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Barriers to AI Adoption in Retail SMEs: Technological, Organizational, and Environmental Challenges

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Abstract

SMEs in retail can gain a lot from AI which boosts customer service, improves how businesses work and helps with planning and strategy. Still, retail SMEs are not using AI as much as big corporations even though the technology is more accessible. This paper studies the factors that prevent companies from adopting AI by using the TOE framework which has been extended to cover data-related problems (TOE-D). A thorough look at the literature finds that the main factors behind resisting adoption are technological (for example, missing explanation and risks in security), organizational (lack of resources and the right people), environmental (uncertainty in rules and ethics) and data-related (low-quality data and weak governance). This demonstrates that adopting AI in retail SMEs involves many factors, including things within the company and factors from outside. It wraps up by providing a summary of how adoption happens and it recommends ways for practitioners, policymakers and researchers to come up with solutions. It helps advance the discussion about digital transformation in SMEs by supplying a useful framework for future research and use of AI.

Keywords: AI adoption; Retail SMEs; Technology-Organization-Environment (TOE) framework; Data governance; Digital transformation; Organizational barriers; Explainable AI; SME readiness

1. INTRODUCTION

With the rapid digital transformation, Artificial Intelligence (AI) is becoming influential in various industries, one of which is retail. Firms are now using AI to predict how customers act and to make their supply chain operations more efficient. For example, AI technology is increasingly used to optimize search engine results (SEO), send personalized information to customers, oversee CRM and interact on social media (Dumitriu & Popescu, 2020; Libai et al., 2020; Mallipeddi et al., 2022). The new approaches should result in happier customers, most effective targeting and clear signs of benefit from marketing spending (Devang et al., 2019; Schipmann, 2019). Large companies have actively started adopting AI, but smaller retailers are not doing the same as quickly as others (Saura et al., 2021; Makrides et al., 2020). Many national economies depend on retail SMEs which employment and support regional development. Notwithstanding, using modern technologies including AI is challenging for them because of various limitations, uncertainties about their plans and restrictions on their operations (Bauer et al., 2020). The use of AI theoretically helps SMEs deal with challenges related to size, tailor services to clients and automate regular tasks (Theodoridis & Gkikas, 2019). In many cases, AI is not yet adopted by these firms and its diffusion is uneven. A large part of retail SMEs fail to use AI properly or simply do not adopt it, even though the tools are readily available. Because many regions have great potential for AI, yet few actually use it, we should find out why this is happening and what keeps them from using AI. In many cases, there are many reasons why AI isn't easily adopted in different places. These barriers can be seen as things that prevent or slow down the adoption of technology such as technical issues, organizational reluctance and

larger rules and regulations (Prince, 2006; Duan et al., 2019). What's more, the way these barriers affect businesses depends on company size, their industry and their country (Sun & Medaglia, 2019; El Hajj et al., 2021). Because there are many factors involved, it is important to use a well-organized approach to look at adoption difficulties. For this reason, the Technology-Organization-Environment (TOE) framework from Tornatzky et al. (1990) is the guiding model of choice. The framework groups various factors affecting AI's adoption into these domains: (1) factors concerning the nature and quality of the technology itself, (2) how ready leaders and the organization are and (3) regulations, pressures from the marketplace and ethics. Considering that AI deals heavily with data, this research covers a fourth type of barrier called "data-centric barriers," which covers issues with data quality, access, privacy and bias (Dwivedi et al., 2019; Sun & Medaglia, 2019; Desouza & Jacob, 2017). This study looks at the existing literature and applies the TOE framework to explain better the challenges retail SMEs meet when adopting AI. Expectedly, the review will guide practitioners, policymakers and researchers in finding solutions to help small and medium retailers use AI.

2. LITERATURE REVIEW: AI ADOPTION IN RETAIL SMES

AI which was once a theory, now plays a key role in transitioning business operations in many industries. Because of AI, companies in retail are better able to understand what customers want, improve inventory management, nurture relations with customers and guide their marketing efforts using digital channels (Hoyer et al., 2020; Devang et al., 2019). Many experts see that AI tools like search engine optimization, targeted advertising, customer journey mapping and content personalization can increase engagement from customers and improve the way the business runs (Makrides et al., 2020; Tahoun, 2020; Eisbach et al., 2023). While AI can help a lot, SMEs in the retail sector are still slow to adopt the technology. Small retail businesses have to deal with competition and fast changes in the market. Although digital marketing makes it possible for them to access various customers and markets, selecting the right AI-powered tools is sometimes not easy because they do not have enough technical knowledge or frameworks for comparison (Bhojaraja, 2018). According to Theodoridis and Gkikas (2019), AI plays a key role in automating decisions in marketing which can lead to fewer risks and higher efficiency. However, many entrepreneurs and managers in the SME sector depend on intuition or old-fashioned advertising which reveals a large difference between having access to technology and actually using it. There is plenty of evidence that AI can boost strategic marketing changes within SMEs. The system is designed for large data analysis, guessing customer trends, making personal offers and coordinating activities through several channels (Schipmann, 2019; Wang et al., 2020). Sometimes, these advantages are not fully taken advantage of because SMEs are limited by money issues, lack of trained employees and a poor strategy when it comes to integrating technology (Bauer et al., 2020; Alsheibani et al., 2019). Earlier studies have shown that there is more to adoption barriers than just technical issues. Duan et al. (2019) state that for AI to work well in organizations, leaders must first understand the company's structure, if employees are ready and how the AI fits the environment. Risk perception and the institutional situation surrounding SMEs can strongly influence whether an SME adopts AI. According to Sun and Medaglia (2019), organizations from the same nation can have unique views on AI, depending on what business they are in, how much they grow and their management's attitude. The same study (El Hajj et al., 2021) highlights how sociocultural conditions and rules can strongly influence how much technology is used. The Technology-Organization-Environment (TOE) model is used as a structured way to view these different challenges. Tornatzky et al. (1990) provided the framework for the TOE and it categorizes the influencing factors of technology-adoption as three main dimensions. Initially, the technological dimension deals with how the innovation is thought to improve or complicate things. Also, the way an organization is structured impacts its readiness, its available resources and the way it plans strategies. Also, part of the environmental dimension consists of outside forces, including changing markets, new rules and stakeholder hopes. According to recent scholars, due to the

importance of data in AI, the TOE framework should be adjusted to add data issues as a fourth dimension (Dwivedi et al., 2019; Desouza & Jacob, 2017).

Having such frameworks as TOE is meaningful as people tend to perceive AI adoption barriers privately and differently. An algorithmic hurdle for one SME might be thought of as a staffing problem or a planning concern for another business, just as a lack of skilled team members or the wrong strategy could be seen as technological problems by another SME. The clarity of regulations or how data is handled in an area or industry greatly affects how people see the environment. Compared to other forms of adoption, the unique nature of AI use in retail SMEs requires looking at factors inside and outside a company which is why TOE is used. The following section takes an in-depth look at each aspect using studies and experts' opinions to explain what stops SMEs in retail from using AI.

3. BARRIERS TO AI ADOPTION IN RETAIL SMES: A TOE FRAMEWORK PERSPECTIVE

In this part, the TOE framework is employed to discuss the many hindrances to using AI in retail small and medium enterprises (SMEs). Analysts go through the different factors technology, organizations, the environment and data to find the main challenges SMEs have when adopting AI-related solutions.

3.1 Technological Barriers

Most SMEs find that technology challenges make it hard to introduce AI. They are related to the basic features of complexity, transparency, security and reliability in AI systems. Most AI technologies rely on machine learning or deep learning and their developers can't always see or explain the ways they work. Many refer to this property as the "black box" aspect of AI which lowers trust and stops widespread use in society (Samek et al., 2017; Shaw et al., 2019). How a decision is explained matters a lot. Most retail SME owners and managers do not understand how AI models produce their results, especially when the models use complex calculations. Because AI models are not always understandable, this raises questions about whether the AI is making fair and accurate choices for customers in areas like personalization and fraud detection. When people cannot understand the reason for a recommendation or prediction, it gets tough for decision-makers to accept and defend it which is more noticeable in high-level business contexts. Concerns over security and data privacy are very closely tied to explainability. For AI systems to work well, they are often provided with sensitive information about a person's transactions, habits and details regarding gender, age, etc. Even so, most SMEs do not have well-built cybersecurity, so they are potentially exposed to attacks and data theft (Iftikhar & Nordbjerg, 2021). This problem leads to serious concerns, particularly as laws like the General Data Protection Regulation (GDPR) call for increased scrutiny. Not managing data well leaves SMEs vulnerable to legal issues and also damages customer trust. In addition, being ready for the latest technologies is a persistent problem. To include AI, SMEs generally need powerful computing, special software and access to lots of information which they may not be able to obtain. Moreover, connecting AI with other business applications (like customer relationship departments or online sales platforms) usually needs them to fit together, but fully compatible systems are often lacking due to older, legacy mechanical systems. Handling both the quality and the large amounts of data presented is an additional technical hurdle. Models from AI work best when they get enough accurate and properly structured input data. Nevertheless, many small retail businesses have a hard time keeping data organized for use with AI methods. Just because there are data and statistics does not always guarantee that the information is detailed enough for strong AI techniques. At times, businesses gather less data because customer communication is low or transactions are infrequent which negatively impacts the effectiveness of AI. Many small and medium businesses have to deal with inadequate technical assistance and trouble getting quality products from vendors. Since big corporations maintain their own IT and AI areas, most

SMEs depend on companies providing AI services. Because companies are so dependent, they face even more issues like conflicting goals, restricted tailoring and possible lock-in with the vendor. Many small and medium-sized businesses find it difficult to use AI, mainly because there are few reliable, affordable and clear AI providers. All of these issues highlight that AI readiness should focus on tools as well as their accessibility, openness, ease of use and safety. Solving these roadblocks helps SMEs in retail feel comfortable using AI and benefit from its use. Table 1 summarizes main troubles such as AI not being easily explained, the lack of cyber security and integration challenges. It points out that SMEs struggle with AI because these elements decrease belief and keep AI from being used more widely.

Table 1: Meta-Analysis Table for Technological Barriers

Barrier	Description	Source(s)	Impact on SMEs
Black-box Nature of AI	AI systems often produce results without interpretable rationale.	Samek et al. (2017); Shaw et al. (2019)	Reduces trust in AI outputs and limits adoption.
Lack of Explainability	AI decisions are hard to explain to users and managers.	Holzinger et al. (2018); Shaw et al. (2019)	Prevents justification of AI-based decisions.
Data Privacy & Security Risks	Sensitive customer data are vulnerable to breaches and misuse.	Iftikhar & Nordbjerg (2021); Kankanhalli et al. (2019)	Raises compliance costs and deters data-driven systems.
High Technical Resource Requirements	AI requires costly infrastructure and technical know-how.	Devang et al. (2019); Schipmann (2019)	Restricts experimentation and scaling.
Legacy System Integration Issues	Existing IT systems are often incompatible with AI tools.	Iftikhar & Nordbjerg (2021); Pavaloiu (2016)	Slows down deployment of AI-enabled applications.
Vendor Dependence	SMEs rely on external vendors, risking misalignment or lock-in.	Sun & Medaglia (2019); Wirtz et al. (2019)	Creates risk of strategic misalignment and dependency.

3.2 Organizational Barriers

Many small retail companies struggle to adopt AI because of issues related to their organizations. These issues arise because of the way a company is set up, organized and how its culture is understood. While technological issues relate to the characteristics of AI technology itself, organizational barriers stem from what a business is ready to do in terms of adopting digital transformation. Many professionals see lack of readiness by organizations as a major problem. Embracing AI is a larger change than simply using new technology; it calls for evaluating important business activities, employees and routines. A major issue is that many small businesses are set up in a traditional way and haven't focused much on innovation, so they struggle to implement such complicated technologies (Johnk et al., 2021). Leadership support, a clear view for the future with AI and a step-by-step plan for various departments are essential parts of being ready for AI. When these pieces are missing, adoption of AI usually gets stuck during the first phase.

Not having a clear digital or AI strategy is also very important. Many SMEs are working using old business methods without having a precise digital roadmap in place. Because of this gap, companies are more likely to make technologies a priority only when it suits them, invest their resources in ways that are not always connected and miss an opportunity to evaluate performance. Goasduff (2019) points out that some SMEs find it hard to know what AI will do for them and how it can help the business, so aligning the costs and projects with the company's wider aims is difficult. So, not having a clear strategy means the initiatives are disconnected, there is less continuity in use and the results fail to reach their potential. If workers are not open to change, the problem gets worse. Some workers might see AI as taking their jobs or they could find it to be too difficult to use. Such concerns are true, since AI can replace people in jobs that require frequent repetition. If not handled by proper change management, this resistance can result in fewer people using AI, less engagement with it and sometimes rejection of the services (Sun & Medaglia, 2019). Having a work culture that fear risk, favors formal hierarchy or is inflexible leads to major problems with digital innovation. A vast skills gap and the shortage of technical workers is also a big issue. For AI to be integrated successfully, one must be an expert in data science, machine learning and managing AI systems which is not easy or cheap to find. Because SMEs do not have much financial resources, attracting and retaining skilled workers is difficult for them (Wirtz et al., 2019). Also, employees in some companies may not have the basic knowledge to use modern technology or understand AI ideas which makes upskilling or reskilling important but is often pushed aside due to budget issues.

Not having enough money makes it more difficult for organizations to use AI. Since AI setup needs computers, programs, licenses, consultancy and training, the expense is seen as very high when the return is not certain. According to Iliashenko et al. (2019), increased economic uncertainty, problems managing cash flow and difficulties in getting loans cause SMEs to avoid financial measures even more. A lot of small retailers with limited budgets consider AI to be optional rather than essential.

Also, when cross-functional communication and decision-making are not good, it can slow down new ideas. When IT, marketing, sales and operations do not work as a group, AI projects likely end up separated from or don't match the goals of the organization. If organizations fail to coordinate their efforts, it becomes more difficult for AI to be used effectively and for the company to learn new things as an AI team.

In general, the organization's structure and strategic decisions are strongly influenced by internal barriers at retail SMEs. Examples are problems like being poorly planned, having limited insight, dealing with cultural setbacks, not enough strong employees, budget shortfalls and poor communication. Removing these barriers means investing in innovation, redesigning the way organizations are led and training employees to work well with AI. Internal organizational challenges as highlighted in table 2 include lacking resources, not meeting business strategies, staff resistance and a shortage of suitable skills. All these barriers in turn prevent SMEs in retail from using AI.

Table 2: Meta-Analysis Table for Organizational Barriers

Barrier	Description	Source(s)	Impact on SMEs
Lack of Organizational Readiness	Organizations lack the vision, structure, and commitment to adopt AI.	Johnk et al. (2021); Alsheibani et al. (2019)	Reduces ability to execute or sustain AI initiatives.
Absence of AI Strategy	No formal roadmap exists to integrate AI into business	Goasduff (2019); Devang et al. (2019)	Leads to fragmented adoption and wasted investment.

	processes.		
Resistance to Change	Employees fear job loss or mistrust the new technology.	Sun & Medaglia (2019); Wirtz et al. (2019)	Undermines engagement and slows implementation.
Skills Gap and Lack of Talent	Inability to attract or afford skilled AI professionals.	Wirtz et al. (2019); Iliashenko et al. (2019)	Limits internal AI capabilities and increases outsourcing costs.
Financial Constraints	Initial AI costs are perceived as prohibitive by SMEs.	Bauer et al. (2020); Bérubé et al. (2021)	Restricts experimentation and innovation.
Poor Cross-functional Communication	Departments work in silos, preventing collaborative implementation.	Sun & Medaglia (2019); Johnk et al. (2021)	Prevents integration of AI across the value chain.

3.3 Environmental Barriers

Some environmental barriers are related to factors outside retail SMEs' control that have a big impact on the use of AI in these businesses. For example, these involve rules and regulations, how the market operates, social expectations and ethical issues. For small and medium-size shops, uncertainty and pressure from outside can very much slow them down because they have few support resources.

Being unsure about regulations makes it harder to operate in sustainability. AI frequently combines with issues such as handling data, respecting customer privacy and decision-taking by machines. Policies dealing with these types of intersections are often divided or unclear in different places. Due to difficulty understanding updated legal standards, a large number of SMEs find it hard to invest in or test AI (Perc et al., 2019). Larger businesses can afford legal teams and rules which is why some SMEs opt to stay away from AI instead of facing legal risks.

Ethical and moral issues are often tied to the process of regulation. The use of AI in retail such as suggestions, price adjustments and customized ads, may be concerning due to risks of bias and control. If algorithms are not clear or use someone's data incorrectly, consumers are likely to feel these interventions are quietly manipulative (Vellido, 2019; Benkert, 2019). The concerns get worse because there are no industry-wide ethical rules for using AI responsibly. Since their brand names are less recognizable and they often make little profit, SMEs are often reluctant to use AI tools that may attract public criticism.

Having social acceptance and trust also adds to the complexities of the barrier landscape. Users are more likely to use AI-driven tools like chatbots or personalized recommender engines when they think them reliable, trustworthy and clear. In markets where people are not used to AI, consumers are less likely to open their minds to its benefits which can affect SMEs' decisions to use it. Besides, how people view automation and job losses can also lead to opposition among local communities, mainly in areas where SMEs form the backbone of employment.

Industry competition and how innovations spread among firms are also major environmental factors. A number of SMEs only adopt innovations after seeing how competitors handle them, rather than being proactive right away. Businesses in retail which experience quick technological changes and low profit margins, use this approach more than other industries. If those early adopters don't see measurable benefits

from new policies, others in the ecosystem lose interest in committing (Fukuda-Parr & Gibbons, 2021). Because of this, wider use of AI by SMEs is slowed down.

Moreover, dealing with poor infrastructure which mostly affects developing countries, slows down improvements in the environment. For AI systems to work, it is important to have strong internet access, use cloud storage and source cheap computing resources. There are many regions where retail SMEs work where these foundational elements are insufficient or inconsistent. Because digital infrastructure is missing, many small businesses who are eager and able to use AI cannot put it into practice.

At the end, the necessary policies and help from institutions are usually lacking for AI to be used more widely in SMEs. Support from the government, special trainings and public-private alliances are main ways to spread technology. But these programs are not fully developed and tend to serve major companies more than small and mid-sized entities. Because of this, SMEs find themselves at a disadvantage, even though they are a major part of the economy (Wirtz et al., 2019).

All in all, retail SMEs face various regulatory, ethical, social and infrastructure obstacles from the environment when adopting AI. Not like internal problems, these challenges call for regulatory bodies, industry sectors and policy makers to come together and make the environment conducive to AI integration across the board. Since access to the system is important, otherwise prepared SMEs could still regard AI as too much effort. Table 3 outlines the external pressures which are regulatory ambiguity, ethical concerns, infrastructural gaps and the lack of institutional support. All of this leads to small and medium firms being cautious about using AI in their work.

Table 3: Meta-Analysis Table for Environmental Barriers

Barrier	Description	Source(s)	Impact on SMEs
Regulatory Uncertainty	Ambiguity in laws and compliance standards for AI technologies.	Perc et al. (2019); Fukuda-Parr & Gibbons (2021)	Discourages experimentation due to fear of penalties.
Ethical and Moral Accountability	Concerns over bias, manipulation, and fairness in AI decisions.	Benkert (2019); Vellido (2019)	Raises reputational risks and public criticism.
Social Acceptance and Trust	Customer distrust in automated systems or AI recommendations.	Vellido (2019); Wirtz et al. (2019)	Lowers customer engagement and system usage.
Industry Competitiveness	SMEs delay adoption due to uncertain benefits among competitors.	Fukuda-Parr & Gibbons (2021); Schipmann (2019)	Delays sector-wide innovation diffusion.
Infrastructural Deficiency	Insufficient digital infrastructure for supporting AI systems.	Desouza & Jacob (2017); Kankanhalli et al. (2019)	Prevents technical feasibility of AI tools.
Lack of Policy Support	Few government programs or incentives targeting SMEs.	Wirtz et al. (2019); Alsheibani et al. (2019)	Reduces motivation and capacity to adopt AI.

3.4 Data-Centric Barriers

Data is key to AI, so making sure there is enough good data and using it appropriately and ethically is very important for retail SMEs to use AI. The TOE model originally did not single out data, yet recent studies show that including data in the model can help accommodate data-related barriers (Sun & Medaglia, 2019; Dwivedi et al., 2019). Dealing with problems related to data infrastructure and strategy is just as difficult for SMEs in the retail sector as problems related to technology, organization or environment.

Not having enough reliable data is a main problem. Effective operation of AI systems depends on there being enough accurate, uniform and representative data available. But, many SMEs are either unable to create organized data records or keep their data in different and unsuitable formats. Companies may track items bought but usually do not have the necessary behavioral or demographic details for developing AI for personalization (Desouza & Jacob, 2017). The lack of usable data limits how far AI can be used, especially in customer segmentation, determining demand and recommendations.

Besides the sheer amount of data, how good the data is also presents a big challenge. Usually, small- and medium-sized enterprises' databases miss some entries, use different names, have duplicate records or contain outdated information. Because of these problems, AI models tend to show biases and become unreliable in their results. In addition, if the data is of poor quality, it could provide false insights, use up resources unproductively and lead to failures in carrying out plans which reduces the desire to make more investments.

Combining different sources of data is another important obstacle. Most SMEs run separate systems for inventory, sales, customer service and accounting, each keeping data in different ways. Having no way to link data prevents smooth data circulation, something necessary for AI systems to offer full understanding of the data. Since small and medium-sized companies lack centralized data platforms, it becomes hard to unify different sets of data needed for model training and analysis (Sun & Medaglia, 2019).

After that, dealing with data governance and ownership matters becomes very important. A lot of SMEs do not create policies for managing their data, protecting it or following compliance rules. Because there are no clear rules, AI use leads to more legal risks, especially for data protection like GDPR and also lowers trust in AI systems. For most SMEs, figuring out who owns the data, who can access it and how it reaches third-party vendors is still unclear. Poor internal control increases the chance of data violations, biased algorithms and ethical problems.

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Table 4: Meta-Analysis Table for Data-Centric Barriers

Barrier	Description	Source(s)	Impact on SMEs
Insufficient Data Volume	SMEs lack access to large, diverse datasets needed for effective AI.	Desouza & Jacob (2017); Devang et al. (2019)	Prevents AI from learning meaningful patterns or making accurate predictions.
Poor Data Quality	Inaccurate, inconsistent, or outdated records hinder model reliability.	Dwivedi et al. (2019); Sun & Medaglia (2019)	Reduces trust in AI outputs and affects performance.
Data Integration Challenges	Disparate systems produce siloed data with no unified structure.	Sun & Medaglia (2019); Alsheibani et al. (2019)	Slows AI deployment and increases technical complexity.
Lack of Data Governance	Absence of policies for data stewardship and ownership.	Desouza & Jacob (2017); Wirtz & Lovelock (2021)	Increases risk of data misuse or loss of control.
Data Privacy and Compliance Issues	Non-compliance with regulations such as GDPR poses legal risks.	Kankanhalli et al. (2019); Holzinger et al. (2018)	Exposes firms to penalties and erodes customer trust.
Bias in Training Data	Skewed data results in biased AI outcomes and unfair decisions.	Dwivedi et al. (2019); Vellido (2019)	Leads to unfair, unrepresentative, or discriminatory outcomes.

4. DISCUSSION

Based on the extended TOE framework, the problems that stop retail SMEs from adopting AI are very complex and strongly connected. Most small and medium-sized businesses face a mix of technological, organizational, environmental and data challenges that usually stops them from enjoying the benefits of AI. It brings these points together and discusses what they require for practice, theory and policy.

It's not only a matter of whether AI tools are available, but also if they are satisfying, accessible and easy to understand for people outside the field. Not knowing how AI works makes many business owners and decision-makers less confident, mainly when the results or decisions cannot be easily detailed. Since cybersecurity structures are missing, SMEs avoid putting sensitive customer or transactional data on AI-driven systems, leading to more concerns about risks and issues with compliance. For these concerns to be solved, the AI used should ensure security, explain itself, be technically sound and suit SMEs.

Also, problems within the organization are the most difficult to change and affect how the company approaches AI from above and below. The inability to adapt, missing computer skills among staff, not being adequately skilled and seeing unclear returns on investment usually stop SMEs from motivating staff for digital transformation. In places where resources are scarce, surviving in the short term becomes the top priority, so innovation is often put aside. Apparently, SMEs require assistance not only with tech tools but also with strengthening their ability to transform through strong leadership, trained employees and planned initiatives.

Also, the environmental dimension argues that AI adoption needs to be viewed with consideration for its overall socio-political environment. Since there are not enough clear regulations and proper enforcement of ethical AI, SMEs, especially those that lack legal knowledge, feel more reluctant. In addition, if consumers question whether automation is safe and how AI is used ethically, this may decrease their trust in retailers which depends greatly on their loyalty to a brand. It follows that when SMEs adopt AI, there also need to be clear rules from regulators, special ethical rules for each area and initiatives to help consumers accept and trust AI.

Including data-centric barriers as a fourth dimension helps the TOE model explain why data is key to modern AI. When data is of low quality, systems are not well-structured and data governance is weak, AI applications cannot function as well. Unlike huge corporations, most SMEs lack organization in handling data and depend on occasional, incomplete data updates. The problems faced here are two layers deep: small businesses first need to handle their data properly and service providers and lawmakers must guarantee that AI tools are helpful with limited data and add value in stages.

It becomes obvious in this discussion that these barriers are closely related. Not being ready as an organization can make technical issues even harder to deal with and poor data management can lead to greater chances of not following environmental rules. Similarly, just because the technical and information tools are set up doesn't guarantee people will use them right away, thanks to cultural or law-related setbacks. So, dealing with these barriers necessitates a wide approach using policies, industry leaders and enterprises.

Because the extended TOE framework now covers data constraints, it gives a better perspective for understanding digital innovation in SMEs. It also adapts to the growth of AI which makes it harder to decide where technology ends and humans begin. Upcoming theories might explore the interaction between the different aspects of TOE or take into account help from institutions or the level of development within a certain industry.

Managers of small and medium enterprises and retail entrepreneurs should see that AI adoption is not just about technology. It needs to match with the culture of the organization, how capable its staff are, what the strategy calls for and what customers want. Giving importance to explainability, usability and phased rollout can help people accept the changes and improve the results. Training programs for people, grants for initial AI projects and specific platforms for small and medium businesses in AI can all help.

To help SMEs use AI, people making policy and supporting the ecosystem need a more imaginative approach than just handing out subsidies. A supportive environment needs to be built with legal understanding, sector-based AI ethical standards, wide-ranging technical services and data that is easily accessible to all. Authorities should be aware of the bigger obstacles for SMEs than for large companies and establish regulatory sandboxes or AI incubators where experiments can be done without fear of punishment.

All in all, the integration of AI in retail SMEs is a difficult task that needs teamwork from within the organization and support from outside it. Using a fragmented method will not eliminate the existing gaps. This TOE-D model helps make AI integration in the retail SME sector more inclusive and sustainable, as it gives a clear structure for understanding and handling these issues.

5. Conclusion and Future Research Directions

Using Artificial Intelligence (AI) in small retail businesses offers many opportunities and introduces various new challenges. Although AI is claimed to improve efficiency, enhance what customers feel and help in business competitiveness, small retailers are usually reluctant, not ready or not interested in using AI yet. Using a TOE framework with a fourth dimension devoted to data-centric barriers, this study looked at the barriers that prevent AI from being used.

It is found that deficiencies related to explainability, cybersecurity problems and poor interoperability in AI systems lead people to doubt and lose confidence in them. When staff resist change, when the organization's goals are unclear, when needed skills are lacking and when resources are scarce, it adds to the problems with readiness and commitment to innovation. From the perspective of protecting the environment, uncertainty in the laws, questions of ethics and public opposition create extra obstacles to the decision to adopt. Focusing on data-related obstacles opens up more areas to analyze, pointing out that data governance, data integration and data quality especially constrain SMEs in putting AI into practice.

All in all, these insights suggest that SMEs in retail need a collaborative strategy that uses the environment and multiple stakeholders to adopt AI. According to the study, using AI step by step and in a way that fits your business and the market is important for companies. AI roadmaps should always include organizational training, committed leadership and tracking the outcomes of performance. There is a strong need for technology companies to design AI tools that SMEs can use, making sure they are clearly explained, fit well with what SMEs already use and anyone can use them. It concludes that policymakers should consider incentives and new regulations meant to help SMEs build capacity in AI.

It adds to the literature by proposing a new version of the TOE framework (TOE-D) that represents modern ways AI is being adopted. Sociologists can verify in real cases the way these dimensions affect each other in different contexts and business environments. Researchers can use longitudinal studies to observe how AI progresses in SMEs as years go on and what pushes them to go from simple AI use to full implementation.

Comparing different nations can help understand how things such as culture, economy and regulations affect the different barriers adopters may encounter, making the observations relevant for locals and globally. It would be useful to explore how people like AI consultants, digital incubators and industry associations help SMEs connect with AI technologies.

Simply making the technology intersection easier does not fully enable AI adoption for small retail businesses. Groups need to keep trying to overcome the various barriers affecting progress. By using the TOE-D framework, people involved with AI in SME retail can guide efforts toward strategies that are inclusive, based on information and fit the various contexts of the industry.

REFERENCES

Alsheiabni, S., Cheung, Y., & Messom, C. (2019). Factors inhibiting the adoption of artificial intelligence at organizational-level: A preliminary investigation. In *Americas conference on information systems 2019* (p. 2). Association for Information Systems.

Bauer, M., van Dinther, C., & Kiefer, D. (2020). Machine learning in SME: an empirical study on enablers and success factors.

Coccia, M. (2021). Technological innovation. *innovations*, *11*, I12.

Desouza, K.C., Jacob, B., 2017. Big data in the public sector: Lessons for practitioners and scholars. Adm. Soc. 49 (7), 1043–1064

Devang, V., Chintan, S., Gunjan, T., Rai, K., 2019. Applications of artificial intelligence in marketing. Ann. Dunarea De. Jos Univ. Galati. Fascicle I. Econ. Appl. Inform. 25, 28–36. https://doi.org/10.35219/eai158404094

Duan, Y., Edwards, J.S., Dwivedi, Y.K., 2019. Artificial intelligence for decision making in the era of Big Data – evolution, challenges and research ag

Dumitriu, D., Popescu, M.A.-M., 2020. Artificial intelligence solutions for digital marketing. Procedia Manuf. 46, 630–636. https://doi.org/10.1016/j. promfg.2020.03.090

Dwivedi, Y.K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., Duan, Y., Dwivedi, R., Edwards, J., Eirug, A., et al., 2019. Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. Int. J. Inf. Manag., 101994 https://doi.org/ 10.1016/j.ijinfomgt.2019.08.002

Fukuda-Parr, S., Gibbons, E., 2021. Emerging Consensus on 'Ethical AI': Human Rights Critique of Stakeholder Guidelines. Global Policy, pp. 1758–5899.12965. https://do i.org/10.1111/1758-5899.12965

Goasduff, L. (2019). 3 Barriers to AI adoption

Holzinger, A., Kieseberg, P., Weippl, E., Tjoa, A.M., 2018. Current advances, trends and challenges of machine learning and knowledge extraction: From machine learning to explainable AI. Int. Cross-Domain Conf. Mach. Learn. Knowl. Extr. 1–8.

Iftikhar, N., & Nordbjerg, F.E. (2021). Adopting artificial intelligence in danish SMEs – barriers to become a data driven company, its solutions and benefits. 2nd International Conference on Innovative

Intelligent Industrial Production and Logistics (IN4PL 2021). https://doi.org/10.5220/0010691800003062.

Iliashenko, O., Bikkulova, Z., Dubgorn, A., 2019. Opportunities and challenges of artificial intelligence in healthcare. E3S Web Conf. 110, 02028. https://doi.org/ 10.1051/e3sconf/201911002028

Johnk, ¨ J., Weißert, M., Wyrtki, K., 2021. Ready or not, AI comes—an interview study of organizational AI readiness factors. Bus. Inf. Syst. Eng. 63 (1), 5–20. https://doi.org/ 10.1007/s12599-020-00676-7

Kankanhalli, A., Charalabidis, Y., Mellouli, S., 2019. IoT and AI for smart government: A research agenda. Elsevier.

Libai, B., Bart, Y., Gensler, S., Hofacker, C.F., Kaplan, A., Kotterheinrich, ¨ K., Kroll, E.B., 2020. Brave new world? On AI and the management of customer relationships. J. Interact. Mark. 51, 44–56. https://doi.org/10.1016/j.intmar.2020.04.002

Makrides, A., Vrontis, D., Christofi, M., 2020. The gold rush of digital marketing: assessing prospects of building brand awareness overseas. Bus. Perspect. Res. 8 (1), 4–20. https://doi.org/10.1177/2278533719860016

Mallipeddi, R.R., Kumar, S., Sriskandarajah, C., Zhu, Y., 2022. A framework for analyzing influencer marketing in social networks: selection and scheduling of influencers. Manag. Sci. 68 (1), 75–104. https://doi.org/10.1287/mnsc.2020.3899

Pavaloiu, A., 2016. The impact of artificial intelligence on global trends. J. Multidiscip. Dev. 1 (1), 21–37.

Perc, M., Ozer, M., Hojnik, J., 2019. Social and juristic challenges of artificial intelligence. Palgrave Commun. 5 (1), 1–7.

Prince, J.R. (2006). Future advanced technology for fostering creativity in virtual teams [PhD Thesis]. University of La Verne

Samek, W., Wiegand, T., & Müller, K.-R. (2017). Explainable Artificial Intelligence: Understanding, Visualizing and Interpreting Deep Learning Models. arXiv: 1708.08296 [Cs, Stat]. http://arxiv.org/abs/1708.08296

Saura, J.R., Palacios-Marqu´es, D., Ribeiro-Soriano, D., 2021. Digital marketing in SMEs via data-driven strategies: reviewing the current state of research. J. Small Bus. Manag. 0 (0), 1–36. https://doi.org/10.1080/00472778.2021.1955127

Schaefer, C., Lemmer, K., Samy Kret, K., Ylinen, M., Mikalef, P., & Niehaves, B. (2021). Truth or dare?–how can we influence the adoption of artificial intelligence in municipalities?.

Schipmann, E. (2019). Artificial Intelligence: The cutting-edge technology that revolutionizes the digital marketing. https://essay.utwente.nl/78559/.

Shaw, J., Rudzicz, F., Jamieson, T., Goldfarb, A., 2019. Artificial intelligence and the implementation challenge. J. Med. Internet Res. 21 (7), e13659. https://doi.org/ 10.2196/13

Sun, T.Q., Medaglia, R., 2019. Mapping the challenges of Artificial Intelligence in the public sector: evidence from public healthcare. Gov. Inf. Q. 36 (2), 368–383. https:// doi.org/10.1016/j.giq.2018.09.008

Sun, T.Q., Medaglia, R., 2019. Mapping the challenges of Artificial Intelligence in the public sector: evidence from public healthcare. Gov. Inf. Q. 36 (2), 368–383. https://doi.org/10.1016/j.giq.2018.09.008

Theodoridis, P.K., Gkikas, D.C., 2019. How artificial intelligence affects digital marketing. Strategic Innovative Marketing and Tourism. Springer, pp. 1319–132

Vellido, A., 2019. Societal issues concerning the application of artificial intelligence in medicine. Kidney Dis. 5 (1), 11–17. https://doi.org/10.1159/000492428.

Wirtz, B.W., Weyerer, J.C., Geyer, C., 2019. Artificial intelligence and the public sector—applications and challenges. Int. J. Public Adm. 42 (7), 596–615. https://doi.org/10.1080/01900692.2018.1498103

Wirtz, J., Lovelock, C., 2021. Services Marketing: People, Technology, Strategy, Ninth Edition. World Scientific.