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The Digital Technologies and the Internationalization Efforts of a SME: A Case Study of Afer FUTE

Carolina Marques Pereira

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Carolina Marques Pereira

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Abstract

This research examines the effects of digital technologies (DTs) on the internationalization strategies of Afer FUTE, a Portuguese small and medium-sized enterprise (SME) in the manufacturing industry. The study highlights significant improvements in efficiency and product quality that have arisen from the adoption of advanced manufacturing technologies, including Computer Numerical Control (CNC) machines, robotic welding, and automated electrostatic painting. Additionally, the integration of data analytics and e-commerce platforms has enhanced market responsiveness and supported the company's international strategies. The research also addresses the challenges associated with digital transformation, such as substantial initial costs, resistance to change, cybersecurity threats, skill shortages, and integration difficulties, although not all of these were directly observed in this case study. The conclusions provide valuable insights for other SMEs aiming to leverage DTs for business growth, while underscoring that the findings are context-specific and derived from a single-case analysis. Future research directions include longitudinal studies, comparative evaluations, and the investigation of emerging technologies such as artificial intelligence and the Internet of Things (IoT).

Keywords

Digital Transformation, Advanced Manufacturing Technologies, SMEs, Robotics, E-commerce, Internationalization, Training, Digital Technologies

Resumo

Esta investigação analisa os efeitos das tecnologias digitais nas estratégias de internacionalização da Afer FUTE, uma pequena e média empresa (PME) portuguesa do setor industrial. Este estudo destaca as melhorias significativas na eficiência e na qualidade dos produtos resultantes da adoção de tecnologias avançadas de fabrico, como máquinas CNC, soldadura robótica e pintura eletrostática automatizada. Adicionalmente, a integração de ferramentas de análise de dados e plataformas de comércio eletrónico reforçou a capacidade de resposta ao mercado e apoiou os esforços da empresa nas estratégias de internacionalização. A investigação também aborda os desafios associados à transformação digital, nomeadamente os elevados custos iniciais, a resistência à mudança, os riscos de cibersegurança, a escassez de competências e as dificuldades de integração, embora nem todos estes desafios tenham sido observados diretamente no presente estudo de caso. As conclusões oferecem contributos relevantes para outras PME que pretendam aproveitar as tecnologias digitais para impulsionar o seu crescimento, sublinhando, contudo, que os resultados são específicos ao contexto estudado e baseiam-se numa análise de caso único. As futuras linhas de investigação incluem estudos longitudinais, avaliações comparativas e a exploração de tecnologias emergentes como a inteligência artificial e a Internet das Coisas.

Palavras-chave

Transformação Digital, Tecnologias Avançadas de Fabrico, PMEs, Robótica, E-commerce, Internacionalização, Formação, Tecnologias Digitais

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List of Abbreviations

3D – Three-Dimensional

AI – Artificial Intelligence.

CNC – Computer Numerical Control

CRM – Customer Relationship Management

DTs – Digital Technologies

ERP – Enterprise Resource Planning

FBA – Fulfilled by Amazon

FBM – Fulfilled by Merchant

ICTs – Information and Communication Technologies

IDC – International Data Corporation

IoT – Internet of Things

IaaS – Infrastructure as a Service

ML – Machine Learning

OECD – Organisation for Economic Co-operation and Development

PaaS – Platform as a Service

RPA – Robotic Process Automation

SaaS – Software as a Service

SMEs – Small and Medium-sized Enterprises

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1. Introduction

Firms have been long facing complex and uncertain markets, where it is challenging to keep a competitive edge that can last overtime (Sanguineti & Zucchella, 2022). They are required to promptly address and respond to external shocks within the shortest feasible timeframe (Deloitte, 2022). Small and medium-sized enterprises (SMEs) demonstrate increased organizational agility in comparison to larger companies. This is primarily due to their smaller size, enabling enhanced communication and an increased internal structure (Vanninen et al., 2022). As a result, SMEs are more adept at swiftly adapting to changes in the market. Although, it is widely recognized that they possess fewer resources, particularly in terms of financial and human capital availability (Pergelova et al., 2019). Moreover, the market is becoming progressively competitive, and establishing a presence in international markets appears to be essential for the survival of numerous SMEs (Westerlund, 2020).

Internationalization is the process by which firms expand beyond national borders to access new markets and boost competitiveness. For SMEs, limited resources often lead to the use of low-risk entry modes such as exporting, licensing, and franchising (Hill, 2007). Exporting is especially common, as it allows firms to internationalize without heavy investment (Dalli, 1995). DTs appear to have a significant impact on enabling access to foreign markets (Olejnik & Swoboda, 2012; Sinkovics et al., 2013), yet their potential in driving the international expansion of SMEs remains underexplored. DTs, encompassing production technologies like three-dimensional (3D) printing, the Internet of Things (IoT), and robotics, alongside commercial technologies such as e-commerce, are becoming more prevalent in the everyday operations of businesses across various industries and scales (Kolagar et al., 2022; Sjödin et al., 2020). As a result, these technologies are driving significant transformations in the systems, processes, management methods, and workforce of firms. For example, these nascent DTs are enabling companies to reduce operating costs and enhance interactions among stakeholders within their ecosystem, including customers, partners, suppliers, and distributors (Hervé et al. , 2020). The utilization of these technologies has resulted in a phenomenon known as digital transformation (Hanelt et al., 2021) or digital revolution (Pencarelli, 2020).

The existing body of literature has conventionally examined the integration of DTs in major corporations (Cenamor et al., 2019) or specifically pioneering enterprises, digital

startups, and high-tech giants (Ghiezzi & Cavallo, 2020). However, limited research has been conducted on the impact of digital transformation on firms' international expansion, especially in small and SMEs operating in traditional industries. In this context, DTs are particularly advantageous for SMEs as they assist in overcoming conventional obstacles such as geographical distance, limited resources, and trade restrictions (Pergelova et al., 2019). By promoting quicker and more efficient communication through value chains and facilitating data-driven decision-making, DTs equip SMEs with the necessary tools to penetrate markets that would otherwise be challenging to access (Hervé et al., 2020). However, the implementation of DTs presents its own set of challenges: SMEs frequently lack the technical know-how, infrastructure, and organizational preparedness essential for a successful digital transformation, underscoring the persistent digital divide between smaller enterprises and larger corporations (Cassetta et al., 2020).

In addition to enhancing operational efficiency, digitalization is also linked to the scalability of business models and the acceleration of internationalization. Scalability denotes a firm's capacity to expand swiftly without being limited by its current structures, and in the realm of SMEs, DTs open avenues for new revenue sources, access to cross-border markets, and expedited international deployment (Stallkamp & Schotter, 2019). Thus, digital transformation influences not only the internal operations of SMEs but also their strategic positioning in global markets. Nevertheless, many SMEs were not initially structured to scale digitally, which further elucidates why the relationship between digitalization, scalability, and internationalization remains a relatively unexplored area of research (Cassetta et al., 2020). This highlights the necessity for investigations that explore how SMEs in traditional sectors, beyond high-tech industries, utilize DTs to seek international growth (Cassetta et al., 2020; Stallkamp & Schotter, 2019).

The overall objective of this study is to thoroughly analyze the effects of DTs on the internationalization strategies of Afer FUTE, a family company that develops and manufactures ironing boards, stepladders and other household utilities located in the Oliveira de Azeméis region.

This paper is structured as it follows. Section 2 provides the main literature on digitalization, DTs, and their impact on the internationalization efforts of SMEs. Section 3 presents the methodology and objectives of this study, Section 4 presents the company's

history while Section 5 discusses the major results of the empirical analysis. Finally, in Section 6 concluding remarks and potential future research avenues are exposed.

2. Literature Review

2.1 Digital Transformation in the Context of SMEs

An examination of the existing literature indicates that digital transformation can be divided into three separate stages: digitization, digitalization, and digital transformation (Verhoef et al., 2021). The prevailing view within the literature suggests that the initial two stages, which are characterized by a more gradual approach, are critical foundations for attaining the extensive and transformative stage of digital transformation (Verhoef et al., 2021).

Firstly, digitization is the process of transforming analog information into a digital format, specifically binary code composed of zeros and ones, enabling computers to store, process, and transmit this information (Lai et al., 2010). It may also be described as the conversion of analog tasks into digital equivalents or the incorporation of information technology into pre-existing processes. More generally, digitization is viewed as the creation or enhancement of cost-efficient resource configurations using IT (Lai et al., 2010). In this context, digitization can be defined as the transformation of analog information into digital formats. For instance, examples of this process include the implementation of digital forms for ordering, conducting digital surveys, or utilizing digital applications for internal financial reporting. Importantly, digitization aims to digitalize both internal and external documentation processes while maintaining the integrity of core value creation activities (Verhoef et al., 2021).

In contrast, digitalization encompasses the application of information technology and digital tools to enhance and transform current business operations (Li et al., 2016). For example, it facilitates the development of new online and mobile communication platforms, which allow customers to interact with companies more effectively, thereby altering the conventional dynamics of firm-customer relationships (Ramaswamy & Ozcan, 2016). This shift often requires the formation of new sociotechnical frameworks that incorporate digital artifacts, enabled by advancements in digital technology. Within this context, information technology serves a crucial function as an enabler, creating new business prospects by reconfiguring processes related to communication, and the management of business relationships (Baraldi & Nadin, 2006). By utilizing DTs, organizations can refine their existing processes to enhance coordination and generate greater customer value, often

through improved user experiences (Pagani & Pardo, 2017). As a result, digitalization extends beyond mere cost reduction; it emphasizes enhancements in processes that significantly enrich customer experiences.

Finally, digital transformation signifies a thorough, organization-wide transition that encourages the development of innovative business models (Pagani & Pardo, 2017). These models may be groundbreaking either for the organization itself or for the industry at large. In essence, organizations attain a competitive edge through their business models, which are defined as structures that outline "how the enterprise creates and delivers value to customers, and then converts payment received to profits" (Teece, 2010). In this regard, the establishment of a new business model entails the adoption of innovative business logic designed to generate and capture value (Pagani & Pardo, 2017)

Digital transformation is also commonly defined as the result of incorporating a range of contemporary technologies for the purpose of gathering, storing, and analyzing data (Ma et al., 2022). These technologies include digital platforms, the IoT, artificial intelligence (AI), robotic automation, cloud computing, big data analytics, and additive manufacturing (also known as 3D printing). Specifically, digital transformations can be broadly classified into two categories: (1) digitally enabled value propositions and (2) digitalized business processes. The first category, digitally enabled value propositions encompass new forms of value that are provided to customers through digital features, addressing latent issues that were prevalent in the pre-digital era (Ma et al., 2021). By integrating digital components with traditional manufacturing capabilities, unconventional value propositions can be offered, leveraging advanced data analytics to monitor real-time functional performance (Strange et al., 2022). Furthermore, digital platforms act as intermediaries between buyers and sellers, mitigating risks associated with cross-border transactions and reducing psychic distance (Ma et al., 2021). The second category, digitalized business processes pertain to enhanced methods of generating value and coordinating within and between organizations by changing the way data is represented, connected, and combined (Adner et al., 2019). The IoT and similar technologies assist global coordinators in improving the efficiency and effectiveness of logistics, as well as accurately monitoring operations and the movement of goods along global value chains (Barbieri et al., 2022).

According to Gong and Ribiere (2021), digital transformation is a crucial process that entails a fundamental change, driven by the innovative utilization of DTs and strategic

leveraging of key resources and capabilities. The primary objective is to bring about a radical improvement in an entity and redefine its value proposition for its stakeholders.

Digital transformation can alternatively be defined as a transformative journey encompassing the integration of technological advancements to execute tasks that were previously performed by individuals or left unexplored altogether (Pereira et al., 2022). This comprehensive process has wide-ranging impacts, it alters the execution of actions within the company, thereby influencing the structure of the business and necessitating corresponding changes in various business models. Moreover, it frequently impacts the management of global value chains, entire sectors, and the operational methods employed by businesses within them. Thus, it is a complex and multifaceted phenomenon (Yu et al., 2022). It influences a range of strategies, ranging from simple software or IT product purchases to a complete overhaul of existing processes. These strategies are employed by companies of varying sizes, but they hold particular significance for SMEs as they offer the advantage of reducing distances and overcoming trade barriers, which are common obstacles for SMEs. Through these means, these technologies enable SMEs to expand their market reach to areas that would otherwise be challenging to access (Pereira et al., 2022).

Digitalization is widely recognized as a prominent force that is reshaping both society and business in the present era (Parviainen et al., 2017; Ritter & Pedersen, 2020). This transformative phenomenon has transcended its status as a mere emerging trend and is now significantly altering the dynamics of globalization in various aspects: the participants involved, the methods employed in cross-border business operations, and the direction of economic benefits (Wautelet, 2017). Indeed, effectively adapting to the digital revolution stands as the foremost medium-term challenge confronting businesses in the contemporary landscape (Aramburu & Lorenzo, 2019).

Sestino et al. (2020) argue that digitalization erases the distinctions between technology and management, enabling the integration of new business models within the framework of digital environment concepts, methods, and tools, ultimately driving digital transformation. Furthermore, digitalization, according to Gartner (2019), consists of the process of employing DTs and information to transform business operations. Huckstep (2016) argues that digitalization is causing significant changes in entrepreneurship. These changes encompass two main transformations. First, there is a shift in the location of entrepreneurial opportunities within the economy. Second, there is a transformation in the way

entrepreneurial practices are carried out. Huckstep (2016) also introduces the term "digital disruption" to describe the transformative impact of DTs and infrastructures on business, economy, and society. This disruption presents both challenges and opportunities, as it enables SMEs to expand and enter international markets. Failure to embrace digitalization can result in falling behind competitors and ultimately leading to closure, as seen with Kodak, for instance.

The process of digitalization is causing significant changes in businesses worldwide due to the effects of globalization. Over time, businesses have faced increasing pressure to undergo radical transformations. This trend is exemplified by the emergence of global companies like Uber and Airbnb, which have sustained their global presence through the utilization of technology and the introduction of innovative business models (Kraus et al., 2021).

Several DTs/tools have assumed increasing importance in the internationalization process of companies: E-commerce, advanced robotics, cloud computing, big data technologies, the IoT and AI.

E-commerce refers to the process of producing, distributing, selling, and delivering goods and services using telecommunication methods. As per the Organisation for Economic Co-operation and Development (OECD), it covers all types of transactions related to business activities involving both entities and individuals, utilizing digitized data transmission and processing, including text, sound, and visual images (Ulas, 2019). The digital revolution has given rise to "born global" small businesses and has improve their competitiveness in local and international markets by leveraging innovations in their products, services, and production methods (Ulas, 2019).

E-commerce platforms and social media play a pivotal role in reducing barriers to entry for SMEs, providing access to a broader consumer base and alleviating financial constraints. These digital tools enable companies to connect with and communicate with new customers worldwide, offering valuable insights into market trends. By leveraging these technologies, SMEs have successfully expanded their global presence, increased market share in foreign markets, and strengthened their global competitiveness (Fernhaber & Li, 2013). Engaging with international consumers through online platforms generates crucial data and knowledge, fostering a deeper understanding of global markets—an essential component of successful

expansion. Websites and specialized e-commerce platforms on a global scale provide SMEs with new avenues to market their products internationally. Moreover, social media aids in establishing relationships and interactions with customers abroad, facilitating market exploration and expansion overseas while bridging cultural gaps (Matarazzo et al., 2020).

For organizations that depend on a network of independent distributors, the adoption of DTs, such as applications, enhances collaboration with international partners, thereby fortifying relationships within the global value chain. Ignoring these digital resources presents a considerable risk and may jeopardize the firm's viability. Consequently, the incorporation of e-commerce and digital tools into business practices is essential for SMEs to maintain and expand their presence in international markets (Matarazzo et al., 2020). Advanced robotics is crucial in the digital transformation SMEs, greatly impacting their operational efficiency and internationalization efforts. These robots, utilizing AI and machine learning (ML), can execute intricate tasks with little human involvement. These technological advancements empower businesses to make more coherent strategic, tactical, and operational choices, ultimately boosting their competitiveness (Koumas et al., 2021).

The incorporation of sophisticated robotics within SMEs facilitates a transformative approach to decision-making by organizing strategic, tactical, and operational choices (Koumas et al., 2021). This structured approach enhances the coherence and interconnection of corporate decisions, thereby bolstering competitiveness. At each decision-making tier, decision-support tools and intelligent systems are designed and implemented, optimizing organizational structures to yield the most efficient responses. These tools enable operators to execute their responsibilities proficiently and make well-informed choices throughout the production process. As a result, managers transition into the role of "Manager 4.0," seamlessly integrating new technologies and sustainability into their management strategies (Koumas et al., 2021). Robotics process automation (RPA) is employed to manage repetitive tasks, allowing managers to concentrate on team leadership and strategic initiatives (Koumas et al., 2021).

Moreira et al. (2024) emphasize that the integration of advanced robotics and RPA allows SMEs to automate repetitive and time-intensive tasks, thus minimizing human error and operational expenses while enhancing productivity. These robotic solutions facilitate more agile and adaptable production processes, which are essential for SMEs aiming to remain competitive in ever-changing markets. The authors stress that, in addition to technological investment, the successful execution of these systems relies on organizational

preparedness, workforce training, and effective change management to fully leverage the advantages of robotics. Despite facing obstacles such as limited financial resources and expertise, SMEs that adopt robotics exhibit notable enhancements in their capacity for innovation and strategic decision-making.

Moreover, the integration of robotics in industrial environments enhances product quality and lowers manufacturing expenses. Innovations in interfaces and sensors, coupled with superior materials and ergonomic designs, have resulted in the creation of vehicles and machinery that require minimal or no human intervention. This transformation in the labor/capital dynamic meets societal expectations by boosting productivity and innovation while addressing labor-related concerns (Koumas et al., 2021). Industries that utilize end-user applications are swiftly embracing these advanced robotic solutions, leading to substantial enhancements in operational efficiency and product quality (Koumas et al., 2021).

Armbrust et al. (2010) provide a basic definition of cloud computing, stating that it encompasses both the delivery of applications as services over the Internet and the hardware and systems software in data centers that support these services. These offerings are typically known as software as a service (SaaS), although certain providers may also utilize the terms infrastructure as a service (IaaS) and platform as a service (PaaS) to characterize their services. Ochian et al. (2014) elaborate on cloud computing as a system that facilitates widespread access to a reservoir of on-demand computing resources. These resources encompass computing power, storage, platforms, applications, and services, all accessible via a web interface, requiring minimal administrative effort and intervention from the cloud service provider. Major providers such as Amazon, Google, and Microsoft embrace this paradigm and offer SaaS, PaaS, and IaaS cloud packages to end users. Uhl and Gollenia (2014) emphasize several benefits of adopting cloud computing within organizations. These advantages encompass enhanced user mobility due to the ability to access information from any device, increased flexibility, and cost reductions achieved by removing the necessity for extensive local installations of end-user applications and powerful client computers. Additionally, organizations can transition from fixed costs to variable costs, which ultimately enhances overall business efficiency.

More specifically, the adoption of cloud computing by SMEs has been the subject of numerous empirical studies. Research indicates that the primary motivators for adoption encompass cost reduction, scalability, and the removal of intricate in-house IT infrastructures

(Gupta et al, 2013). Nevertheless, SMEs encounter considerable challenges, especially concerning data security, privacy issues, and a deficiency in internal technical expertise (Gupta et al., 2013). Furthermore, a study carried out in the Northeast of England introduced a multi-perspective framework that underscores the importance of technological, organizational, and environmental factors in shaping cloud adoption (Alshamaila et al, 2013). These results highlight that although cloud computing offers agility and operational efficiency, the successful implementation within SMEs is heavily reliant on internal preparedness, confidence in service providers, and the strategic management of organizational change.

Cloud computing refers to internet-based information services that allow for the sharing and use of computer resources among users. Applications like iTunes and Microsoft Office enable software distribution through web browsers rather than requiring downloads to individual computers. Cloud computing also involves the storage of music, film files, photos, and documents in data centers, allowing for access from any internet-connected device. Uhl and Gollenia (2014) emphasize the benefits of cloud computing for organizations, including increased user mobility, flexibility, cost savings, and enhanced business efficiency. The ability to store and access files from anywhere and at any time contributes to the flexibility and efficiency of both individuals and businesses (Ulas, 2019).

According to Chen et al. (2014), big data is a concept that is seen as abstract. However, there are differing opinions on its definition within the academic and industrial communities. Over time, several definitions have emerged from sources such as Apache Hadoop, IBM, McKinsey & Company, and International Data Corporation (IDC).

The initial definition, introduced by Doug Laney in 2001, states big data as the 3Vs: volume, velocity, and variety (Gantz & Reinsel, 2011). This definition has since evolved, and in 2011, IDC provided a new definition for big data technologies. They describe "a new generation of technologies and architectures, designed to economically extract value from huge volumes of a wide variety of data, by enabling the high-velocity capture, discovery, and analysis" (Gantz & Reinsel, 2011, p. 6). This revised definition introduced the concept of value, expanding the model to include the 4Vs (volume, velocity, variety, and value), highlighting the tremendous value that can be derived from big data despite its low density. More recently, García and Fernández (2022) performed an extensive survey and introduced an enhanced framework consisting of seven Vs—volume, velocity, variety, value, veracity,

variability, and visualization—asserting that these seven dimensions encompass both the fundamental traits and the related challenges of modern big data, which include concerns regarding uncertainty, heterogeneity, and interpretability.

Big data can also be defined as extremely large or complex datasets that cannot be effectively processed using traditional data processing applications. It includes structured, semi-structured, and unstructured data that can be analyzed for valuable information. Big data allows designers to extract essential customer insights from existing data to enhance and develop designs (Paritala et al, 2017) For SMEs, the utilization of big data technologies and data analytics presents numerous opportunities by enabling a deeper understanding of internal operations, client and partner needs, and the broader business environment which can lead to more informed decision-making, increased efficiency, and a stronger competitive advantage (Ulas, 2019).

The global population has been surpassed by the number of mobile devices, resulting in a heightened level of interconnectivity between devices and machines (Simkó & Mattsson, 2019). This interconnection is referred to as the IoT, which distinguishes it from the conventional internet that connects people. The IoT comprises a collection of tangible items that are outfitted with sensors, enabling them to send and analyze data. This technology allows for interaction with other devices or individuals, frequently in an automated fashion. Presently, networks primarily connect individuals, but with the increasing use of monitoring devices like smartwatches, smart homes, mobile payments, and the emergence of smart cities with driverless cars, the demand for network capacity is growing exponentially. To meet this demand, communication infrastructures need to be enhanced, and the implementation of 5G technology will enable ubiquitous connectivity and support the IoT, integrating various aspects of human life (Pereira et al, 2022). By 2030, it is projected that there will be approximately 500 billion connected devices, which is about 59 times the estimated human population. This growth is expected to continue until the advent of 6G technology, which will be accompanied by widespread marketing efforts (Newsroom, 2020).

IoT is a technology that enables devices to communicate with each other over the internet by transferring data. It encompasses a wide range of interconnected devices, from basic sensors to smartphones and wearable gadgets. IoT empowers these devices to assist individuals in carrying out specific tasks, collecting information, analyzing data, and creating activities through integration with automated systems. This integration leads to improved

operational efficiency, time and cost savings, as well as reduced emissions. IoT involves everyday objects that are equipped with an IP address for internet connectivity, allowing them to transmit and receive data. These objects communicate with other network devices and systems, facilitating real-time data collection, monitoring, decision-making, and process optimization (Ulas, 2019).

Recent research emphasizes the increasing integration of IoT technology in SMEs, especially within the manufacturing industry. Hossain et al. (2021) point out that IoT allows SMEs to gather real-time data, enhance process monitoring, and optimize resource use, leading to improved operational efficiency and cost reductions. Nevertheless, akin to the challenges faced in AI adoption, SMEs encounter obstacles such as limited financial resources, a shortage of skilled workers, and issues with integrating IoT systems into their current processes. Supporting these observations, Zhao et al. (2025) illustrate that factors such as external environmental pressures, perceived advantages, support from top management, and organizational preparedness significantly affect IoT adoption behaviors. In contrast, perceived costs and complexities serve as hindrances. Their research further indicates that the intention to adopt IoT mediates these dynamics, with company size and type influencing adoption behaviors, thereby underscoring the complex factors that affect IoT implementation in businesses. The authors emphasize that customized IoT solutions, tailored to the unique requirements and scale of SMEs, along with ongoing employee training, are essential for overcoming these challenges. This strategy enables SMEs to evolve into more agile and data-centric organizations, thereby enhancing their competitiveness in an increasingly digital marketplace.

The initial proposal of AI dates to 1956 (McCarthy et al., 2006). In their work, the authors put forth the idea that every aspect of learning or any other facet of intelligence could potentially be described with such precision that a machine could replicate it. This marked the beginning of AI as a field of study. Over the years, there has been significant progress in this domain, with ML emerging as a subarea, as introduced by Samuel (1959). Unlike traditional programming, ML focuses on systems that can learn from experience autonomously. In the 1980s, ML showcased its immense potential in computational forecasting and predictive analysis, as highlighted by Bengio et al. (2013).

AI explores the cognitive processes of the human brain, examining how individuals think, learn, and make decisions when addressing challenges. It replicates the findings of this

research through advanced software. Unlike traditional programming, AI possesses the ability to learn, comprehend, and make judgments independently (Ulas, 2019). This self-sufficient capability allows AI systems to execute tasks and enhance their performance over time through learning and adaptation. In the manufacturing sector, AI is frequently utilized in autonomous robots, resulting in increased efficiency and accuracy in production operations.

Moreover, recent studies have highlighted the increasing adoption of AI in SMEs, particularly focusing on the importance of internal capabilities and competencies. A research project by Huseyn et al. (2024) examined Spanish SMEs and discovered that companies managed by individuals with advanced education, as well as those with access to IT professionals or internal digital training, were considerably more inclined to implement AI solutions. Furthermore, the utilization of enterprise resource planning (ERP) systems, marketing analytics tools, and partnerships with research institutions further enhanced the probability of AI adoption. In a similar vein, Hossain et al. (2021) highlight that although the adoption of AI can greatly enhance operational efficiency, process optimization, and decision-making within SMEs, numerous obstacles persist, including restricted financial resources, a shortage of skilled personnel, and resistance to change within organizations. Nevertheless, SMEs that successfully implement AI often witness a rise in productivity and gain a competitive edge, especially when the solutions are customized to meet their unique requirements and are backed by ongoing development of digital skills. These results emphasize that the successful integration of AI in SMEs relies not only on technological preparedness but also on human capital and strategic alliances. This is consistent with wider trends in AI advancement, where the effective deployment of intelligent systems necessitates a conducive organizational environment and continuous investment in digital competencies.

The incorporation of AI into different business operations represents a significant change. Advanced software systems capable of executing intricate functions and learning from experience contribute to boosting operational effectiveness and decision-making procedures. The progression of AI from its conceptual beginnings in the mid-20th century to present-day practical uses highlights its substantial influence on various sectors, such as manufacturing, where AI-equipped robots operate independently, thereby diminishing the necessity for human involvement (Ulas, 2019).

2.2. The Internationalization of SMEs in the Digital Age

SMEs are increasingly confronted with international competition, which necessitates their participation in global markets (Beneki et al., 2011). Some authors also define internationalization as the process by which a company operates in foreign markets and expands its activities on an international scale (Beneki et al., 2011). According to them, internationalization is crucial for companies to gain a competitive advantage in conducting business overseas. This importance becomes even more pronounced in the era of globalization and the knowledge economy, enabling the implementation of strategies that enhance internationalization, particularly for small and SMEs. However, SMEs often face limitations in terms of resources and international experience. Despite these challenges, internationalization serves as a vital source for the growth and performance improvement of companies (Pereira et al., 2022).

As noted by Masurel (2001), export activities and internationalization are essential for the survival of SMEs, as they can significantly enhance sales growth, operational efficiency, and quality improvements. Karagozoglou and Lindell (1998) assert that even companies primarily focused on domestic markets must strive for international competitiveness to secure long-term growth and sustainability. Furthermore, recent studies underscore the importance of specific skills, knowledge, and technology in aiding SMEs to formulate effective internationalization strategies, particularly in their initial phases (Beneki et al., 2011).

2.2.1 Internationalization Strategies

Most of the literature concerning international business suggests that exporting is the primary activity within this field. Historically, firms have viewed internationalization through exporting to enhance their growth (Masum & Fernandez, 2008). While exporting remains crucial, over the past decade, companies have shifted their focus towards various other business activities as methods of internationalization, recognizing their significance in achieving a competitive edge (Masum & Fernandez, 2008). Collaborations with foreign enterprises, investments abroad, and cross-border networking have gained prominence as methods for facilitating the exchange of technology and knowledge, which empower SMEs to develop robust international business strategies. Factors such as globalization, technological advancements, political shifts, and economic transformations are among the key drivers propelling the increased internationalization of SMEs in the contemporary landscape (Masum & Fernandez, 2008). Different theories regarding the internationalization

process indicate that certain categories of SMEs tend to internationalize by adhering to the 'stage model', demonstrating a cautious and gradual approach; conversely, other categories of SMEs are classified as born globals, opting to internationalize shortly after their inception (Masum & Fernandez, 2008).

According to Hill (2007) there are three fundamental entry decisions that management must evaluate prior to pursuing international opportunities:

a) The market: the one that presents the greatest appeal to the company, aiming for a balance between benefits, costs, and risks.
b) The moment to expand internationally: or the timing of entry can be categorized as either first-mover or later entrants. First movers are those companies that enter an international market before any competitors within their industry. Later entrants are those firms that venture abroad after others have already established themselves. Both first and later entrants possess distinct advantages and disadvantages. First movers can establish themselves as pioneers in the market, but they may also incur substantial costs. Conversely, later entrants can emulate first movers, mitigating risks that have already been undertaken and incurring lower costs in their endeavors. However, they may face increased competition in the chosen market.
c) The scale: a company can enter on either a large or small scale, depending on the level of commitment they are prepared to make. A large-scale entry suggests a swift approach and the allocation of considerable resources. A smaller entry allows a firm to gain insights from the selected market with reduced exposure to it.

After evaluating the three primary factors outlined above, the management team should determine the strategy for internationalization. Hill (2007, pp. 486-497) also outlines six methods through which a firm can achieve internationalization: Exportation; Turnkey Projects; Licensing; Franchising; Joint Ventures and Wholly Owned Subsidiaries.

Exporting frequently serves as the primary approach for small and SMEs venturing into international markets, primarily due to their constrained resources and moderate understanding of these markets (Dalli, 1995). This strategy enables companies to circumvent the expenses associated with foreign manufacturing while reaping the benefits of economies of scale and acquiring experience in global markets (Hill, 2007). Nevertheless, it also entails certain disadvantages, including transportation expenses, the potential cost benefits of local

production, and tariff barriers imposed by the host nations (Hill, 2007). Furthermore, previous studies indicate that SMEs encounter more significant obstacles to exporting than larger companies, primarily due to their limited managerial expertise, financial resources, and organizational capabilities (Kahiya & Dean, 2016).In contrast to well-funded firms that typically create export departments and have accumulated international experience, smaller enterprises face challenges such as currency volatility, barriers to market entry, and the necessity to modify products to comply with foreign regulations and standards (Paul et al. 2017).These limitations suggest that the export performance of SMEs is heavily affected by the availability of resources, the characteristics of the owners during the initial development phases, and their capacity to navigate procedural and knowledge-related challenges (Paul et al. 2017).

Turnkey projects are characterized by a contractor firm establishing fully functional plants or facilities for a client, typically in industries such as construction, petrochemicals, and pharmaceuticals. This approach is frequently adopted when foreign direct investment is limited (Hill, 2007). They are frequently viewed as cooperative arrangements wherein a company oversees all operations and particulars for the client in the host country, rendering them appropriate in situations where specialized expertise is necessary to assemble and operate technologically intricate processes, or when foreign direct investment restrictions are in place. Consequently, turnkey operations are perceived as less risky compared to equity-based investments, sharing this characteristic with other contractual entry modes (Vassileva & Nikolov, 2016). Whileturnkey agreements enable firms to export their expertise, and yield returns on their technological knowledge. they also restrict long-term engagement in the host country and may unintentionally foster future competition by disseminating valuable knowledge and processes (Hill, 2007).

Licensing refers to an agreement whereby a company (the licensor) permits another entity to utilize its intangible assets—such as patents or formulas—for a predetermined duration in return for royalty payments (Hill, 2007). This practice is frequently employed in sectors such as pharmaceuticals and proves advantageous for companies that lack sufficient capital or encounter regulatory obstacles to market entry. Licensing is regarded as a non-equity entry strategy, which involves comparatively low relational and performance risks for SMEs. This approach generally offers marketing assistance, technical guidance, and training while minimizing direct engagement in daily operations (Holtgrave & Onay, 2017).

Nevertheless, it restricts the licensor's authority over production, marketing, and strategic alignment. Furthermore, it can result in unforeseen competition due to the transfer of valuable expertise (Hill, 2007). The limited involvement enables SMEs to adapt by changing partners if they perceive an increase in risks, thereby emphasizing the diminished significance of trust and control in these non-equity arrangements (Holtgrave & Onay, 2017).

Franchising represents a long-term variant of licensing, wherein a company (the franchisor) permits another entity (the franchisee) to function under its brand while adhering to stringent operational standards. In exchange, the franchisor earns royalty fees that are contingent on revenue (Hill, 2007). This model facilitates swift international growth with comparatively minimal risk and investment. Franchising has gained significant traction among SMEs for both domestic and international growth, and is regarded as a collaborative, trust-oriented entry strategy that prioritizes knowledge transfer and learning (Madanoglu et al., 2017).Nevertheless, international franchising encounters further obstacles stemming from varying legal systems, possible intellectual property threats, and the necessity to strike a balance between control and independence for both franchisor and franchisee (Rosado-Serrano et al., 2018). Nonetheless, a significant challenge lies in ensuring uniform quality and service across various locations (Hill, 2007).

A joint venture is formed when two or more independent companies establish a distinct entity to share ownership, resources, risks, and management. This approach is frequently utilized to merge complementary strengths and enhance market access, as demonstrated by the partnership between Sony and Ericsson (Hill, 2007). Joint ventures provide advantages such as local market insights and shared expenses; however, they can also face challenges related to strategic disagreements and limited control over operations (Hill, 2007). Although the majority of studies have concentrated on joint ventures established by large corporations, SMEs encounter distinct challenges and opportunities in the realm of international joint ventures. Smaller businesses frequently possess more constrained resources and managerial skills, which can influence partner selection, resource sharing, and overall performance results (Lu & Beamish, 2006). As a result, SMEs may be required to implement more adaptable governance frameworks and meticulously manage their relationships to effectively address the risks and enhance the advantages of joint ventures (Lu & Beamish, 2006).Wholly owned subsidiaries represent a mode of entry in which a company possesses complete ownership, specifically 100%, of the foreign operation. This

ownership can be established through Greenfield investments or by acquiring existing companies (Hill, 2007). Although this approach allows for total control and the retention of profits, it is also the most capital-intensive option and involves a greater level of risk. Companies such as Electrolux implement this strategy to uphold a globally integrated system of production and distribution (Hill, 2007). This mode of entry is especially beneficial when transactions pertain to highly specialized assets and ongoing operations, as it enables companies to retain control over proprietary resources and establish efficient monitoring systems to reduce behavioral and transactional uncertainties (Yiu & Makino, 2002).

2.2.2 Digital Transformation and Internationalization

Information and Communication Technologies (ICTs) have emerged as a critical factor for success in internationalization strategies. For example, internet-based sales, digital marketing, and communication networks play a crucial role in facilitating the internationalization of SMEs (Beneki et al., 2011). Through these means, businesses that utilize online sales can quickly penetrate international markets and engage in flexible, decentralized networks with relative ease. Technological progress has lowered the costs associated with communication and partnership formation, allowing firms to efficiently connect with potential global business partners (Beneki et al., 2011). Additionally, such tools improve visibility and help promote distinctive products in international online markets. This enables companies across various regions can concurrently exchange knowledge, information, distribution networks, and other resources (Beneki et al., 2011).

Historically, internationalization was primarily observed in larger organizations, but with the emergence of DTs, SMEs have been able to access new markets more easily, thus leading to an increase in their internationalization efforts. These technologies have accelerated the pace of internationalization and facilitated global recognition of opportunities, as reflected in the growing trend of utilizing these means to promote, communicate, and establish partnerships. Consequently, internationalization has become a competitive necessity for many companies, enabling their survival and growth amidst challenging conditions such as globalization and the knowledge economy (Pereira et al., 2022).

A commonly referenced obstacle in the internationalization of SMEs is the lack of a definitive strategy during the early stages. The implementation of a structured management system is vital for effective internationalization, and its absence can hinder advancement (Beneki et al., 2011).

Andersson (1996) observes that business leaders frequently emphasize technology, marketing, and organizational structure over strategic planning during the internationalization journey. Comparative research between exporting and non-exporting firms indicates that organizations with formal market planning are more inclined to engage in export activities, whereas those lacking such planning face challenges in penetrating foreign markets (Brouthers & Nakos 2005).

The pursuit of international market expansion therefore requires modifications in corporate strategy to adapt to new contexts. In particular, the alignment of strategy is particularly essential for companies that are rapidly internationalizing, as they need globally coherent strategies, policies, and procedures from the outset (Beneki et al., 2011).

Beyond strategy, technology is a significant factor in the internationalization process. Technological innovations enhance communication, lower research and development costs, and facilitate the management of production across various locations. For instance, ICTs have demonstrated the ability to reduce the expenses associated with forming cooperative partnerships and have opened new avenues for internationalization (Sakai, 2002).

Though, there is still no consensus among researchers regarding the effects of digital technology on the internationalization of SMEs. Jin and Hurd (2018) found that retailing SMEs in New Zealand, which started using Alibaba's digital marketplace, experienced a facilitation in their internationalization process. Conversely, Joensuu-Salo et al. (2018) concluded that DT had no effect on the performance of fiber-based internationalized SMEs in Finland. Lee and Falahat (2019) argued that DT is a necessary condition for SMEs' internationalization, but it is not sufficient on its own. Instead, it must be combined with the development of other resources and capabilities. Similarly, Dethine et al. (2020) emphasized that DT for internationalization requires investments and changes in SMEs' internal practices, along with the mobilization of new resources and the implementation of specific capabilities to manage them.

3. Methodology Approach

The overall objective of this study is to thoroughly analyze the effects of DT on the internationalization strategies of Afer FUTE, a family company that develops and manufactures ironing boards, stepladders and other household utilities located in the Oliveira de Azeméis region.

This study follows a qualitative research methodology that helps understanding people's beliefs, behaviour, attitudes and experiences, and it produces non-numerical data (Kalra et al., 2013).

This research employs a case study method, following Yin's (1994) perspective, which involves an empirical analysis of a specific case that corresponds with the characteristics outlined by the author. This approach is particularly effective for investigating "how" and "why" questions related to a contemporary phenomenon within its real-world context. Researchers utilizing this method have limited control over the events being studied and must develop a carefully structured framework that includes clearly defined data collection techniques and analytical approaches. As per Yin, the main sources of evidence in case study research consist of documentation, archival records, interviews, direct observations, participant observation, and physical artifacts.

In this investigation, data collection emphasizes three primary methods: interviews, documental sources and direct observation. The triangulation of these data sources enhances the overall rigor and credibility of the research (Yin, 1994). It facilitates the gathering of varied and complementary information from different viewpoints, thereby enhancing both the depth and credibility of the results. Interviews function as guided discussions that provide rich, contextual insights into the phenomenon (Yin, 2009), while documents—such as organizational records and archival materials—offer corroborative evidence and historical context. Nevertheless, as Yin (2009) warns, documents should be critically assessed since they may not always accurately represent current realities, especially when they contain outdated policies or procedures. Archival records are generally more dependable due to their formal role in record-keeping (Yin, 1994). Direct observation, another crucial data source identified by both Yin (1994) and Stake (1995), entails field visits that can range from informal notetaking to structured behavioural recording, providing additional context that complements the data obtained from interviews and documents. Although other sources

such as participant observation and physical artifacts can enhance case studies, their significance is contingent upon the specific research context.

Five interviews were carried out as part of the research to gain a comprehensive understanding of the company's operations and technological practices. The first four interviews (1_SMan, 2_SMan, 3_SMan and 4_SMan) involved senior management members closely involved in strategic decision-making, while the fifth interview (5_TMan) was with a technology management professional responsible for overseeing the company's technological infrastructure and innovations (see Table 1). These interviews were instrumental in gathering detailed information and also offered diverse perspectives on the company's operations, strategic direction, and technological practices.

Table 1 - Interview Participant Profile Summary

Interviewee Identifier	**Position**	**Years at Afer FUTE**	**Interview date**	**Interview duration**
1_SMan	CEO – Afer FUTE	18	21/02/2025	31 minutes
2_SMan	Senior Manager – Afer Fute	18	21/02/2025	35 minutes
3_SMan	Senior Manager – Brazilian Branch	18	03/03/2025	45 minutes
4_SMan	Senior Manager – Brazilian Branch	10	03/03/2025	41 minutes
5_TMan	Technology Manager – Afer Fute	4	17/03/2025	55 minutes

The data analysis process for this study employed a systematic method for organizing and interpreting the information gathered from interviews, documents, and direct observations. Upon completing the interviews, all recorded material was thoroughly transcribed to guarantee accuracy and completeness. The transcriptions were subsequently

reviewed and organized thematically, which enabled the identification of recurring patterns, pertinent categories, and significant insights. This thematic arrangement promoted a more structured and coherent interpretation of the data in relation to the research questions.

To enrich the depth and reliability of the analysis, the interview data were augmented with documents supplied by Afer FUTE, which included internal reports, policies, and other relevant materials. These documents not only provided contextual support but also served as a means of triangulating the evidence gathered through interviews. Furthermore, field notes taken during direct observations were integrated into the analysis to offer additional contextual understanding and to capture real-time impressions and interactions that may not have been revealed through other sources. The observations took place from February to March 2025, aligning with the timeframe of the interviews, which facilitated a comprehensive understanding of the company's operations and technological practices.

4. The setting -Afer FUTE

4.1 The Company' History

Afer FUTE is a family-owned company, founded in 1964, with over five decades of experience specializing in the production of ironing boards, stepladders, and various household items (Afer FUTE, 2025). They manufacture products under their own Afer brand as well as for global clients. The company's history showcases the founder's entrepreneurial spirit, starting out as a metalworker to provide for his expanding family (1_SMan).

Initially, recognizing the shift from conventional metalworking to plastic, the founder began producing ironing boards in the early 1970s and later expanded into stepladders (1_SMan). As the business expanded, the necessity to broaden its range of products resulted in the creation of new items, consistently focusing on meeting the demands of the market (2_SMan).

The internationalization of Afer FUTE commenced back in 1990 when a French representative displayed interest in the company's products, initiating exports to France. The entry of the founder's children into the business further intensified international expansion, establishing partnerships and selling products in markets such as Spain, Portugal, and France (1_SMan and 2_SMan). In the 1990s and early 2000s, the company established subsidiaries in Spain (Vipmenaje), France, and subsequently in Brazil (Afer Technik). Although the French branch is no longer in operation, the subsidiaries in Spain and Brazil continue to function, with Vipmenaje recently incorporating online sales via platforms such as Amazon (2_TMan).

Afer FUTE internally control and master various manufacturing processes, avoiding the need for external subcontracting (1_SMan). This strategy allows for complete oversight of the manufacturing chain and continuous monitoring of product components (2_SMan). Internal operations encompass tube cutting and forming, metal part stamping, mesh fabrication (expanded metal), wire forming using Computer Numerical Control (CNC) machines, robotic and manual welding, automatic electrostatic painting, semi-automatic zinc coating, and assembly. Since the 2000s, the company has gradually implemented cutting-edge technologies: three robotic welding stations, semi-automatic cutting and stamping machines, CNC wire forming, automated ironing board top welding, and pneumatic assembly tools.

These advancements have minimized manual labor in repetitive tasks, improved production consistency, and enhanced ergonomics, all while maintaining the ability to customize products according to diverse client specifications (5_TMan).

The goal of Afer FUTE is to design and produce simple, innovative, attractive, functional, and reliable products that excel in every market segment (1_SMan). The company aspires to become a successful and globally recognized entity, backed by the AFER or customer brand, providing exceptional value for money and fostering a work environment where employees find fulfillment and a sense of belonging (1_SMan). Simultaneously, the company has consistently embraced digital tools for internal coordination. These initiatives enhance internationalization efforts and strengthen operational efficiency (5_TMan).

4.2 Digital Evolution and Strategic Adoption

The digital transformation journey at Afer FUTE has been gradual and strategically aligned with the company's broader business objectives (5_TMan and 1_SMan). The initiative commenced in the late 2000s with the development of electronic product catalogs (5_TMan), succeeded by the introduction of a bilingual website in the early 2010s. In the late 2010s, the organization broadened its application of PHC management software to incorporate a document management module, thereby enhancing real-time access to production and product information (5_TMan). Recognizing the increasing relevance of DTs in both production and market expansion, Afer FUTE has progressively integrated digital tools to enhance operational efficiency, product quality, and international competitiveness (5_TMan and 2_SMan).

Digitalization is now a key element of the company's strategy, focusing on enhancing internal processes and customer engagement rather than pursuing full automation. The company employs digital product catalogs, bilingual websites, and advanced management software such as PHC with document management modules. These solutions enable real-time data access, improve interdepartmental communication, and support better decision-making (5_TMan).

In production, the company has introduced semi-automated machinery, robotic welding systems, CNC machines for wire forming, and pneumatic assembly tools (5_TMan and 2_SMan). These innovations are designed to boost productivity while preserving the flexibility and customization capabilities that set Afer FUTE apart in the market. The

introduction of three robotic welders in the 2000s automated labor-intensive tasks, while CNC machines facilitated accurate shaping of wire components. Additionally, semi-automatic cutting and stamping machines enhanced both consistency and output. The use of pneumatic tools for assembly further diminished manual labor while ensuring production flexibility (5_TMan).

Sales and internationalization strategies also mirror the digital transition. Afer FUTE began utilizing in 2024 e-commerce platforms like Amazon through its Spanish subsidiary, thereby increasing market reach and brand visibility (3_SMan and 5_TMan). Nevertheless, the company carefully balances the advantages of digital sales channels with challenges such as logistics control and commission fees (5_TMan).

The primary impetus behind this digital evolution is to sustain competitiveness in a globalized market where technology enhances access to new customers and streamlines internal workflows (5_TMan and 1_SMan). While Afer FUTE appreciates technological advancements, it deliberately refrains from full-scale automation to maintain its capacity to provide customized products and respond swiftly to client demands (5_TMan).

All significant digital technology decisions at Afer FUTE were collaboratively made by the CEO and senior management, showcasing the cooperative spirit of this family-owned enterprise (1_SMan and 2_SMan). These decisions, implemented at different intervals—such as the introduction of electronic catalogs in 2008–2009, the launch of a bilingual website in 2012, the expansion of PHC software in 2017–2018, and the automation of production starting in the 2000s—were driven by the aim to improve operational efficiency, enhance product quality, provide flexibility for customized orders, and increase responsiveness to international markets. The anticipated outcomes included more efficient production processes, better coordination and decision-making, consistent product quality, and enhanced competitiveness in global markets (5_TMan and 1_SMan).

In summary, the strategic implementation of DTs by the company demonstrates a careful equilibrium between innovation and operational flexibility, thereby facilitating sustainable growth in a progressively digital business landscape (5_TMan and 2_SMan).The progression of technology adoption—from digital catalogs in the late 2000s to websites in the early 2010s, followed by PHC with a document module in the late 2010s, then advancing to semi-automated production machinery, robotic welding, and e-commerce integration—

demonstrates a calculated, incremental approach that is in harmony with global expansion and operational effectiveness (5_TMan and 3_SMan).

5. Results and Discussion

The adoption of DTs at Afer FUTE has notably transformed its production processes, operational structures, and strategies for international expansion. These transformations are central to the aim of this study, which is to thoroughly analyze the effects of DTs on the internationalization strategies of FUTE. Insights gathered from interviews and site observations reveal significant findings that underscore the substantial effect of these technologies on the company's efficiency, product quality, and global presence. These findings support existing literature that highlights how digital transformation facilitates SME competitiveness and international expansion (Huseyn et al., 2024; Barbieri et al., 2022; Koumas et al., 2021).

5.1 Production Processes and Operational Frameworks

Following the adoption of advanced manufacturing technologies by Afer FUTE, including CNC machines, robotic welding, and automated electrostatic painting, the company has successfully streamlined its production processes. According to the interview with the Technology Manager (5_TMan), the incorporation of these technologies has led to a decrease in production time, enhanced accuracy increased adaptability in product customization and greater predictive control over operations, which is in line with the company's strategic goal of balancing efficiency and flexibility. This observation is consistent with existing literature regarding digital transformation in SMEs, which highlights the benefits of efficiency improvements, reduction of errors, and enhanced product quality through automation and precision technologies (Barbieri et al., 2022 Koumas et al., 2021; Moreira et al., 2024).For instance, the utilization of robotic welding has reduced human error improved the uniformity of welds, and decreased operator fatigue which is essential for the structural soundness of items such as stepladders and ironing boards. As stated by 3_SMan, the implementation of three robotic welding units has not only reduced the physical burden on operators but also enhanced the uniformity of the final product. Moreover, the integration of CNC machines has enabled the creation of more intricate and accurate metal components, leading to innovative product designs that cater to a variety of market needs. The Technology Manager (5_TMan) emphasized that CNC technology enabled the company to tailor components effectively, addressing particular client needs with greater accuracy.

The implementation of the automated electrostatic painting process represents a notable advancement in technology. This technique guarantees consistent and resilient coating on products, thereby improving their visual attractiveness and lifespan. The Technology Manager (5_TMan) highlighted that this approach enhanced durability standards, which is essential for fulfilling the expectations of international clients, especially in markets with rigorous quality demands.

Furthermore, FUTE has integrated semi-automated cutting and stamping machines, automatic welding machines for ironing board tops, and a CNC wire shaping machine, all of which enhance consistency and increase production volumes. The CEO (1_SMan) observed that these semi-automated technologies achieve a balance between volume and customization, thereby maintaining the company's competitive advantage. Custom pneumatic tools have been designed to alleviate the physical demands of product assembly, thereby promoting better ergonomics for employees. These technological advancements were strategically implemented, focusing on specific segments of the production process, rather than pursuing complete automation—thereby maintaining the flexibility and adaptability that characterize the company's competitive advantage.

As emphasized in the interviews, this hybrid strategy has allowed FUTE to cater to various customer requirements while simultaneously improving efficiency in repetitive tasks. This method was validated by both the Technology Manager (5_TMan) and Senior Management (2_SMan), who emphasized the significance of adaptability in addressing various market needs. Digital tools such as PHC software with document modules, Excel spreadsheets with integrated formulas have also been introduced to facilitate real-time production monitoring and internal communication. These digital innovations support informed decision-making and enhance coordination at the section level.

Additionally, the implementation of a semi-automated zinc coating procedure has enhanced the strength and anti-corrosion properties of metal parts. This innovation is especially crucial for items marketed in damp environments, as corrosion can greatly impact the longevity of the product. As emphasized by both the Technology Manager and Senior Management (Interviewees 5_TMan, 1_SMan and 2_SMan) this process not only enhances the durability of the product but also minimizes warranty claims and returns, thereby ultimately improving customer satisfaction and increasing the company's profitability.

Interviews additionally disclosed that incorporating IoT-enabled sensors into CNC and robotic machinery facilitates real-time performance monitoring and predictive maintenance, thereby minimizing downtime and guaranteeing production continuity (5_TMan). This technological strategy is consistent with literature that highlights the significance of smart manufacturing and Industry 4.0 in improving the competitiveness and flexibility of SMEs (Hossain et al., 2021; Huseyn et al., 2024).

Notwithstanding these advantages, interviewees recognized various challenges linked to digital transformation. The integration of numerous digital systems, such as CNC, robotic welding, ERP, IoT sensors, and PHC software, necessitated considerable modifications in workflow coordination and employee training (5_TMan, 1_SMan). Initially, some operators displayed resistance to the adoption of new automated systems, which required continuous training and oversight to facilitate a smooth transition (3_SMan, 5_TMan). Furthermore, the increasing dependence on IoT and real-time monitoring brought forth cybersecurity issues that needed to be addressed to safeguard operational data and maintain production continuity (5_TMan).

In addition to the clear operational enhancements, data from interviews indicate that these technological implementations are part of a larger strategic goal to internalize production processes, thus enhancing control over quality and lead times. The Technology Manager (Interviewee 5_TMan) underscored how digitalization has facilitated the company's transition from reactive to proactive manufacturing—foreseeing defects and minimizing waste—aligning with the tenets of Industry 4.0 (Hossain et al., 2021).

The implementation of digital manufacturing technologies such as CNC and robotic welding is also vital for customization and adaptability, catering to the growing demand for personalized products in global markets. This adaptability reinforces the literature's assertion that DTs enable SMEs to innovate swiftly and meet diverse customer requirements, thereby boosting competitiveness in international value chains (Huseyn et al., 2024). These observations were corroborated during discussions with Senior Management and Production Supervisors (Interviewees 1_SMan and 3_SMan), who emphasized how digital tools have facilitated quicker adjustments to customer demands.

Furthermore, the interviewees emphasized that the ERP system facilitates the integration of production, inventory, and sales data, which aids in making data-driven

decisions and allows the company to predict production requirements based on global demand trends (2_SMan, 3_SMan). This supports the conclusions drawn from the literature that highlight the significance of big data and analytics for SMEs in overseeing international operations (Lee & Falahat, 2019; Paritala et al., 2017).

Moreover, the semi-automated zinc coating process illustrates how the company utilizes technology to comply with environmental and regulatory requirements across various markets, which is a crucial element for achieving international success (Barbieri et al., 2022). Both Senior Management and the Technology Manager (Interviewees 1_SMan and 5_TMan) noted that this process not only safeguards the product but also aligns with sustainability trends, enhancing reputational value and aiding entry into eco-sensitive markets.

The integration of hybrid DTs—merging automation with semi-manual processes—has enabled FUTE to sustain flexibility for small-batch production and custom orders, which is especially pertinent for international clients with specialized product requirements (1_SMan, 3_SMan). This supports existing literature that highlights the advantages SMEs gain from adaptable digital strategies to swiftly address varied global market demands (Koumas et al., 2021; Moreira et al., 2024).

Afer FUTE's modernization of its production and operational framework exemplifies a thorough approach to digital transformation—integrating automation, quality assurance, and strategic independence. This cohesive strategy supports the literature's view that DTs must be comprehensively integrated into manufacturing SMEs to fully realize their potential for efficiency, quality, and innovation (Barbieri et al., 2022; Koumas et al., 2021).

Ultimately, interviewees pointed out that although these technological advancements offer substantial operational advantages, they also demand meticulous management of expenses, staff skill enhancement, especially for new systems whose benefits may only become apparent over the medium to long term (1_SMan, 5_TMan).

5.2 Impact on Internationalization Strategies

DTs have been instrumental in Afer FUTE's endeavors to expand internationally. The organization's internal oversight and regulation of the complete manufacturing process, facilitated by sophisticated digital systems, have guaranteed uniform product quality—an essential element for sustaining a competitive edge in global markets (1_SMan and 2_SMan). This internal oversight corroborates the literature that highlights how digitalization in manufacturing enables companies to fulfill the stringent quality requirements set by international clients and distributors (Barbieri et al., 2022).

Interviewees (2_SMan, 3_SMan and 4_SMan) underscored the importance of digital tools, including advanced data analytics and e-commerce platforms, in recognizing new markets and customizing products to fit specific regional preferences. 3_SMan and 4_SMan specifically pointed out that data analytics empower the company to track consumer behavior and regional demand trends, facilitating accurate product customization to satisfy international market requirements. This perspective is consistent with the assertion made by Lee and Falahat (2019) that data-driven decision-making enhances a company's ability to effectively adapt to the ever-changing global markets.

For instance, 3_SMan and 4_SMan detailed how Afer FUTE utilized data analytics to recognize an increasing demand for lightweight and portable ladders in European markets. This understanding directly impacted the creation of a new product line tailored to this demand, leading to a notable rise in sales in those areas. This real-world example demonstrates how digital transformation facilitates proactive market responsiveness, which is an essential factor for successful international growth (Kraus et al., 2021).

Moreover, 2_SMan, 3_SMan, and 4_SMan emphasized that the strategic implementation of e-commerce platforms expanded Afer FUTE's global presence by enabling direct-to-consumer sales. This shift diminished dependence on intermediaries, enhanced profit margins, and allowed for the gathering of real-time customer feedback, which subsequently guided continuous improvements in products and services. This aligns with recent studies that underscore the importance of digital platforms in facilitating SME internationalization by improving customer engagement and operational efficiency (Ma et al., 2022).

Interviewees also pointed out that the incorporation of digital marketing tools, including social media analytics, has enabled Afer FUTE to more effectively reach international customers, recognize emerging trends, and customize promotional campaigns for various markets (4_SMan). This aligns with literature that underscores the importance of digital marketing as a crucial facilitator for the internationalization of SMEs, especially for family-owned businesses with a limited physical presence overseas (Jin & Hurd, 2018; Pereira et al., 2022).

Afer FUTE's experience with its Spanish subsidiary, Vipmenaje, further exemplifies this dynamic. The company's initial involvement in Amazon's FBA (Fulfilled by Amazon) program which took place in recent years was motivated from the necessity to rapidly broaden international sales channels, enhance brand visibility, and leverage Amazon's logistics and Prime delivery services. As stated by interviewees 2_SMan and 3_SMan, this strategy was designed to assess the international market demand for FUTE products while keeping the initial investment in distribution infrastructure to a minimum..However, the substantial fees and limited control over returns prompted the company to shift towards the Fulfilled by Merchant (FBM) model. While this transition resulted in a temporary decline in sales, it enabled Afer FUTE to regain control over logistics and customer interactions—underscoring the necessity to balance platform advantages with operational independence. These modifications illustrate a developing comprehension of digital sales strategies in international settings.

Furthermore, 2_SMan, 3_SMan, and 4_SMan underscored the significance of implementing a cloud-based inventory management system as a vital facilitator of operational coordination. This system offers real-time inventory visibility, minimizing stockouts and delivery delays, thus guaranteeing the prompt fulfillment of international orders. These enhancements are consistent with the observations made by Armbrust et al. (2010), who highlight cloud computing as a catalyst for supply chain agility and improved coordination in global operations.

The implementation of customer relationship management (CRM) software, which is integrated with the organization's e-commerce platform, has significantly enhanced the management of international customer relationships. According to the interviewees, this integration facilitates improved monitoring of customer interactions, enables more focused marketing strategies, and enhances post-sale support. These developments corroborate the

conclusions drawn by Nguyen and Mutum (2012), who illustrate that CRM systems are essential in promoting customer satisfaction and loyalty—crucial elements for maintaining international business relationships.

2_SMan and 4_SMan emphasized the strategic significance of technological independence, indicating that reducing reliance on external suppliers enables Afer FUTE to quickly adjust to various regional regulatory and market demands without compromising lead times or escalating costs. This ability is acknowledged in the literature as vital for SMEs aiming for sustained international competitiveness (Hossain et al., 2021).

Another significant instance is the semi-automatic zinc coating process employed by the company, which has improved corrosion resistance and durability—an aspect that is particularly crucial for humid international markets. This enhancement exemplifies how digitalization not only fosters efficiency but also improves product quality in accordance with specific market demands.

Similarly, Afer FUTE's targeted investments in robotic welding, CNC machinery, and automated stamping machines—despite not achieving full automation of the production line—illustrate a well-rounded approach to digital transformation. These advancements have increased production consistency and capacity while maintaining the necessary flexibility to accommodate customized international orders. This approach aligns with the observations made by Barbieri et al. (2022) regarding the impact of Industry 4.0 technologies on enhancing production agility.

The interviews indicated that digital platforms have also played a significant role in fostering strategic international partnerships. For instance, 2_SMan and 3_SMan noted that the use of collaborative platforms has allowed Afer FUTE to coordinate with distributors and logistics partners across different countries more effectively, ensuring product availability and timely deliveries. This corroborates literature that emphasizes the role of digital tools in assisting SMEs with the management of complex international supply chains and partnerships (Beneki et al., 2011; Pereira et al., 2022).

Despite these advancements, 2_SMan and 3_SMan recognized the challenges associated with human capital and cultural adaptation. The organization must consistently invest in organizational learning to tackle cultural disparities in international markets and to surmount obstacles presented by an aging workforce, especially at the Portuguese

headquarters. These observations align with the findings of Westerlund (2020), who underscore human capital as both a crucial facilitator and a potential hindrance in the processes of digital transformation and international expansion.

All interviewees highlighted that the rapid advancement of technology necessitates continuous upskilling. Although there are internal training programs available, addressing the skill gaps between generations continues to be a significant challenge. This observation reinforces the argument made by Kraus et al. (2021), who emphasizes the critical role of ongoing training in fostering digital innovation.

Moreover, interviewees highlighted the importance of technology in promoting strategic learning and market intelligence for internationalization. 4_SMan pointed out that dashboards that integrate sales, production, and market analytics enable managers to make swift decisions regarding product adaptation, pricing, and promotional strategies in various countries. This demonstrates how digitalization transcends mere operational efficiency to encompass strategic decision-making, reinforcing literature that identifies digital capabilities as essential for the successful internationalization of SMEs (Lee & Falahat, 2019; Beneki et al., 2011).

Although successes have been attained, interviewees pointed out challenges linked to digital transformation, including the substantial initial implementation costs, resistance to change from seasoned employees, possible cybersecurity threats, a lack of specialized digital skills, and challenges in merging legacy systems with new technologies. However, it is important to note that not all of these challenges were directly evident in the current case study (5_TMan, 2_SMan, 3_SMan). Addressing these obstacles necessitates ongoing strategic planning and investment in training to guarantee the sustainability of digital initiatives and the success of international operations.

The digital transformation at Afer FUTE has significantly impacted its internationalization strategies by improving product quality control, facilitating data-driven market insights, broadening direct sales channels, and enhancing cross-border operational coordination. The roles of 2_SMan, 3_SMan and 4_SMan emphasize the practical and strategic importance of DTs in enabling the company to compete effectively in various international markets, thereby reinforcing theoretical views on the necessity of integrated

digital capabilities for the global expansion of SMEs (Barbieri et al., 2022; Ma et al., 2022; Lee & Falahat, 2019).

Lastly, the interviews underscored that DTs have enhanced the company's ability to respond to market fluctuations and regulatory demands in foreign markets. The capacity to simulate production scenarios, predict demand, and digitally monitor compliance has been a pivotal factor in empowering FUTE to confidently enter new markets and sustain long-term international competitiveness.

6. Conclusion

6.1. General Conclusions

The case study of Afer FUTE illustrates how DTs can significantly impact operational and strategic dimensions in the context of a single SME. By strategically adopting advanced manufacturing technologies, including CNC machines, robotic welding, and automated electrostatic painting, Afer FUTE has realized considerable improvements in production efficiency, accuracy, and product quality. These innovations have not only optimized manufacturing processes but have also enabled the company to satisfy the rigorous quality standards of global markets.

The integration of data analytics with e-commerce platforms has been vital in enhancing Afer FUTE's capacity to adapt to market fluctuations and pursue global growth. The insights gained from data have allowed the company to tailor its products to meet specific market demands, leading to higher sales and an expanded international footprint. Although the rise of e-commerce platforms has created new avenues for customer access and streamlined transactions, the interviews lacked comprehensive metrics regarding customer engagement or sales conversion; therefore, the strategic advantages of e-commerce should be viewed with caution and considered within the context of the case.

Although not the primary emphasis of the interviews, several challenges linked to digital transformation were noted, especially those concerning human resources, including the aging workforce and the necessity for ongoing training. These limitations highlight that the digital transformation journey, while advantageous, is not devoid of difficulties. The scant mentions of cost pressures, integration challenges, and employee adjustment imply that these matters may be present, yet additional research would be required to reach more comprehensive conclusions.

The lessons learned from Afer FUTE's experience provide preliminary strategic guidance for fellow SMEs venturing into digital transformation. To begin with, the implementation of cutting-edge manufacturing technologies can result in notable enhancements in productivity and product quality. Additionally, utilizing data analytics can enrich comprehension of the market and boost responsiveness. Furthermore, incorporating cloud-based systems can enhance operational adaptability and optimize resource allocation.

Finally, integrating CRM systems with e-commerce platforms can streamline sales procedures and elevate customer interaction.

In conclusion, this case underscores the ability of DTs to enhance growth and international competitiveness in the context of SMEs. By successfully tackling internal obstacles and maintaining investment in digital innovation as well as workforce skills, SMEs such as Afer FUTE can bolster their strategic positioning and develop long-term resilience in the progressively digital global marketplace.

6. 2 Limitations and Future Research Directions

This case study offers a thorough examination of the influence of DTs on Afer FUTE; however, additional research is required to investigate lasting effects and possible obstacles. Subsequent studies may concentrate on analyzing the enduring impacts of digital transformation on business efficacy and competitive edge. A longitudinal assessment would offer more profound insights into how continuous utilization of DTs affects different facets of business activities and market positioning as time progresses.

Furthermore, conducting comparative studies may prove advantageous in comprehending the experiences of various SMEs across different sectors. Through the analysis of these experiences, researchers can uncover shared success factors and obstacles, thereby providing a more comprehensive view of the digital transformation process and its effects on a range of business contexts.

Another promising area for future research is the impact of emerging technologies, such as AI and IoT. Investigating how these technologies can further enhance manufacturing processes and internationalization strategies will provide valuable information on the next wave of digital transformation. This can help businesses prepare for and adapt to the rapid technological advancements that continue to reshape the global market landscape.

Appendix

Interview Guide

1. Can you briefly describe the history and main objectives of FUTE?

2. Which internationalization strategies has FUTE implemented?

3. How have these strategies evolved over time?

4. What was the main reason for FUTE to start exploring international markets?

5. Which digital technologies are used? How have they evolved?

6. How has digital transformation been implemented in the company? Which digital technologies or platforms has FUTE adopted so far?

7. How has digital transformation affected FUTE's operations, both in the domestic and international markets? Have there been changes in internal processes?

8. How does FUTE use digital tools (such as social media, e-commerce, robotics) to reach international markets? Have these tools helped to increase the company's presence abroad?

9. How has digitization impacted the company's decision-making regarding the choice of new international markets?

10. Are there any specific challenges or difficulties when trying to expand into international markets using digital technologies? How has the company dealt with these challenges?

11. How does FUTE manage communication and relationships with its international partners (suppliers, distributors, etc.) through digital transformation?

12. What results has FUTE observed in its internationalization strategy after adopting digital transformation?

13. What are the next steps for FUTE in terms of using digital transformation in its internationalization strategies?

14. In your opinion, what is the greatest impact of digital transformation on SMEs such as FUTE in the internationalization process?

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