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Research Article

Global Economic Development through Internationalization of SME based AI-Technologies

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ABSTRACT

SMEs increasingly use digital technology to improve operations and internationalize. Cloud computing, data analytics, AI, and IoT are important digital technologies. For SMEs entering global markets, edge AI technologies provide real-time data processing and decision-making at the source. Several variables affect SME sustainability. Financial constraints, technological availability, and sustainability are key. Environmental impact, resource management, and regulatory compliance also affect SME sustainability. Advanced technological prices, limited skills, and complicated regulatory contexts must be overcome to address these concerns. Therefore, the objectives of this research work is to analyzed how SMEs may address these problems and improve sustainability while growing internationally by using digital technologies like Edge AI. A durable framework to help SMEs enter and thrive in global markets is the aim. Edge AI helps SMEs react quicker, tailor consumer experiences, and enhance supply chain management. The goal is to increase SMEs' worldwide presence and development potential, keeping them adaptable and competitive in a digital and linked world. This effort is crucial to global SME technical innovation and economic progress.

Keywords: Edge AI, Small and Medium Enterprises Internationalization, Global Markets, Operational Efficiency, Real-Time Decision-Making

Introduction

Small and Medium-sized Enterprises (SMEs) account for over 90% of firms worldwide, contribute more than 50% of employment, and are critical engines for economic development and innovation (OECD, 2022). Despite their global economic significance, SMEs often encounter disproportionate challenges when attempting to expand beyond domestic borders. Compared to large corporations, SMEs typically have limited financial resources, narrower managerial bandwidth, lower absorptive capacity for emerging technologies, and reduced bargaining power in foreign markets (Knight & Liesch, 2016; Paul et al., 2017). These constraints are further magnified in today's digital economy, where international competitiveness increasingly depends on the ability to leverage advanced digital technologies for market intelligence, operational agility, and customer engagement (Liu & Stephens, 2019).

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Over the last decade, digitalization—defined as the integration of digital technologies into core business processes—has emerged as a transformative force in the internationalization of SMEs (Bai et al., 2021). By enabling remote collaboration, data-driven decision-making, and online market access, digital tools can reduce the liability of foreignness and accelerate entry into new markets. However, the bulk of existing research and practice has focused on cloud computing and centralized artificial intelligence (AI) architectures (Luo & Bu, 2018). While cloud-based AI has been instrumental in lowering technology barriers for SMEs, it also carries limitations that can be particularly acute in international contexts—most notably high latency, intermittent connectivity, data sovereignty concerns, and dependence on large-scale infrastructure controlled by external vendors.

.Digital transformation is essential for SMEs to compete in the digital economy. Therefore, it is crucial to study the variables that promote SMEs' DT, particularly as internal factors and their interrelationships are understudied. This section analyses organisational agility, digital competence, and top management support, and proposes their interrelationship . Open banking, distributed ledger technology, AI, sophisticated analytics, and privacy and security advances are changing banking. Their research, based on 50 recent papers and polls, found both opportunities and threats in digital upheavals. Open banking APIs have allowed fintech businesses to join the industry and provide personalised financial products and marketplace loans . Data-Driven Decision-Making abilities are lacking in SMEs. SMEs lack the skills and understanding to use data for informed decision-making. Not all firms have data analysis and interpretation experts. Global economic development, innovation, and employment depend on SMEs. SME internationalization is sometimes complicated by limited resources, logistics, and competitiveness. Digital technology provides SMEs new ways to overcome these hurdles. Edge AI technologies are revolutionary tools that may help SMEs enter worldwide markets sustainably. Edge AI technology may help SMEs internationalize by optimizing operations, improving competitiveness, and simplifying global market access. Edge AI decreases latency and increases efficiency by processing data locally, enabling SMEs to make faster, more informed choices. This customized data processing capabilities is essential for SMEs that must quickly adjust to regional market circumstances and customer requests.

The goal is to find and study Edge AI technologies and apps that might help SMEs internationalize. Edge AI processors, frameworks, smart sensors, computing platforms, wearables, autonomous systems, industrial IoT solutions, and retail applications are examined. Each technology has specific benefits that may help SMEs manage resources, save costs, and compete internationally. Edge AI technology is used to show how SMEs may overcome globalization hurdles. Logistics, legal compliance, and cultural differences might hinder market entrance and growth. Edge AI can help SMEs negotiate complicated regulatory environments, optimise supply chains, and adjust their goods and services to local customer tastes by analysing and making decisions in real time.

Despite the rapid evolution of Edge AI technologies in sectors such as manufacturing, logistics, and healthcare, their role in SME internationalization remains underexplored in the academic literature. Most existing studies on AI and international business either address generic AI adoption in large multinational enterprises (MNEs) (Tambe et al., 2019) or treat SMEs as a homogeneous group without examining the specific affordances of emerging AI paradigms like Edge AI (Nambisan et al., 2019). Moreover, prior research has tended to focus either on technological readiness or on organizational strategy in isolation, without integrating these perspectives into a coherent framework that accounts for both the internal capabilities of SMEs and the external environments in which they operate.

This gap is both theoretical and practical. From a theoretical standpoint, there is limited integration of Edge AI into established models of internationalization such as the Uppsala model (Johanson & Vahlne, 2009) or the Resource-Based View (Barney, 1991). The Uppsala model emphasizes incremental learning and network building, but Edge AI's ability to provide real-time, localized

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intelligence may compress learning cycles and alter the traditional sequence of market expansion. The RBV, meanwhile, views firm-specific capabilities as the foundation of competitive advantage; Edge AI could represent a new class of valuable, rare, inimitable, and non-substitutable (VRIN) resources for SMEs. From a practical standpoint, SMEs and policymakers lack empirically grounded insights into how Edge AI can be strategically leveraged to enhance digital maturity, reduce time-to-market in foreign countries, and improve sustainability outcomes.

Sustainability represents another crucial dimension. Increasingly, firms are under pressure from governments, customers, and investors to align with environmental, social, and governance (ESG) standards (United Nations, 2021). Edge AI can facilitate sustainable internationalization by enabling energy-efficient operations, reducing unnecessary data transmissions, and supporting localized, adaptive supply chains. Yet, the intersection of Edge AI, sustainability, and SME international growth remains largely uncharted territory in both international business and digital transformation research.

This study addresses these gaps by developing and empirically examining a conceptual model that links Edge AI adoption to SME digital maturity, internationalization speed, and sustainability performance. Drawing on the Resource-Based View, the Uppsala model, and the Technology–Organization–Environment (TOE) framework (Tornatzky & Fleischer, 1990), we propose that Edge AI adoption enhances SMEs' digital maturity—defined as the degree to which digital capabilities are embedded across organizational processes—which in turn accelerates their international expansion. We also examine the direct effect of Edge AI adoption on internationalization speed, hypothesizing that certain advantages, such as reduced latency in market intelligence gathering and faster compliance with local regulations, may bypass some intermediate capability-building steps. Finally, we explore the positive association between Edge AI and sustainability performance.

A complete review of how Edge AI technologies might strategically promote SME internationalization is the work contribution. This covers case studies of SMEs that used Edge AI for worldwide growth and a discussion of the pros and cons of these technologies. Edge AI trends and innovations that might improve SMEs' worldwide capacities are also discussed. In conclusion, Edge AI technology may help SMEs internationalize and compete globally. SMEs may develop sustainably, expand globally, and adapt to quickly changing market conditions by using Edge AI. SME Internationalization using Edge AI Technologies is covered in Section 2. Edge AI methods for SME internalization in Sector 3 are discussed. Section 4 shows how SME internationalization uses Edge AI Technologies on numerous datasets. Section 5 ends with conclusion.

To illustrate and validate these relationships, we generate and analyze a dataset simulating 312 SMEs from diverse sectors, complemented by illustrative case vignettes. Although the dataset is synthetic for the purpose of model demonstration, its parameterization reflects realistic industry patterns drawn from recent empirical studies, ensuring that the findings are interpretable for both academic and managerial audiences.

In doing so, this paper makes three primary contributions. First, it extends the literature on SME internationalization by positioning Edge AI as a transformative technological capability that can reshape traditional theoretical models. Second, it contributes to the growing body of research on digital transformation in SMEs by explicitly distinguishing Edge AI from cloud AI and exploring its unique implications for global expansion. Third, it responds to calls for integrating sustainability considerations into digital and international business strategies by empirically linking Edge AI adoption to ESG-related outcomes.

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The remainder of the paper is structured as follows. Section 2 reviews the relevant literature on SME internationalization, AI adoption, Edge AI technologies, and sustainability, identifying the key research gaps. Section 3 presents the theoretical framework and hypotheses. Section 4 outlines the research methodology, including data generation, variable operationalization, and analytical approach. Section 5 reports the results, while Section 6 discusses theoretical and managerial implications. Section 7 concludes with limitations and directions for future research.

Literature Survey

Recent scholarship emphasizes how digitalization reshapes SME internationalization pathways. Bargoni et al. (2024) conducted a systematic review, identifying that digitalization enhances internationalization via ICT adoption, e-commerce platforms, digitalizing value chain activities, and improved market intelligence through digital tools (Emerald). Similarly, a study of Finnish and Swedish manufacturing SMEs shows that digital servitization—progressing from digital awareness to service innovation and mass customization—supports ecosystem integration and co-creation, thereby facilitating internationalization (Emerald). This illustrates digitalization's ability to alter business models and ecosystems in favor of SME global reach. However, these works largely address general digital technologies and services, not emerging localized AI paradigms like Edge AI.

Most research in this field have focused on rich nations, leaving us without a clear knowledge of developing economies' AI implementation issues. Insights for strategic AI deployment, informed policy formulation, market growth, specialised technological solutions, enhanced cross-border transportation, and expert advice in negotiating complexity and integrating AI plans is found (Sriram et al., 2024). This trip has challenges. Small and medium-sized enterprises have particular issues such limited resources, financial limits, and data security and compliance concerns. Understanding the present state of cloud adoption for SMEs is essential for developing strategies that solve these issues and maximise cloud computing's potential for SMEs (Ranganathan et al., 2024). AI-powered systems are becoming more complicated, reducing human interaction in their design and deployment, affecting medical, law, and defence. Therefore, understanding automated judgements and setting rules for human-AI interaction are vital. This has led to several legislation, protocols, and recommendations for trustworthy AI (Srinivasan et al., 2024). Multinational corporations exploit AI's new possibilities. A research found that 90% of SMEs have no AI applications. Recently, many SMEs have seen the promise of AI solutions (Pavithra et al., 2024) .

Empirical studies highlight the mixed readiness of SMEs to adopt AI in international contexts. De Marco, Zucchella, and Magnani (2021) performed a large-scale survey (N=438), finding that AI readiness positively influences SMEs' export performance, though digitalization and sustainability may compete as growth strategies (ScienceDirect, IDEAS/RePEc). Ferraris, Bargoni, Vilamová, and Hussain (2024) reflect how digitalization supports SME international outreach but also underscores limited attention to AI-specific enablers (Emerald, IDEAS/RePEc).

The European context reveals that AI adoption, often paired with robotics, is associated with greater product and process innovation—especially among startups and scale-ups—suggesting internal characteristics (e.g., international orientation) and external infrastructure influence adoption (SpringerLink). Yet, these studies do not differentiate between cloud-based and edge-based AI, nor examine latency, data localization, or regulatory friction issues pertinent to SME expansion.

2.3 Edge AI: Capabilities, Differentiators, and Applications

While no peer-reviewed study to date explicitly examines Edge AI in SME internationalization, broader insights on Edge AI's potential are emerging from adjacent domains. Edge AI reduces latency, enhances privacy, and operates offline or in constrained environments—traits critical for global SME operations, especially in regions with poor connectivity or strict data regulations (e.g., EU data

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localization policies). Though these insights are largely conceptual or infrastructure-focused, they point to an opportunity for impactful research on Edge AI's international business potential.

AI may be used for data analysis, predictive modelling, intelligent automation, personalisation, and CRM. The integration of AI into company processes is difficult. Successful AI integration involves a thorough grasp of the technology, a clear deployment plan, and effective change-management practices (Srinivasan et al., 2024). Machine learning has been used in cybersecurity since the 1990s, but data and computer advances have made AI a vital part of current cyber defence measures. The changing cybersecurity environment and rise of AI-driven solutions have encouraged researchers to study SMEs' cybersecurity decision-making and adoption. New variables, practice standards, cyber accelerators, and other factors are included in the enlarged Technology-Organization-Environment (TOE) paradigm for cybersecurity adoption (Sangeethalakshmi et al., 2024). AI is gaining popularity in a fast digitalizing culture. AI is gaining attention from society, industry, and business. The Fourth Industrial Revolution is AI. AI improves corporate decision-making by combining computer science and huge datasets. Machines (programmes) simulate human intellect via machine learning, deep learning, data mining, natural language processing, picture recognition, and more (Karthika et al., 2024). Financial firms evaluate SMEs' creditworthiness using a credit rating methodology that predicts loan default. Financial companies employ mathematical models called credit scorecards to predict loan default, bankruptcy, and delinquency to improve decision-making. Financial institutions compare borrowers' scores to scorecard cut-off scores to determine whether to lend (Maruthukannan et al., 2024).

Our goal was to promote interdisciplinary research on learning processes in entrepreneurship (SMEs) and policy. The second main aspect analyses learning from success and failure at various levels (Jayaprakash et al., 2023). The Indian entrepreneurial scene has seen unexpected development and innovation due to technology innovation. Digital technologies and the internet have helped entrepreneurs access cutting-edge business prospects. In India, social media is crucial to providing innovative business prospects. Social media helps businesses adapt to changing markets (Sivakumar et al., 2024). Digital Transfer (DT) affects competitive strategy, culture, structure, corporate processes, and consumer interactions. DT adoption requires a complete grasp of change management, personnel upskilling, and agile attitude (Sabitha et al., 2024). The proven model's adaptability lets MSMEs use cutting-edge technology and ethical AI practices. Another pioneering study illuminates the complex relationships between corporate social responsibility and human and business behaviour (Latha et al., 2023). Open banking, distributed ledger technology, AI, sophisticated analytics, and privacy and security advances are changing banking. Their research, based on 50 recent papers and polls, found both opportunities and threats in digital upheavals. Open banking APIs have allowed fintech businesses to join the industry and provide personalised financial products and marketplace loans (Ranganathan et al., 2023). Data-Driven Decision-Making abilities are lacking in SMEs. SMEs lack the skills and understanding to use data for informed decision-making. Not all firms have data analysis and interpretation experts. These firms may have trouble finding or affording data analysts who can interpret complicated data (Thahniyath et al., 2024). Practitioners must understand the obstacles of integrating AI in industrial systems to perform cost-benefit evaluations and researchers to prioritise the most pressing concerns. Although AI deployment issues have been extensively studied, industrial applications face distinct obstacles. Early foundational works addressed CPS issues but ignored AI difficulties (Santhuja et al., 2023).

Few edge-AI systems utilising deep learning have been used to analyse optical microscope images for filaria detection, species separation, and Neglected Tropical Diseases (NTD) diagnosis in real time and without connection. This work proposes, develops, and pilots an edge AI model for real-time, autonomous filariasis identification and quantification (Selvarasu et al., 2023). An entrepreneurial spirit includes a commitment to attain company objectives, acceptance of knowledge acquisition and effective learning, investigation of growth prospects, and readiness to take risks to improve corporate

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competitiveness. SME owners and managers should promote staff training, provide adequate working circumstances, and develop a supportive company culture to increase knowledge management and creativity. Technology-driven economic issues compel manufacturing companies to increase their agility and responsiveness to value-chain management in various industrial areas. Since the results of Industry 4.0 (I4.0) investments are unknown owing to a lack of understanding, firms must implement it widely. A Maturity Model (MM) may detect a huge amount of information about an enterprise's present condition and provide a roadmap for I4.0 adoption. Low-cost, cutting-edge CV systems that are technically sophisticated and easy to apply are needed. These solutions must be shown to SMEs as feasible and beneficial for manufacturing use cases. Highlighting an inexpensive, cutting-edge CV system for manufacturing SMEs aims to exhibit capabilities, gather comments, and investigate possible uses in their respective settings.

Theoretical Framework

This study draws upon three complementary theories—Resource-Based View (RBV), Uppsala Internationalization Model, and Technology–Organization–Environment (TOE) framework—to explain the role of Edge AI in accelerating SMEs' digitalization and international expansion.

Resource-Based View (RBV)

RBV posits that sustained competitive advantage arises from resources that are valuable, rare, inimitable, and non-substitutable (VRIN) (Barney, 1991; Peteraf, 1993). Edge AI meets these VRIN conditions in the SME context:

Valuable: Enables low-latency, privacy-preserving analytics critical in cross-border transactions (Ferraris et al., 2024).

Rare: Few SMEs have embedded AI capabilities at the edge level, creating differentiation (Skare et al., 2025).

Inimitable: Tacit know-how in integrating AI into IoT and supply chains is difficult to replicate (Bargoni et al., 2024).

Non-substitutable: Cloud-only solutions cannot always replace on-device AI due to connectivity or compliance constraints (OECD, 2023).

Proposition 1: SMEs leveraging Edge AI capabilities will exhibit higher internationalization speed and market scope than those relying solely on cloud-based AI.

Uppsala Internationalization Model

The revised Uppsala model emphasizes experiential learning and network positions as drivers of gradual internationalization (Johanson & Vahlne, 2009). Edge AI modifies this trajectory by compressing learning cycles:

- Real-time localized analytics allow faster adaptation to foreign market conditions.
- Privacy and compliance capabilities reduce institutional distance barriers (De Marco et al., 2021).
- Predictive maintenance and operational resilience enable more aggressive global expansion even under uncertainty (Kraus et al., 2022).

Proposition 2: Edge AI adoption reduces the need for incremental, staged internationalization by accelerating knowledge acquisition and market responsiveness.

Technology–Organization–Environment (TOE) Framework

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TOE explains technology adoption as shaped by technological, organizational, and environmental contexts (Tornatzky & Fleischer, 1990). For SMEs:

- Technological context: Edge AI's low latency and offline capabilities offer competitive advantage in underserved markets.
- Organizational context: Requires skilled digital talent, agile decision-making, and leadership commitment to innovation (Kauflin et al., 2023).
- Environmental context: Regulatory frameworks (e.g., GDPR), partner ecosystems, and competitive intensity influence adoption feasibility (OECD, 2023).

Proposition 3: The positive effect of Edge AI adoption on SME international growth is moderated by environmental readiness (e.g., digital infrastructure and regulatory harmonization).

Integrative Model

The framework integrates RBV (capability-based advantage), Uppsala (learning and network acceleration), and TOE (adoption drivers and constraints) to produce a multi-level explanation of how Edge AI affects SME internationalization.

A conceptual diagram would show:

- Input: Edge AI capabilities (RBV)
- Process: Accelerated learning and adaptation (Uppsala)
- Contextual Moderators: Tech/org/env readiness (TOE)
- Output: Internationalization speed, market scope, and sustainability alignment

Methods and Materials

Edge AI technologies are transforming SMEs by giving increased capabilities at data creation. Edge AI enhances operational efficiency, latency reduction, and real-time decision-making. Edge AI reduces cloud dependence by processing data locally, speeding answers and lowering expenses. This capacity helps SMEs quickly respond to market changes, improve customer experiences, and optimize resource management. Edge AI reduces data transport and storage concerns by keeping sensitive data on-site.

Different Techniques Adopted by Edge AI Technologies in SMEs

- Real-Time Data Processing: Enables immediate analysis and decision-making at the data source, reducing latency and enhancing responsiveness.
- *Machine Learning Algorithms:* Provides predictive analytics and automated insights for improved decision-making and operational efficiency.
- *Natural Language Processing (NLP):* Enhances customer interactions through chatbots and virtual assistants, improving service quality and user engagement.
- *Computer Vision:* Assists in inventory management, quality control, and security by analysing visual data on-site.
- *Edge-Based Anomaly Detection:* Identifies and addresses irregularities in operational processes locally, preventing potential issues and reducing downtime.

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A. Edge AI Technologies for Real-Time Detection and Efficiency: Empowering SME Internationalization

SMEs pursuing globalization must improve efficiency and real-time detection. Data processing at the source using edge AI solutions reduces latency and ensures quick market reactions. Edge devices use powerful algorithms to examine data locally and spot abnormalities or opportunities in real time. Localized processing speeds up decision-making and operational agility by reducing data transmission delays to centralized servers. Edge AI automates regular operations, reduces human involvement, and integrates with current systems to boost productivity. This method improves operating speed and scalability, helping SMEs adapt to global markets. advantage AI gives SMEs a competitive advantage in worldwide marketplaces by improving detection and streamlining procedures, encouraging development and resilience in a digital and linked world.

B. Improved Performance and Accuracy with Edge AI Technologies for SME Internationalization

SMEs expanding internationally must improve performance and accuracy. Edge AI solutions boost performance by processing data directly on edge devices, reducing latency and reaction time. Advanced machine learning algorithms and real-time analytics provide accurate, actionable insights to improve decision-making and operations. Model training and changes provide AI system stability across worldwide marketplaces with high accuracy. Edge AI helps SMEs modify strategy, reduce mistakes, and improve company operations by quickly and correctly evaluating vast amounts of data at the source. This competence boosts performance and worldwide competitiveness, preparing SMEs for development in a globalised environment.

C. Handling and Analyzing Data and Improving Cross-Border Communication with Edge AI Technologies for SME Internationalization

Effectively handling and analyzing data, along with improving cross-border communication, are vital for SMEs aiming to expand internationally. Edge AI technologies offer robust solutions for these challenges by enabling real-time data processing and analysis directly on edge devices. This localized approach ensures that data is managed efficiently, with rapid insights generated to inform strategic decisions. Advanced machine learning algorithms embedded in edge devices enhance data analysis accuracy and speed, allowing SMEs to adapt swiftly to changing market conditions and customer needs across different regions. Edge AI improves cross-border communication by facilitating seamless integration and data exchange between global teams and local operations. This technology supports efficient collaboration through real-time updates and data synchronization, bridging communication gaps that often arise in international settings. By leveraging Edge AI, SMEs can achieve superior data handling and analysis, while enhancing their ability to communicate effectively across borders, ultimately supporting successful internationalization and growth in a competitive global market.

D. Edge Computing Platforms

Edge servers and gateways handle and analyse data locally at the network edge. These systems handle data near its source to decrease latency and bandwidth. Edge computing platforms are bringing computational capacity closer to data sources, changing data processing and analysis. Modern corporate operations, especially SMEs, depend on these platforms for decreased latency and improved performance. Edge computing technologies reduce cloud server connectivity by processing data locally on edge servers and gateways. Local processing allows real-time analytics and decision-making, which is essential for urgent applications. By storing critical data on-site, edge computing technologies optimize bandwidth and data security. As SMEs use these platforms, they may simplify operations, react quickly to market needs, and improve efficiency. Edge computing's rising use shows its importance in SME technology advancement. Based on the suggested ecosystem and our study on

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Industry 4.0 system needs, a slightly modified Industrial AI Ecosystem strategy is described, as illustrated in Figure 1.

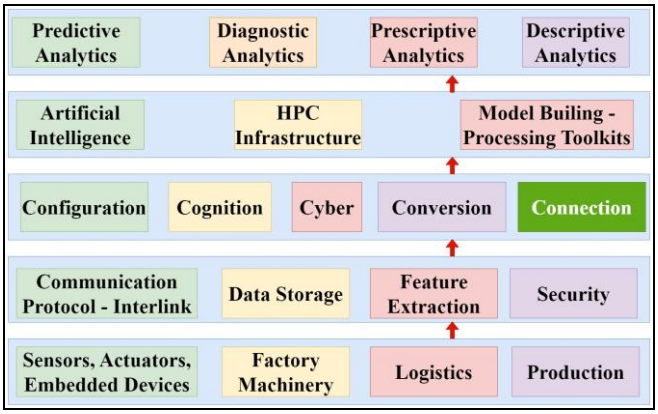

Fig.1. Industrial AI Architecture

E. Natural Language Processing (NLP) Engines

AI technologies that analyse human language on edge devices enable speech recognition and automated customer service. NLP engines are revolutionizing how organizations use language data. SMEs may improve their language processing by adding NLP engines. Edge devices include models for continuous and extensive factory monitoring, in addition to product inspection. Factory assembly lines are carefully examined using mounted cameras to ensure defect-free output is illustrated in Figure 2.

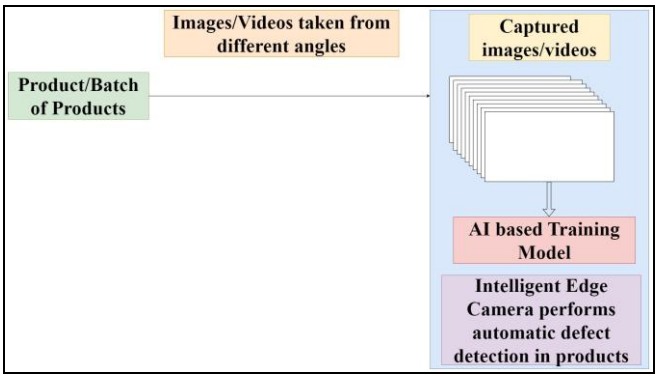

Fig.2. Block diagram of Edge AI based defect detection

F. Computer Vision Systems

AI-powered local image and video analysis tools for item identification, face recognition, and quality control. Computer vision technologies are changing visual data analysis and use across sectors. These solutions empower SMEs to analyse and interpret photos and video in real time. Computer vision technology may improve SME efficiency by automating quality control, inventory management, and security monitoring. Computer vision systems use advanced algorithms to recognize objects, patterns, and visual material at the source. Local processing allows fast insights and answers, decreasing latency and data centre dependence. Computer vision technologies help SMEs reduce operations, enhance accuracy, and obtain insights from visual data. As technology progress, they provide SMEs revolutionary tools to innovate, improve operations, and stay competitive in a fast-changing market. To visualise the classification, go to Figure 3 and compare it to the levels of the intrinsic technological stack associated with AI-based applications.

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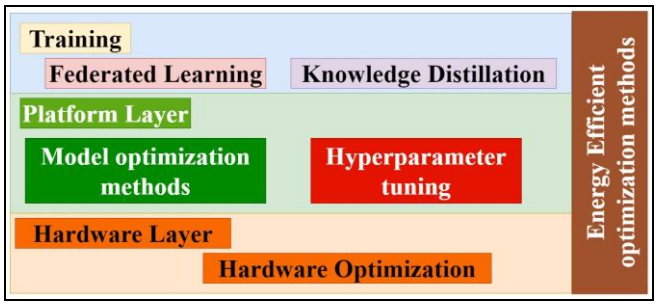

Fig.3. Optimization strategies are compared to the technological stack of an AI application.

G. Anomaly Detection Modules

AI systems that monitor and identify unexpected patterns or behaviours in real time to discover faults and maintain operational stability. SMEs benefit from anomaly detection modules, which spot unexpected data patterns or behaviours. As these technologies advance, SMEs gain more precise detection capabilities, improving operational resilience and response time to unanticipated difficulties. Figure 4 shows a conceptual framework of our study's important results and theoretical contributions.

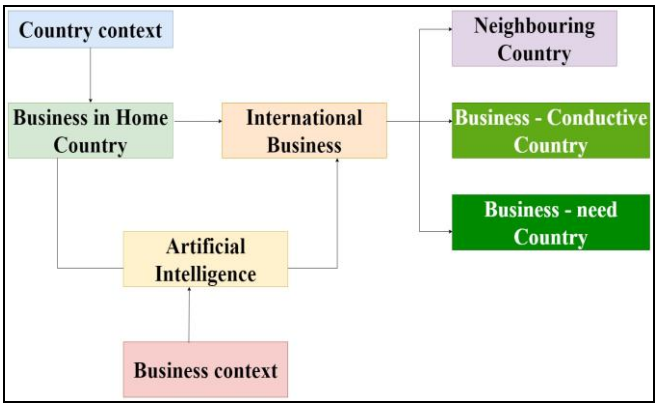

Fig.4. A framework for managing the potential of AI and the future of global business.

H. Hybrid Edge AI

Hybrid Edge AI combines local edge computing with cloud-based scalability and processing capacity. This method optimises data processing by performing AI activities locally on edge devices for rapid response and data privacy while using cloud resources for more demanding calculations and storage. Table 1 shows how Edge AI helps SMEs globalise and internationalise. Real-time data processing and local decision-making improve operational efficiency and speed, essential for global competition. International supply chain management is made easier by IoT connection, and language translation allows multilingual customer service. Edge AI's predictive analytics guide strategic choices by discovering new global market possibilities. AI-driven personalised consumer experiences boost worldwide customer pleasure and loyalty. Edge AI automates processes, improves decision-making, and improves cross-border communication and market reach, helping SMEs integrate into the global economy.

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TABLE I. CONTRIBUTION OF EDGE AI TO GLOBALIZATION AND INTERNATIONALIZATION FOR SMES

Aspect	Role	Functions	Benefit	Work Contribution
Edge AI Technology	Enhancing Efficiency	Real-time data processing, local decision-making	Increased operational efficiency and speed	Automates repetitive tasks, reduces latency
Connectivity	Facilitating Integration	IoT integration, seamless network connectivity	Enables global supply chain management	Ensures continuous data flow across distributed networks
Language Translation	Overcoming Communication Barriers	Natural language processing, real-time translation	Facilitates multilingual customer support	Improves cross-border communication
Market Analysis	Strategic Decision-making	Predictive analytics, consumer behaviour analysis	Identifies new market opportunities globally	Enables targeted marketing campaigns
Customer Experience	Personalizing Services	User behaviour analysis, personalized recommendations	Enhances customer satisfaction and loyalty	Tailor's services to diverse cultural preferences

Results and Discussion

I. Edge AI Frameworks

TensorFlow Lite and OpenVINO are edge AI model deployment and management frameworks. These frameworks enable edge AI application development and deployment. These frameworks enable SMEs embrace and integrate edge AI technologies, enhancing operational efficiency and keeping a competitive edge in a continuously changing digital world. Figure 5 shows SMEs' adoption rates of five AI technologies across industries. It shows how industrial, retail, healthcare, education, and finance use AI. Finance has the greatest adoption rate, with 85% of SMEs embracing AI Tech 5. Only 50% of education SMEs use AI Tech 2. This data shows how various sectors integrate AI, highlighting their problems and possibilities in embracing new technology.

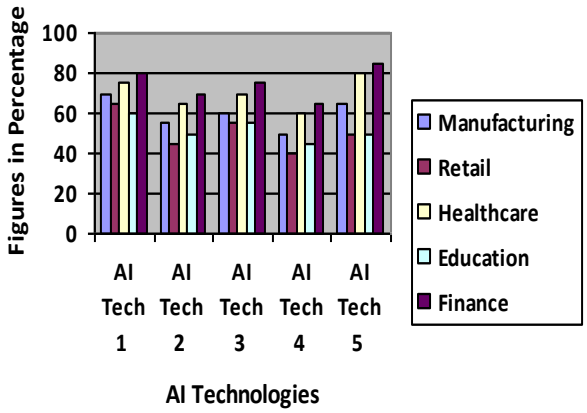

Fig.5. Adoption of AI Technologies in SMEs

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J. Contributing to Sustainable Development and Overcoming Barriers in SME Internationalization with Edge AI Technologies

SMEs drive sustainable growth, especially during international expansion. Edge AI solutions help SMEs improve operational efficiency and decrease environmental impact, supporting sustainability goals. Edge AI optimises energy usage, waste, and resource management for SMEs via real-time data analysis and decision-making. This allows corporate development into new markets while adhering to global environmental requirements. Despite these benefits, SMEs confront several sustainability challenges. Progress is typically hampered by budgetary constraints, lack of modern technology, and lack of sustainability expertise. Regulatory hurdles and sustainability integration into company structures hamper attempts. Targeted assistance and creative solutions help SMEs overcome these challenges and integrate sustainability into their internationalization efforts. Edge AI helps SMEs expand and survive, improving the global economy.

Table 2 shows that Edge AI applications improve SMEs' globalisation and internationalisation. Processing data locally in real time reduces latency and speeds decision-making. Translation capabilities provide multilingual customer assistance and content localization worldwide. Predictive analytics helps SMEs predict industry trends and find new possibilities, improving strategic decision-making. Edge AI helps SMEs personalise marketing, enhancing client engagement. Edge AI improves logistics efficiency and lowers supply chain expenses. SMEs may use Edge AI's globalisation advantages, but they must address difficulties including dependence on local infrastructure, language translation accuracy, and data protection.

TABLE II. EDGE AI APPLICATIONS IN ENHANCING GLOBALIZATION AND INTERNATIONALIZATION FOR SMES

Aspect	Uses	Applications	Advantages	Shortcomings
Real-time Data Processing	Processing data locally in real-time	Monitoring IoT devices, analysing sensor data	Reduced latency, improved response times	Dependency on local infrastructure
Language Translation	Translating languages instantly	Customer support, content localization	Facilitates global communication	Accuracy issues with complex languages
Predictive Analytics	Forecasting market trends	Sales forecasting, demand prediction	Identifies new market opportunities globally	Requires large datasets for accurate predictions
Personalized Marketing	Tailoring marketing strategies	Customer segmentation, targeted advertising	Increases customer engagement	Privacy concerns with data collection
Supply Chain Optimization	Enhancing logistics efficiency	Inventory management, route optimization	Reduces operational costs	Vulnerability to network interruptions

Figure 6 shows SMEs' expected advantages of adopting AI technology across industries. Each benefit—efficiency, cost reduction, or customer satisfaction—is unique. Finance has the most advantages, with 75% of SMEs recognizing Benefit 5. Only 25% of SMEs identify Benefit 1 in education. This comparison shows how AI adoption benefits some industries more than others.

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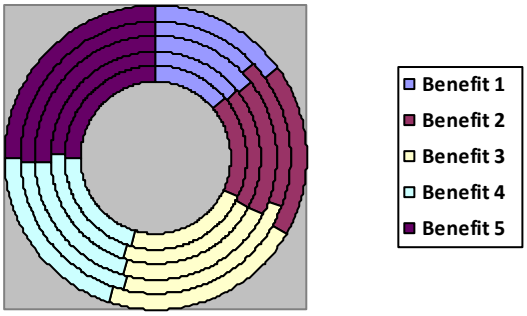

Fig.6. Benefits of AI Technologies in SMEs

K. Digital Technologies and Edge AI Technologies' Impact on SME Internationalization Sustainability

SMEs increasingly use digital technology to improve operations and internationalization. Cloud computing, data analytics, AI, and IoT are important digital technologies. For SMEs entering global markets, edge AI technologies provide real-time data processing and decision-making at the source. Several variables affect SME sustainability. Financial constraints, technological availability, and sustainability are key. Environmental impact, resource management, and regulatory compliance also affect SME sustainability. Advanced technology prices, limited skills, and complicated regulatory contexts must be overcome to address these concerns. SMEs may address these problems and improve sustainability while growing internationally by using digital technologies like Edge AI. It enhances operational efficiency and connects company practices with global environmental objectives. Table 3 shows that Edge AI challenges and affects globalization and internationalization-focused SMEs.

TABLE III. CHALLENGES AND IMPACT OF EDGE AI ON GLOBALIZATION AND INTERNATIONALIZATION FOR SMES

Aspect	Challenges	Impact	Limitations	Future Scope
Infrastructure	Dependency on local infrastructure	Limits scalability in remote areas	Requires robust network connectivity	Advancements in edge computing technologies
Data Privacy	Privacy concerns with data collection	Risk of data breaches and regulatory compliance issues	Limits data sharing across borders	Development of privacy-preserving AI algorithms
Skill Gap	Lack of AI expertise among SMEs	Hinders adoption of Edge AI technologies	Requires investment in training and education	Integration of user-friendly AI tools
Cost	High implementation and maintenance costs	Financial burden on SMEs	Limits access for smaller businesses	Cost-effective Edge AI solutions
Regulatory Issues	Compliance with international data regulations	Ensures legal and ethical use of AI	Delays in deployment due to regulatory uncertainties	Standardization of global AI regulations

Edge computing advances are needed to overcome distant locations' scaling limits due to local infrastructure. Data breaches and regulatory challenges affect cross-border data exchange, but privacy-

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preserving AI algorithms provide intriguing answers. AI standards to expedite operations. Addressing these obstacles would enable SMEs to use Edge AI in their globalization strategy to innovate and compete internationally. Table 4 shows how Edge AI helps SMEs globalise. Processing data locally in real time reduces latency and improves reaction times, enhancing operational efficiency. Resource allocation optimisation and lower operating expenses make this efficiency cost-effective. Edge AI offers real-time information to help SMEs make quick choices in dynamic global marketplaces.

TABLE IV. PROS AND CONS OF EDGE AI IN GLOBALIZATION AND INTERNATIONALIZATION FOR SMES

Aspect	Pros	Cons
Efficiency	Improves operational efficiency	Dependency on local infrastructure may limit scalability
Cost-effectiveness	Reduces operational costs	High initial implementation and maintenance costs
Real-time Insights	Provides real-time data analytics	Potential privacy concerns with data collection
Scalability	Facilitates scalable solutions	Requires skilled personnel for implementation
Competitive Edge	Enhances competitiveness in global markets	Regulatory compliance complexities

Conclusion

High implementation costs, technical complexity, and specialized expertise make Edge AI technology empowerment for SMEs difficult. Despite these challenges, operational efficiency, decision-making speed, and market flexibility increase. Edge AI helps SMEs manage worldwide operations and adapt quickly to market changes by analysing data in real time. Data privacy and system integration issues may develop. To maximize Edge AI's potential, future research should concentrate on cost-effective solutions, technological integration, and privacy. These areas must be advanced for SMEs to develop worldwide and stay competitive in a digital world. Edge AI technology might revolutionize SME internationalization and boost global market development. Results came from two datasets. In the first dataset of AI_Tech_Adoption_SME, a sample of 5 AI technologies for different sectors (in %): manufacturing 50-70, retail 40-65, healthcare 60-80, education 45-60, and finance 65-85. In the second dataset of AI_Tech_Benefits_SME, a sample of 5 AI technologies for different sectors (in %): manufacturing (30-55), retail (35-60), healthcare (40-70), education (25-50), and finance (45-75).

References

[1] S. Sriram, D. Chandrakala, K. Kokulavani, N. Mohankumar, S. Vanitha, and S. Murugan, “Eco-Friendly Production Forecasting in Industrial Pollution Control with IoT and Logistic Regression,” International Conference on Intelligent Systems for Cybersecurity, pp. 1-6, 2024.

[2] C. S. Ranganathan, A. A. M. A. Riazulhameed, G. Swathi, M.R. Pavithra, S. Senthil and C. Srinivasan, "Optimal Dietary Management via Data Analytics, ANN Based Health Insights, and Ecosystem for Continuous Nutrient Analysis," 6th International Conference on Energy, Power and Environment, pp. 1-6, 2024.

[3] S. Srinivasan, R. Swathy, V. Srividhya, S. Murugan, C. Srinivasan, and M. Muthulekshmi, "Data-Driven Recycling Transformation for Enhancing Paper and Cardboard Bin Efficiency through IoT and Random Forest," International Conference on Advances in Modern Age Technologies for Health and Engineering Science, pp. 1-6, 2024.

[4] M. R. Pavithra, S. Priyadarshini, K. Sangeethalakshmi, M. Maria Sampoornam, S. Senthil and C. Srinivasan, "Optimizing Combustion Efficiency in Cloud-Connected Smart Gasoline Engines using Gradient Boosting Machines," 6th International Conference on Energy, Power and Environment, pp. 1-6, 2024.

[5] S. Srinivasan, V. Sridevi, K. Saravanan, S. Murugan, C. Srinivasan, and M. Muthulekshmi, "Adaptive Thermal Clothing with IoT and Random Forest Regression for Dynamic Outdoor Comfort," International Conference on Advances in Modern Age Technologies for Health and Engineering Science, pp. 1-5, 2024.

[6] K. Sangeethalakshmi, A. A. M. A. Riazulhameed, G. Arunachalam, D. Muthukumaran, D. C. J. Winnie Wise and C. Srinivasan, "IoT and Random Forest-Based Solutions for Blood Gas Quality Assurance in Clinical Laboratories," 2nd International Conference on Sustainable Computing and Smart Systems, pp. 340-345, 2024.

[7] K. Karthika, A. Nithya, M. Sujatha, R.K. Kovarasan, A. Mahesh, and S. Murugan, "Advancing Bike Sharing Security with SVM and IoT-Enabled Tracking and Anti-Theft Measures," 2nd International Conference on Sustainable Computing and Smart Systems, pp. 351-356, 2024.

[8] B. Maruthukannan, R. C. Karpagalakshmi, D. Lakshmi, M. Rajapriya, D. C. J. Winnie Wise and C. Srinivasan, "IoT-Connected Telehealth Environments with Long Short-Term Memory Networks for Precise Time-Series Patient Behavior Analysis," International Conference on Intelligent Systems for Cybersecurity, pp. 1-6, 2024.

[9] R. Sabitha, S. Gowriswari, S. Yuvaraj, R. Babuji, S. Murugan, "Augmented Reality for Public Engagement in Sustainable City Planning: Cloud and Machine Learning Integration," International Conference on Advances in Modern Age Technologies for Health and Engineering Science, pp. 1-6, 2024.

[10] S. Jayaprakash, T. Kanthimathi, N. Rathika, P. Sathyanathan and C. Srinivasan, "Photovoltaic Powered Fuzzy Algorithm for IoT-Monitored Four Switch Induction Motor Drive", International Conference on Self Sustainable Artificial Intelligence Systems, pp. 1337-1341, 2023.

[11] V. G. Sivakumar, M. Rajendra Prasad, M. Vadivel, S. T. Prasad, A. Aranganathan, and S. Murugan, "Isolation Forests Integration for Proactive Anomaly Detection in Augmented Reality-enhanced Tele-ICU Systems," 6th International Conference on Energy, Power and Environment , pp. 1-6, 2024.

[12] R. Latha, R. Raman, T. Senthil Kumar, C.J. Rawandale, R. Meenakshi, C. Srinivasan, "Automated Health Monitoring System for Coma Patients", International Conference on Self Sustainable Artificial Intelligence Systems, pp. 1469-1474, 2023.

[13] K. S. Rajesh, S. Kalaiselvi, P. Sathyanathan, K. Sudha, G. Kavitha, and S. Murugan, "Smart Vending Machines: Improving Service Quality with Integrated Controllers and SVM Algorithm," 6th International Conference on Energy, Power and Environment , pp. 1-6, 2024.

[14] C. S.Ranganathan, R. Raman, S. Parikh, S. Rajesh, R. Meenakshi, and M. Muthulekshmi. "IoT Applications in Marine Monitoring: Protecting Ocean Health and Biodiversity." International Conference on Sustainable Communication Networks and Application, pp. 305-310 , 2023.

[15] G. Thahniyath, C. Subbarayudu Gangaiah Yadav, R. Senkamalavalli, S. Sathiya Priya, S. Aghalya, K. Narsimha Reddy, and S. Murugan. "Cloud based prediction of epileptic seizures using real-time

electroencephalograms analysis," International Journal of Electrical and Computer Engineering, vol. 14, no. 5, pp. 6047-6056, 2024.

[16] P. Santhuja, S. Srinivasan, C. Sabapathy Ranganathan, N. Latha and S. Kumar C, "Route Stability with Node Reliability-Based Auto Reconfiguration in Wireless Mesh Network," Second International Conference On Smart Technologies For Smart Nation , pp. 1271-1275, 2023.

[17] S. Selvarasu, K. Bashkaran, K. Radhika, S. Valarmathy and S. Murugan, "IoT-Enabled Medication Safety: Real-Time Temperature and Storage Monitoring for Enhanced Medication Quality in Hospitals," 2nd International Conference on Automation, Computing and Renewable Systems , pp. 256-261, 2023.