts. To design policies and entrepreneurial support mechanisms that enable inclusive digital transformation, it is important to understand these experiences. To overcome such lacunae, the present study will take a qualitative research method with semi-structured interviews with the women entrepreneurs of MSMEs in the cities of Delhi, Uttar Pradesh, Haryana, Punjab and Rajasthan. Taking a Technology Acceptance Model (TAM)

and Digital Inclusion lens, this study explores the impact of digital technologies on business operations, market expansion, entrepreneurial autonomy and business sustainability and sees the contextual challenges that remain to hinder technology adoption for women entrepreneurs. This study is different from the previous studies where the focus was on the adoption of digital technologies and is aimed at explaining how and why digital technologies can contribute to sustainable women entrepreneurship in various entrepreneurial environments. The study uses a qualitative approach to integrating a behavioral and contextual framework and therefore adds to the understanding of digital entrepreneurship in emerging economies.

To further clarify the contribution of this research, Table 2 summarizes how the present study differs from previous literature.

Table 2. Novelty of the Present Study

Research Aspect	Previous Studies	Present Study
Research design	Predominantly quantitative	Qualitative thematic analysis
Study participants	Mixed entrepreneurs	Women-led MSMEs
Geographical focus	Mainly developed countries or metropolitan areas	North India (Delhi, Uttar Pradesh, Haryana, Punjab and Rajasthan)
Theoretical perspective	TAM, DOI, UTAUT or TOE individually	TAM integrated with Digital Inclusion
Outcome	Technology adoption or performance	Sustainable women entrepreneurship
Contribution	Variable relationships	Rich explanation of lived entrepreneurial experiences

3. Methodology

3.1 Research Design

The research design of the study was qualitative research and the study was conducted to understand the impact of digital technologies on sustainable entrepreneurship of women entrepreneurs in micro, small and medium enterprises (MSMEs) in North India. A qualitative approach was deemed appropriate as a study that aimed to gain an understanding of participants' experiences, perceptions and interpretations of digital technology adoption in their daily work. Qualitative research methods are used to explore complex social phenomena in depth and provide an understanding of the meaning given to experiences by those undergoing them, as opposed to

quantitative methods that tend to focus on the relationships between pre-defined variables (Creswell & Poth, 2018). Thematic analysis, using the six-phase approach presented by Braun and Clarke (2006), was used in this study. Thematic analysis was chosen due to its systematic, yet flexible nature of identifying, analysing and interpreting patterns from qualitative data. This approach is especially suitable for exploratory research with the goal of gaining a deep understanding of the experiences participants are living in their local context, and not to test a priori formulated research questions. Thematic analysis was used to identify patterns in the present study that emerged from the themes of digital empowerment, market expansion, entrepreneurial autonomy and challenges to digital technology adoption among women entrepreneurs. The study took a 'interpretivist' approach to understanding the research process, assuming that the experiences of digital transformation were socially constructed and that the individual business environment, socio-cultural environment, and entrepreneurial journey of the participants all shaped their experiences. In this context, the goal of the study was not to determine universal causal relationships but to gain an understanding of the opportunities and problem women entrepreneurs see and understand in their enterprise with digital technologies.

3.2 Participant Selection

The non-probability sampling of purposive sampling was used to select participants, as it is often done in qualitative research to identify information-rich cases that can provide detailed information about the phenomenon studied (Patton, 2015). Purposive sampling was deemed suitable as it was not important that the sample be statistically representative, but rather, that it provide the researcher with an in-depth understanding of the women entrepreneurs' experience and use of digital technologies in running their businesses. The sampling strategy facilitated the selection of participants with direct experiences of the adoption of digital technology in the context of women led MSMEs.

Four criteria had to be met to enter the study. First, they were required to be female businesses owners in registered or unregistered micro, small and medium enterprise (MSME). Second, they had to be involved in the daily business operations and in strategic decision making of their enterprises. Third, participants should have had experience in using one or more digital technologies in their business operations (such as digital payment systems, social media platforms, ecommerce marketplaces, mobile business applications, or other digital business tools). Lastly, the participants had to agree to participate in the interview on a voluntary basis and had to give informed consent for the interview.

Twenty-five women entrepreneurs were involved in this study. The participants came from various industries such as retail, handicraft, food processing, food services, fashion, home based business, consulting services, education services and beauty products. They were selected from five states of North India, namely Delhi, Uttar Pradesh, Haryana, Punjab and Rajasthan in both urban and semi-urban entrepreneurial environment. The geographical and sectoral dispersion allowed the

study to reflect the diversity of entrepreneurial experiences; and the variation in digital infrastructure, market conditions and socio-cultural contexts.

Table 3. Demographic and Business Profile of the Participants

Participant	State	Business Sector	Enterprise Type	Business Location	Primary Digital Technologies Used
P1	Delhi	Retail	Micro	Urban	UPI, Instagram
P2	Uttar Pradesh	Food Processing	Micro	Semi-urban	WhatsApp Business, UPI
P3	Haryana	Handicrafts	Micro	Semi-urban	Facebook, E-commerce
P4	Punjab	Services	Small	Urban	UPI, Mobile Applications
P5	Delhi	Retail	Micro	Urban	Instagram, UPI
P6	Uttar Pradesh	Food Services	Micro	Semi-urban	WhatsApp Business
P7	Haryana	Retail	Micro	Urban	Facebook
P8	Punjab	Services	Small	Urban	UPI
P9	Delhi	Handicrafts	Micro	Urban	E-commerce Platforms
P10	Uttar Pradesh	Retail	Micro	Semi-urban	Instagram
P11	Rajasthan	Handicrafts	Micro	Semi-urban	Instagram, UPI
P12	Haryana	Fashion Boutique	Small	Urban	Facebook, WhatsApp Business
P13	Punjab	Food Processing	Small	Urban	UPI, E-commerce

P14	Rajasthan	Handicrafts	Micro	Semi-urban	Instagram, Facebook
P15	Delhi	Home-based Business	Micro	Urban	WhatsApp Business
P16	Haryana	Retail	Small	Urban	UPI, Mobile Applications
P17	Punjab	Education Services	Small	Urban	Social Media Platforms
P18	Rajasthan	Fashion Accessories	Micro	Semi-urban	Instagram, E-commerce
P19	Delhi	Food Services	Micro	Urban	UPI, WhatsApp Business
P20	Haryana	Beauty Products	Small	Urban	Facebook, Instagram
P21	Punjab	Retail	Small	Urban	UPI, E-commerce
P22	Uttar Pradesh	Handicrafts	Micro	Semi-urban	WhatsApp Business, Facebook
P23	Rajasthan	Consulting Services	Small	Urban	LinkedIn, UPI
P24	Haryana	Home Décor	Small	Urban	Instagram, E-commerce
P25	Rajasthan	Food & Beverage	Micro	Semi-urban	UPI, WhatsApp Business

Source: Developed by the authors based on interview data.

The participants included a cross-section of women-led MSMEs from various sectors and across various locations as seen in Table 3. This diversity contributed to enriching the data by documenting different experiences of digital technology use depending on different entrepreneurial and socio-economic contexts. Sampling was continued until data saturation was reached. Data saturation occurs when the number of interviews is adequate to produce new concepts, themes and insights that are substantial in relation to the research objectives, and further interviews will not add significantly to this (Saunders et al., 2018). In the latter phases of data

collection, the participants consistently reported similar experiences with digital payments, social media marketing, market expansion, entrepreneurial autonomy and factors that hinder the adoption of technology. No new themes came up, so the researchers decided that the number of participants was sufficient for the purpose of the study.

3.3 Data Analysis

Data from the interviews were analysed reflexively, in accordance with the six phase reflexive thematic analysis proposed by Braun and Clarke (2006). This method was chosen as it offers a systematic approach to pattern analysis and identification of patterns in qualitative data with flexibility and also maintains the researcher in close contact with the experience of the participants. It was believed that thematic analysis was particularly suitable for the present case study as the aim of the study was to understand the experience of the women entrepreneurs with the adoption of digital technologies in managing and sustaining their business without prior assumptions. Data analysis began as soon as the interviews were completed. The audio recordings were transcribed verbatim and the interviews were done in Hindi and Punjabi and translated into English, with care taken to ensure that the meaning and context of the responses were preserved. After each transcript was read several times along with the field notes, the researchers familiarized themselves with the data to start coding. This phase allowed the researchers to identify patterns, recurring ideas and meaningful expressions that could capture the participants experience of the adoption of digital technology.

It was decided to use a manual coding process in order to remain closely attuned to the data and to allow the process to be iterative so as to interpret the evidence in a way that each participant would agree with, understanding the narrative of the participants. Transcripts were analysed systematically and meaningful codes were created from identifying digital technology use, business operations, customer engagement, entrepreneurial decision making and challenges of technology use. These codes were then clustered into larger groups on a conceptual basis. After preliminary coding, categories that were related were compared across all transcripts to look for patterns and initial themes. Themes were continually refined as codes were matched to the full data-set to be sure that each theme reflected some of the participants' experiences and was not identical to another theme. Through this iterative process, four broad themes emerged: (1) Digital Empowerment of Business Operations, (2) Market Expansion through Digital Platforms, (3) Entrepreneurial Autonomy, and (4) Persistent Barriers to Digital Technology Adoption.

The researchers regularly returned to the transcripts to confirm consistency of interpretation, and to ensure that the themes were grounded in participants' narratives throughout the analysis. Quotations were selected to be representative of each theme to capture the voice of the participants. Verbatim quotations also helped clarify the analytical process by providing a means for readers to assess the relationship between the data and the researchers' interpretations. The six phases of thematic analysis adopted in the study are summarised in Table 4.

Table 4. Phases of Reflexive Thematic Analysis

Phase	Description
Phase 1	Familiarisation with the data through repeated reading of interview transcripts and field notes.
Phase 2	Generation of initial codes by identifying meaningful segments of text related to digital technology adoption and entrepreneurial experiences.
Phase 3	Grouping similar codes into broader categories and identifying preliminary themes.
Phase 4	Reviewing and refining themes by comparing coded extracts with the complete dataset to ensure coherence and distinctiveness.
Phase 5	Defining and naming the final themes to accurately reflect participants' experiences.
Phase 6	Producing the final report by integrating thematic interpretations with representative participant quotations and existing literature.

Source: Adapted from Braun and Clarke (2006).

3.4 Research Quality and Trustworthiness

For the purpose of providing rigour and trustworthiness to the study, the criteria proposed by Lincoln and Guba (1985) namely credibility, transferability, dependability and confirmability were adhered to throughout the research process. A variety of criteria have been used to determine the quality of qualitative research and to assess whether conclusions drawn from qualitative studies accurately reflect participants' experiences or the assumptions of the researchers.

3.4.1 Credibility

Credibility is an assessment of how well the results reflect the participants' perspectives (Lincoln & Guba, 1985). Several steps were taken to improve the credibility. Firstly, semi-structured interviews allowed the participants to talk in detail and the researchers could ask questions for clarification when required. Second, interviews were carried out with women entrepreneurs from various business sectors and geographical locations of North India which were diverse in terms of their views. In third place, representative quotations by participants were included in the findings to illustrate the relation between the findings of the interview and the themes found in the analysis. These procedures helped to enhance the authenticity and credibility of the findings.

3.4.2 Transferability

Transferability is how well the results of the study can be transferred to other situations that are similar in characteristics. Qualitative research does not seek to make statistical generalisations, but rather offers rich descriptions in context so that the reader can decide about the transferability of the findings to similar contexts (Lincoln & Guba, 1985). In this study, detailed information on the research context, participant selection, MSMEs business sectors, geographical coverage, and data collection procedures are included to help readers determine if the results of the study can be applied to other women-led MSMEs that function in a similar socio-economic environment.

3.4.2 Dependability

Dependability is a dimension of the trustworthiness of the research process that refers to consistency and transparency. The study was conducted using a well-designed research process with regard to the selection of participants, the process of interviews, transcription, coding and thematic analysis, which were clearly documented to ensure the dependability of the study. Braun and Clarke's (2006) six-phase thematic analysis framework was rigorously applied during the analysis process to make sure the thematic development was transparent and logical. It is important to have a clear description of each stage of the research process to put an audit trail behind the research which will improve the reliability of the research.

3.4.3 Confirmability

Confirmability is the extent to which the findings are based on the data and not on the researcher's bias. For confirmability, the coding and theme development was done directly from the participants' statements, and interpretations were constantly re-checked with the participants' interview statements during analysis. The findings were presented using verbatim quotations to illustrate that the themes were not imposed on the participants' experience by the researchers, but rather were theirs. This helped to increase the objectivity and transparency in analyzing the situation. All these procedures together strengthened the methodological rigour, thus elevating the credibility, consistency and trustworthiness of the research findings.

3.5 Ethical Considerations

The ethical principles were adhered to in the entire research process to safeguard the rights, privacy and welfare of the research participants. Participants were informed about the purpose of the study, the voluntary nature of participation and their confidentiality to withdraw from the interview at any time, without giving a reason, prior to each interview. Prior to the interviews, informed consent was obtained from all participants. Participants were given unique identification codes (P1–P25) and all personally identifiable information was deleted from the interview transcriptions, to ensure confidentiality and anonymity. Audio recordings, transcripts of interviews, and field notes were kept securely, and can only be accessed by the researchers. Data collected was to be used only for academic work. The study did not require formal ethical approval based on the institutional

guidelines of the researchers' university because the study involved the voluntary participation of adult subjects and did not include any clinical procedures, personal interventions of sensitive nature or vulnerable subject groups. The study, however, followed ethical guidelines for qualitative research as described in the international literature, such as: Voluntary participation, informed consent, confidentiality, anonymity, and responsible data management.

The quotations from the participants have been reported anonymously, so that their voices are not known to the reader, but still reflect their own experience.

4. Findings and Discussion

4.1 Digital Empowerment of Business Operations

One of the recurring themes from the interviews was digital empowerment of business operations. Digital technologies were consistently reported as tools that can be used in everyday business to increase operational efficiency, to facilitate finance transactions and to help in running the business. Digital technologies were not only used as tools for communication, but also digital payment processes, mobile applications and online banking services were also incorporated into the regular business activities of women entrepreneurs. These technologies helped limit cash transactions, streamlined records keeping, and helped to provide better customer service. One thing that was consistently observed was the strong preference for Unified Payments Interface (UPI) and other digital payment methods. The respondents mentioned that digital payment systems have enhanced the speed of transactions, minimized risks associated with cash transactions, and streamlined financial transparency. Entrepreneurs could keep track of sales, confirm customer payments, and keep their business files better organised with digital records than with traditional cash-based systems. Some of the respondents also stated that people are going cashless more often, and digital payment systems are critical to the day-to-day operations of businesses.

One participant explained:

“It was earlier, when I was just paying for things in cash, but now, most people pay online and it is easier to keep track of all this.” (P2)

Likewise, an other entrepreneur mentioned the benefits of digital financial management when it comes to operating business:

“Having a system to handle digital payments has helped me eliminate issues with handling cash and have a proper record of transactions.” (P11)

In addition to financial transactions, participants told about digital applications used for everyday business management. Mobile applications were used to keep an eye on inventories, to handle client orders, to keep an eye on sales records, and to communicate with clients. These digital tools helped entrepreneurs to manage administrative tasks more efficiently and eliminate tedious

paperwork and time. Some of the participants reported that the more efficient operation enabled them to focus more on their customers and on business development.

The results also indicate that digital technologies helped to build customer trust and satisfaction. Participants noted that digital payment options were convenient, fast, and transparent to the customers. As a result, the use of digital technologies eliminated unnecessary business processes and helped to build customer trust, thereby enhancing business relationships. Theoretically, the results of this study reinforce the Technology Acceptance Model (TAM). Women entrepreneurs embraced digital technologies due to the perceived usefulness of digital technologies in enhancing business performance and ease of incorporating them in daily activities. The results also suggest that the adoption of technology spread beyond the traditional TAM constructs of usefulness and ease of use. The entrepreneurs appreciated digital technologies due to the improved financial transparency, ease in business operation, and improved customer relations that they provided, which showed that tangible business benefits played a crucial role in facilitating the acceptance of digital technologies in women-led MSMEs. The findings are therefore suggestive of the overall argument of the study, which is that contextual business benefits are a key factor that influences the uptake of digital technology by women entrepreneurs.

4.2 Market Expansion through Digital Platforms

The second prominent theme that came from the interviews was the positive impact of digital technologies in creating market opportunities for women entrepreneurs of MSMEs. Digital platforms had completely changed how participants promoted their products, how they communicate with their customer base and how they access new markets was a consistent theme. Social media apps, online shopping platforms and online comms tools allowed entrepreneurs to expand their businesses beyond their local geographic area and made opportunities available that would not have been possible with traditional marketing.

The most popular digital technologies referred to in the discussion were Instagram, Facebook and WhatsApp Business. All participants described how these platforms helped them to present products, communicate directly with their customers, respond to their questions and accept orders from various cities and states. Digital platforms provided increased visibility and reach of customers, as well as a more cost-effective way to promote business, in comparison with traditional word-of-mouth marketing.

One of the participants explained how social media helped to grow her clientele tremendously:

“Instagram, I began receiving orders from Delhi and even from other states.” (P5)

Likewise, another businessman said:

“Social media has enabled me to establish contact with customers from various parts of the world; previously my business had been restricted to local customers.” (P18)

These stories illustrate how digital platforms opened up new possibilities for women entrepreneurs that were hindered by geographical constraints for small business owners. Participants were able to reach out to customers who were out of their reach in their immediate business circles by creating an online identity. Some said digital channels helped them have consistent customer queries, repeat sales and made their business more visible.

Digital marketing was another aspect mentioned by participants as affordable. Social media platforms were a great opportunity for entrepreneurs to advertise their products at low-costs, unlike the conventional marketing strategies that cost a lot of money. This was especially useful for women in micro and small businesses who have small marketing budgets. Entrepreneurs had no problems with steady business growth as they said regular product updates, customer engagement and online promotions helped them grow without heavy investments.

Some participants also said that their business is not only expanding in the domestic market but they were also getting orders from abroad from the internet. While the scope of international sales was small, these experiences demonstrated the potential that digital technologies offer to link women entrepreneurs to expanded commercial networks and open up new business opportunities outside of the local market. This experience is a good case in point of how digital technologies enable businesses to be scalable, break geographical constraints and access a wider customer base.

These results reflect the perspective of the Technology Acceptance Model (TAM) that women entrepreneurs viewed digital platforms as very useful in the improvement of the visibility of their businesses and increasing their interactions with customers and improving their business performance. Overall, there were high levels of perceived usefulness in the use of social media for product promotion, and for customer communication, and easy access and usability of social media added to their continued use. The study also suggests that market expansion went beyond mere technology; it also involved the willingness of the entrepreneurs to embed digital technologies into their wider business agendas, thereby emphasising the need to understand technology within its context and in relation to the entrepreneur.

4.3 Entrepreneurial Autonomy

The third central theme was "entrepreneurial autonomy," which underscored how digital technologies can enhance women's autonomy, confidence and decision-making power. Every participant consistently reported that the introduction of digital tools allowed them to be able to carry out the basic activities of their business without the need for intermediaries or employees or even family members. Women entrepreneurs used digital technologies to have more autonomy in financial transactions, customer interaction, marketing and business operation, thus strengthening their feeling of ownership and self-efficacy.

One consistent finding was that digital payment solutions and e-commerce platforms boosted participants' trust in their businesses. Many of the business owners explained that prior to the

implementation of digital technologies, they relied on others to make financial transactions for them, answer to customers' questions, or market their products. But digital tools helped them to carry out these activities on their own, and boost their confidence in running and growing their businesses.

One participant stated:

"Now I do my own payments and customer queries, I'm not as stressed about the business now".
(P7)

Likewise, another entrepreneur noted:

"Having to complete online orders and payments myself has created a sense of confidence and decision making for me." (P23)

The stories suggest that the use of digital technologies not only helped in making the business more efficient, but also more self-confident. Participants felt that to be able to run their own business with respect to digital payments, communications with customers, and online orders was an important step in their entrepreneurial career. This helped women entrepreneurs to have greater control on the day-to-day business activities and this limited their need on external assistance and helped them to take business decision in timely and informed manner. Some participants also said that digital technologies helped them to increase their financial independence. They were able to track their earnings; the amount of money they sent out on their business and keep their books in order without needing to consult with family members or outside accountants for the day-to-day workings of their business. More funding transparency boosted the trust of participants in managing business resources and making future investments. In addition to financial autonomy, participants highlighted that digital technologies helped them to be more proactive in their search for business opportunities, communicate more directly with the customer, make strategic choices on how to promote products and expand the market. In these experiences digital technologies were not just operational tools, they were also means of strengthening entrepreneurial agency and empowerment. The results support the Technology Acceptance Model (TAM) in view of the fact that women entrepreneurs even continued to use digital technologies beyond business efficiency, due to the perception of tangible benefits. Perceived usefulness and perceived ease of use were still significant, but participants also attributed digital technologies to greater independence, confidence and control of their entrepreneurial processes. This implies that technology use not only enhances business performance, but also has a wider impact on the process of women entrepreneurship and economic empowerment within women-led MSMEs.

4.4 Persistent Barriers to Digital Technology Adoption

While there were a lot of advantages of digital technologies, the participants systematically identified several barriers that still did not allow them to use and implement the technologies effectively in their women-led MSMEs. In addition to offering advantages for business operations,

market access and entrepreneurship autonomy, women entrepreneurs faced challenges associated with the digital infrastructure, technological skills and socio-cultural norms. The barriers affected both the degree and impact of digital technology adoption for their business processes.

Poor internet connectivity was a common problem, especially for those in semi-urban enterprises. The internet services were unstable, which impacted communication with customers, slowed down online transactions and also influenced the timeliness of business activities. Reliable Internet connection was key to ensure customer relationship and online business operations, according to the participants. But disruptions in the network decreased the efficiency of digital business practices.

One participant explained:

“The internet sometimes doesn't work correctly and I can't reply to customers in time”. (P3)

The result underscores the need to build digital infrastructure to support tech-enabled entrepreneurship. While entrepreneurs were keen to use digital technologies, lack of internet connectivity was a constraint on their ability to make full use of digital business platforms.

The other major challenge mentioned by the participants was a lack of digital literacy and technical expertise. Several female entrepreneurs reported that learning to use new digital applications was initially difficult, especially for women who have less experience with using digital technologies. Early adoption of technology revealed challenges with mobile applications, online payment services and digital marketing platforms for participants.

As one participant said:

It was initially challenging for me to learn new digital applications as I had not had a lot of technical knowledge. (P14)

These experiences indicate that more than access to digital tools, digital skills and digital confidence of the entrepreneurs are important for successful digital adoption. Participants highlighted that through an ongoing learning and hands-on experience, their own capacity to utilize digital technologies effectively was enhanced.

Besides the technological challenges, social-cultural barriers affecting the adoption of technology were reported. A few female entrepreneurs stated that family members were not initially open to the idea of smartphone, social media and digital finances solutions being used for business. This resistance was due to the traditional view on women's use of digital technologies and the concerns about online business activities. Participants also noted, however, that these attitudes shifted over time as family members saw the effectiveness of digital technologies and the effects on business performance.

The overall results show that digital technologies offer women entrepreneurs significant opportunities, but also face multiple contextual barriers to adoption. Despite significant strides in

digitalisation, suboptimal digital infrastructure, lack of digital skills, and socio-cultural expectations remain a barrier to the effective use of digital technologies in women's MSMEs. The findings indicate that increasing access to digital technologies and investments in digital infrastructure, digital literacy programmes and enabling social environments are needed to promote sustainable digital entrepreneurship to ensure women participate in digital business activities.

These barriers suggest that the adoption of new technology is influenced by not only perceptions of usefulness and ease of use of the technology, but also by external contextual factors, according to the Technology Acceptance Model (TAM). The experiences of participants illustrate how although digital technologies are seen as positive, infrastructure and technical skills can be limiting and socio-cultural considerations can be an additional barrier to effective adoption. The findings thus further strengthen the need to look at the overall environment when looking at digital technology adoption with the female entrepreneur.

4.5 Discussion

The present study attempted to investigate the impact of digital technologies on women entrepreneurship in the context of sustainable women entrepreneurship among women entrepreneurs of MSME in North India using thematic analysis approach of qualitative research method. Themes that emerged were: digital empowerment of the business processes; market expansion via digital platforms; entrepreneurial autonomy; and ongoing obstacles to the use of digital technology. Together, these results confirm that digital technologies can be used as tools for operation but they can also serve as strategic factors for the sustainability of a business, entrepreneurial empowerment and market competitiveness. The results, however, also suggest that the advantages of digital technologies are not realized equally – contextual factors still play a role in the adoption and effective use of digital innovations.

The first theme, Digital Empowerment of Business Operations, illustrates how digital technologies have revolutionized common business operations, through enabling better business processes, digital payments, customer communication and financial management. These results align with previous studies indicating that digital technologies enhance organizational performance and create more competitiveness for small business (Kraus et al. 2022; Verhoef et al. 2021). The findings of the current study, however, differ from the previous studies which mainly focus on the productivity gains from digital technologies, as women entrepreneurs also view digital technologies as tools to enhance their business transparency, customer trust and business resilience. This qualitative evidence enriches the understanding of how Digital transformation plays a role in sustainable business practices in Women led MSMEs.

The second theme, Market Expansion through Digital Platforms, highlights the important role of social media and digital marketplaces in overcoming traditional geographical and market barriers. Participants said platforms like Instagram, Facebook and WhatsApp Business gave them

opportunities to target more customer segments, promote more effectively, and build direct relationships with customers. The results corroborate previous studies on digital entrepreneurship that suggest digital platforms lessen the constraints of the market and generate new opportunities for entrepreneurship (Nambisan, 2017; Elia et al., 2020). However, the present study goes beyond the existing literature by providing evidence that growth in the market is strongly connected with women's entrepreneurial confidence and longevity, not just with the visibility of their products in the online market.

The third theme, Entrepreneurial Autonomy, shows how digital technologies can be used to empower women economically, by boosting their confidence, building their capacity for independent decision making and enhancing their financial control of business activities. The results of this study agree with Jennings and Brush (2013) who say that entrepreneurship contributes to the economic participation and empowerment of women. The present study, however, also shows that digital technologies are enabling tools that contribute to the development of entrepreneurial autonomy, indicating that the impacts of digital transformation are not only on business performance, but also on other dimensions of women empowerment.

The final theme, Persistent Barriers to Digital Technology Adoption, offers the great theoretical contribution of the study. While participants acknowledged the beneficial role of the digital technologies, some still faced challenges with internet connectivity, digital competences and socio-cultural expectations. This result indicates that perceived usefulness and perceived ease of use are important but not enough predictors of digital technology adoption by women entrepreneurs. Instead, however, the effective use of digital technologies relies on wider contextual factors such as digital infrastructure, digital capabilities, institutional support, and supportive socio-cultural contexts. This is a new finding that helps extend the TAM by showing that individual perceptions do not fully account for technology adoption in women-led MSMEs in emerging economies. Rather, technology adoption needs to be recognized as the product of the interaction of individual perceptions with contextual aspects of digital inclusion.

The results also make another theoretical contribution to the Digital Entrepreneurship literature. Existing research has largely been conducted on a technology adoption or behavioural or organisational approach, while this study has shown that digital entrepreneurship is part of broader social, institutional and infrastructural contexts. This study showed how insights from TAM can be incorporated with the idea of digital inclusion to understand digital technology adoption from the perspective of women entrepreneurs in a more context-sensitive manner. This is especially true in new economies, in which the digital infrastructure, institutional support and socio-cultural context remain relevant factors in entrepreneurial opportunities.

The study overall shows that the use of digital technologies is a key enabler for sustainable women entrepreneurship, but its effectiveness is not only related to entrepreneurs' attitude to technology, but also to the technology environment. In light of this, the findings highlight the need for

contextual factors to understand sustainable technology adoption among women entrepreneurs of MSMEs, thus adding to the existing body of literature on digital entrepreneurship.

5. Conclusion, Implications, Limitations, and Future Research Directions

The current study aimed at understanding the role of digital technologies in fostering sustainable women entrepreneurship among women micro- and small- and medium enterprises (MSMEs) in North India using a thematic analysis qualitative research method. The study uses a qualitative approach with 25 women entrepreneurs to gain deeper insights into the role of digital technologies in business sustainability, entrepreneurial empowerment and digital transformation in an emerging economy. The results indicate that digital technologies are key enablers in sustainable entrepreneurship, as they enhance business performance, open up market opportunities and bolster the entrepreneurial autonomy. Digital payment systems, social media platforms, and other digital business applications supported the women entrepreneurs to run their businesses efficiently, engage in communication with customers as well as reach out to customers from a broader range of markets that extend beyond their geographical reach. Concurrently, digital technologies helped women's confidence, financial autonomy and decision-making capacity, reflecting wider impacts of digital technologies on women's entrepreneurial empowerment. Nevertheless, the study uncovered ongoing issues that remain hampering the acceptance of digital technologies. Several participants found that socio-cultural factors, lack of digital literacy and poor internet connectivity negatively affected the effective use of digital technologies. The results indicate that, beside the accessibility of the technological tools, the success of sustainable digital entrepreneurship is also closely linked to supportive institutional environments, better digital infrastructure and capacity building programs to make the best use of the digital opportunities for women entrepreneurs. Theoretically, the study contributes to the Technology Acceptance Model (TAM) by being the first to show that women entrepreneurs use digital technology measures not only in terms of the usefulness and ease of use, but also in terms of how these technologies can improve their business operations, increase access to markets, increase their independence and sustainability in business. The qualitative evidence also emphasizes the need to take into account contextual factors when studying technology adoption in women-led MSMEs in emerging economies. The study also provides valuable insights for the policy field, entrepreneurship support organisations, education providers, financial service providers and developers of digital platforms. To reap maximum benefits of the digital transformation, strengthening of digital infrastructure, enhancement of digital skills, expansion of entrepreneurship development programmes and development of supportive entrepreneurial ecosystem will be vital for women entrepreneurs.

Finally, digital technologies are not just instruments to run a business; they are strategic enablers to sustainable women entrepreneurship, strengthening business resilience, entrepreneurial capability and competitiveness. Inclusive access to digital technologies and boosting women's

digital skills will be essential to sustainable and equitable economic development as digital transformation will continue to transform entrepreneurial ecosystems.

5.1 Theoretical Implications

The current research study has several significant theoretical contributions to the body of literature related to digital entrepreneurship, women entrepreneurship, and technology adoption. This study can be qualitative, which will provide a better understanding of how women entrepreneurs are experiencing digital transformation in the context of women entrepreneurship as part of MSMEs in an emerging economy. Although most studies have focused on quantitative approaches to the study of technology adoption, this research provides rich contextual insights that provide a way to understand how digital technologies impact business sustainability from the participants' lived experiences.

First, the study is an extension of the Technology Acceptance Model (TAM) as it shows that besides perceived usefulness and perceived ease of use, women entrepreneurs also consider the practical business outcomes of technology usage as well. Operational efficiency, market expansion, entrepreneurial autonomy and the relationship with the customer were cited as key factors for incorporating digital technologies into their enterprises. The results indicate that technology acceptance is strongly correlated with the overall value to the business achieved by digital transformation for women entrepreneurs.

Second, the study adds to the discourse and literature on women's entrepreneurship by demonstrating how digital technologies are used as tools of entrepreneurial empowerment. The results show that digital tools help women entrepreneurs to operate their businesses more independently, improve their financial decision making, and boost their confidence in managing their businesses. This builds on previous research by demonstrating that digital technologies impact not only business performance, but also women's entrepreneurial agency and the sustainability of the business.

Third, the study advances the current research on digital entrepreneurship in the context of technological opportunities and contextual constraints. The participants acknowledged the advantages of digital technologies but also knew about certain challenges concerning internet connection, digital literacy and socio-cultural expectations. The results of this research indicate that more than just acceptance of technology is required for successful digital transformation, the entrepreneurial context in which technology is embraced is also an important part of the process.

Lastly, with emphasis on the MSMEs led by women in the North Indian context, the study provides context-specific evidence from an emerging economy. While much of the existing literature has focused on developed countries or large organisations, the qualitative evidence on women-owned MSMEs is relatively scarce. Based on this, the present study expands the geographical and



contextual knowledge of digital entrepreneurship and meets the demand for further studies in different entrepreneurial contexts.

Overall, the study makes its contribution to the theory by showing that the adoption of digital technology by women entrepreneurs is a multidimensional process which involves the entrepreneurs' motivations, needs and context. The insights gained help to better understand the Sustainable Digital Entrepreneurship and direct future theoretical development for entrepreneurship and adoption studies.

5.2 Practical and Policy Implications

The result gained from this study is very practical for women entrepreneurs, policy makers, business support agencies and digital service providers. It shows the potential of digital technologies in making business more efficient, more market opportunities and more autonomous for women entrepreneurs of MSMEs. Supportive policies and targeted interventions are needed that tackle the challenges identified by participants, however, for these benefits to be realised.

Based on the findings it is advisable that women entrepreneurs should be encouraged so as to use digital technologies in conducting their day to day business activities. Digital payment systems, social media platforms, and e-commerce applications can streamline operations, enhance customer relationships and boost market visibility. Entrepreneurial development programmes need to, therefore, emphasize not just the adoption of technology but also, practical digital skill development that will enable effective business management.

Second, the research points to the fact that there is a need for digital literacy and capacity building programmes targeted at women entrepreneurs. Participants acknowledged the advantages of digital technologies but many endorsed that they had some initial challenges in learning how to use digital applications and online business platforms. There should be a collaboration between government institutions and entrepreneurship development institutes, MSME support organisations and higher education institutions to impart practical training on digital marketing, financial management, e-commerce operations, cyber security awareness and online customer relationship management. This would allow women entrepreneurs to easily and confidently adopt digital technologies.

Thirdly, the results highlight the need to consolidate the digital system, especially in semi-urban and rural regions. The lack of Internet connectivity was cited as one of the top challenges to communication with customers and using digital business tools. Building on robust broadband infrastructure, low-cost Internet access, and digital infrastructure is therefore critical for fostering inclusive digital entrepreneurship and closing technology adoption gaps between regions.

Fourth, family and community support were also shown to be significant factors in successful digital technology adoption. Some of the participants reported difficulties within the family to use digital technologies for business. Educating the general public about the economic and social impacts of women entrepreneurs in the digital domain can help shift the perception of women's

digital businesses and promote acceptance. Establishing conducive entrepreneurial environments, therefore, can contribute to increasing women's involvement in the digital economy.

Last, digital platform providers and financial institutions have implications. It is important that end-users of digital business applications have an intuitive user interface that supports entrepreneurs of different digital literacy levels. Financial institutions and Fintech firms can also create financial literacy programmes, multilingual customer support, and secure online transaction systems that are beneficial for MSMEs, and provide simplified digital payment solutions for women entrepreneurs.

The study concludes that empowering small women entrepreneurs for sustainable entrepreneurship should be achieved by multiple approaches which include the development of technological infrastructure, digital skills, institutional support and facilitating socio-cultural environments. It will be key to have a partnership between governments, education, industry organizations, financial institutions and digital platform providers to ensure that women entrepreneurs can make the best use of and contribute to the digital economy.

5.3 Limitations and Future Research Directions

This study has some limitations that should be noted, although they have added value to the understanding of sustainable women entrepreneurship and the use of digital technologies to support it.

The study used a qualitative research design with twenty-five women entrepreneurs from 5 states of North India using semi-structured interviews. This approach allowed for a detailed understanding of the experiences of participants, but the findings are specific to the context and are not meant to be statistically generalisable to all women entrepreneurs or MSMEs.

Secondly, the study was limited to women entrepreneurs of MSMEs only in North India. The entrepreneurial journey might vary in other parts of the country because of the differences in the economic development, digital infrastructure, institutional support and socio-cultural conditions. Thus, the results should be analyzed as pertaining to the specific geographic setting of the study.

Third, the study investigated participants' experience at one time. Digital technologies and entrepreneurial practices are still developing fast, and with the creation of new technologies, women's experience may change. Longitudinal studies would thus help to understand the impact of digital technology adoption on business sustainability in the long term.

Fourth the study was largely dependent on self-reported interview data. Participants shared their experiences, perceptions and reflections openly, but there is a chance that personal interpretation or recollection may affect a participant's perceptions. Future research could further support the findings by employing qualitative interviews along with other data sources like business records, digital platform analysis, observation or quantitative surveys.

These restrictions indicate some future research directions. Future studies could use a mixed methods or quantitative design to further investigate the relationships found in this study on larger and more diverse samples. Comparative studies between women and men entrepreneurs, between various sectors or between various regions may facilitate to achieve a wider vision about digital entrepreneurship in different contexts. The impact of new technologies like AI, big data analytics, blockchain, Internet of Things (IoT), and generative AI on women entrepreneurs of MSMEs and sustainable entrepreneurship can also be explored. Furthermore, future research might focus on the effectiveness of government's digital programs, entrepreneurship development programs, and digital literacy programs in supporting women entrepreneurs.

In summary, the directions for future research offer insights for advancing the knowledge of digital entrepreneurship and offer a contribution to the creation of more inclusive and sustainable entrepreneurial ecosystems.

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