



DIGITAL TRANSFORMATION  
AND THE INTERNATIONALIZATION OF SMALL  
AND MEDIUM-SIZED FIRMS

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**Abstract**

**Purpose.** We propose a reflection on the role of technologies in the internationalization process of small and medium-sized enterprises (SMEs).

**Design/methodology/approach.** Through a narrative literature review, we comprehensively synthesize the current state of the art of literature, including academic and non-academic findings.

**Findings.** The study's outcomes confirm the role of digital technologies (DTs) as tools to support SMEs' business processes and, more specifically, their internationalization process. We propose a summary of the main impacts of adopting DTs and the related barriers that SMEs may face along the process.

**Practical and Social implications.** Many companies have recently had to change how they do business to respond to the new market needs and to everything that the new realities have brought, such as the shortage of raw materials or the significantly increased cost of logistics and transport. At the same time, however, these external forces have boosted processes and trends such as digital transformation. Such a process can help, for example, to reach foreign markets or to create international partnerships and collaborations; however, its impact varies depending on the size, sectors, and countries in which businesses operate. Understanding both the impact and the barriers they may face while engaging in the digital transformation process is of high importance not solely for the successful implementation of these DTs but also for the survival of the firm itself.

**Originality of the study.** Most academic literature seems to focus mainly on the determinants of DTs' adoption. Nevertheless, there is an increasing interest in investigating their role in SMEs' international growth process. Thus, we highlight how these DTs could actively help SMEs' survival and success.

## 1. Introduction

Companies have long been coping with increasingly uncertain and complex markets (Ghobadian et al., 2020; Hoisl, Gruber, & Conti, 2017), where it is difficult to maintain a competitive advantage that lasts over time (Elia et al., 2021; Lindskov, Sund, & Dreyer, 2021; Mahto, Ahluwalia, & Walsh, 2018). They must respond and react to external shocks in the shortest possible time (Deloitte, 2020). On the one hand, small and medium-sized enterprises (SMEs) appear to have more agile organizations than large enterprises. This is mainly due to their small size allowing faster communication and a more agile internal organization (Vanninen et al., 2022), thus allowing them to react more readily to market changes. On the other hand, it is well known that they have more limited resources, especially regarding the availability of financial and human capital (Pergelova et al., 2019; Tseng & Johnsen, 2011). However, the market is increasingly competitive, and the presence in foreign markets seems to have become a necessity for the survival of many SMEs (Durmaz et al., 2015; Westerlund, 2020). Digital technologies (DTs) seem to play a key role in facilitating access to international markets (Olejnik & Swoboda, 2012; Sinkovics et al., 2013), though their contribution to the international growth of SMEs has not been explored enough.

Academic contributions mainly focus on the determinants of adopting, disseminating, and implementing specific digital solutions such as the Internet, e-commerce, and IoT (Fosso Wamba and Carter, 2016; Pradhan et al., 2018; Gregory et al., 2019; Cassette). Little attention is addressed to the impact of these and other technologies on a company's different growth pathways. Some authors have highlighted how these technologies can help companies expand in foreign markets (Olejnik & Swoboda, 2012; Sinkovics et al., 2013), mainly focusing on the international expansion of start-ups or young companies (i.e., Piqueras, 2020; Überbacher et al., 2020; Veglio & Romanello, 2020). Established SMEs, which represent the overwhelming part of the Italian production system, are instead hardly considered (Confindustria & Cerved, 2022). This, in turn, highlights existing gaps within the current academic literature, particularly concerning the actual role of these technologies in SMEs' internationalization process, but also the barriers and difficulties SMEs face in this realm. Thanks to a narrative literature review that highlights findings from academic and non-academic works and focuses on Italian SMEs, the current study starts filling the gaps mentioned above and calls for scholars' attention to the topic by examining how digital transformation can support SMEs' internationalization.

Digital technologies, which include both production technologies such as 3D printing, the Internet of Things (IoT), and robotics, as well as commercial technologies such as e-commerce, are increasingly present in the

day-to-day reality of businesses of all sectors and sizes (Kolagar et al., 2022; Sjödin et al., 2020). The increasing use of these technologies has led to a process that is identified as a digital transformation (Hanelt et al., 2021) or digital revolution (Pencarelli, 2020). It is often questioned what is actually meant by this concept, which definition in both academic and grey literature is generally unclear also because of the variety of potential technologies and tools available (Elia et al., 2021; Rachinger et al., 2019; Ulas, 2019). In the context of the current study with the term digital transformation, we mean a process of change that involves the adoption of technologies to carry out actions previously undertaken by individuals or not launched at all (Raimo et al., 2021). This transformation has a cross-cutting impact. On one side, it changes how actions are carried out within the company, thus influencing the business organization and the various business models that should be changed accordingly (Cassette et al., 2020; Spiezia, 2012). On the other side, it also often affects the management of global value chains, entire sectors, and how a business operates within them. It is, therefore, a complex and multi-faceted phenomenon. It influences a range of different strategies, from the simple purchase of software or IT products (such as a CRM tool) to a total revision of existing processes (e.g., purchase and positioning of 3D printers close to the end consumer or adoption of smart solutions such as IoT or robotics for warehouse automation).

DTs have thus become one of the most powerful forces for transformation in economic systems and enterprises (Raimo et al., 2021; Salvi et al., 2021; Vitolla et al., 2020). These are used by companies of different sizes but are particularly important for SMEs as they have the advantage of reducing distances and some trade barriers, typical limits for SMEs (Pergelova et al., 2019; Tseng & Johnsen, 2011). Such technologies allow for expanding horizons to markets that would otherwise be difficult to reach (Denicolai et al., 2021; Raimo et al., 2021). Some DTs (e.g., IT software and blockchain technology) allow for better communication within the organization and more effective communication with actors upstream and downstream along the value chain. Thus, communication becomes more accessible and faster, allowing anyone to easily create and share information (Hervé et al., 2020; Raimo et al., 2021). Other DTs, on the other hand, may have effects on the production chain (e.g., 3D printing and robotics), on in-house security (e.g., IoT), or allow more efficient data collection and analysis for competitive advantage (e.g., artificial intelligence).

On the other hand, digital transformation for SMEs is a complex process because it requires specific resources and expertise that are difficult to find. No less crucial to making such a transition is the need for a change in organizational structures, business culture, and business models (Cassetta et al., 2020; Raimo et al., 2021; Taiminen & Karjaluo, 2015). In light of this, despite the adoption of DT bringing numerous benefits for SMEs

(Eller et al., 2020; Fisher et al., 2018; Jones et al., 2014; Martín-Peña et al., 2020), to date, they still face several difficulties in their full adoption and implementation (Raimo et al., 2021) which widens the digital divide with large companies (Bughin et al., 2017; Casset al., 2021). These difficulties are mainly attributable to infrastructural and institutional constraints and limitations, lack of technical knowledge of TDs, and scarcity of available resources (Bughin et al., 2017; Cassette et al., 2020; Raimo et al., 2021). These considerations further underline how necessary and complex the digital transformation process for SMEs can be.

The paper is structured as follows. First, we offer an overview of the various DTs and their role in the internationalization process of SMEs. Second, we dig deeper into the difficulties SMEs face when adopting DTs. Third, we present a picture of SMEs' current DTs' adoption degree, focusing on the European area and Italy. Finally, we provide concluding remarks and highlight the main factors outlined in the paper.

## **2. The internationalization process of SMEs**

Internationalization is the process by which companies expand their presence in foreign markets (Welch & Luostarinen, 1988). This development can take place in various ways, from exporting to opening foreign subsidiaries. Several theories have been developed in the literature to explain how this process is taking place, what levers must be considered for successful internationalization, and the limits and barriers companies may face in pursuing this path. Among the leading theories is the Uppsala model (Johanson & Vahlne, 1992), which focuses on the gradual learning process of foreign markets and the existence of a physical and psychological distance with these markets. This construct promotes a sequential view of the outward expansion of business activities by assuming that international markets are approached only after obtaining a competitive advantage within the domestic market and, in any case, starting from the geographically and culturally close markets. However, what companies face in reality is not always a gradual path (Anderson & Narus, 1990; Coviello & McAuley, 1999). Some companies, for example, start expanding abroad from their inception (born global) (Knight & Cavusgil, 2004).

Despite the cases of 'born global' companies, international growth tends to be more complicated for SMEs, mainly due to their small size, which implies limited financial resources (Bellone et al., 2010; Cerrato & Piva, 2012), time and expertise (Freeman et al., 2012), as well as difficulties in obtaining and processing information on target foreign markets for expansion (Bianchi & Wickramasekera, 2013). However, SMEs have a less complex organizational structure, allowing them to adapt better to change (Wang

et al., 2017). There are thus also some advantages for SMEs, if compared to larger enterprises with more structural complexity (Bettiol et al., 2020).

In recent years, SME internationalization strategies have undergone significant changes. This process is being pushed towards an increase in digitalization, such as the need for automated transactions, the development of an increasing amount of high-quality data, the development of niche markets, and a service-based economy (OECD, 2017). Digital technologies, therefore, necessarily have a crucial role to play in the international expansion of businesses (Brouthers et al., 2016; Denicolai et al., 2021; Jean et al., 2010).

As anticipated above, talking about digital transformation is complex and dispersive since it is a trend characterized by the breadth of contours, which affects multiple technologies and involves various building blocks of the business organization (OECD, 2016; Kotarba, 2017; Rachinger et al., 2019; Ulas, 2019). To clarify this concept, we will distinguish DTs in trading and manufacturing technologies (Kolagar et al., 2022; Sjödin et al., 2020), focusing on what appears to be, to date, the most widely implemented technologies at the firm organizational level. Among these, *e-commerce* is the most widespread among SMEs, followed by the *Internet of Things*, *blockchain*, *artificial intelligence*, and *3D printing* (Ifis Bank, 2021). How can these technologies affect the process of internationalization?

### 3. Methodology

The scope of the current study is to highlight what we know and do not know about the role played by DTs in the internationalization process of SMEs. Given the novelty and importance of the topic, we wanted to offer a comprehensive narrative synthesis of previously published information, both at academic and non-academic levels. Thus, we developed a narrative literature review to survey the current state of knowledge on this particular topic (Baumeister & Leary, 1997).

After specifying the scope of the project and the related research question, we have started a first skimming of the extant literature through the three main web-based databases: Clarivate's Web of Science, Elsevier's Scopus, and Google Scholar (Jones et al., 2011). Keywords have been chosen based on the topic's core, thus using terminology referring to DTs in general and specific to each technology (i.e., e-commerce, 3D printing, Internet of Things, etc.) and those referring to SMEs internationalization. Keywords were used with both the "OR" and "AND" Boolean operators for a more comprehensive search of their interplay. To ensure the study's comprehensiveness and due to the topic's novelty, we have also used the Google search engine to look for non-academic publications.

For what concerns the search criteria, we did not set any boundaries on the period, language, types of documents, or sources. The exclusion criteria were if the study (i) does not refer to SMEs but to other firms' typologies; (ii) does not discuss SMEs' internationalization process; (iii) does not include digital technology/ies and internationalization.

After reading the abstracts of the studies and applying inclusion and exclusion criteria, we searched for other related studies through the snowballing procedure. We then read the full manuscripts to finalize our dataset and collectively discussed the results to reach a consensus among all authors. We had a final sample of 52 studies. Then, we pulled together what is known about the role of DTs in SMEs' internationalization process to provide an overview, highlight potential existing gaps, and discuss the current adoption degree of DTs by SMEs. Finally, we propose a general framework for the impact that DTs have on the internationalization process of SMEs at both the initial and subsequent phases.

#### **4. Digital technologies and the internationalization process**

Recent studies in the field of international entrepreneurship have identified the adoption of marketing technologies, such as *e-commerce*, as a strong aid for the international expansion of SMEs (Cassette et al., 2020; Dethine et al., 2020; Elia et al., 2021). These expose SMEs to a more significant number of contacts, also offering more partnership opportunities (Westerlund, 2020) and greater chances of entry into previously untapped markets, thus reaching previously untargeted and untargetable consumers (Cassette et al., 2020; Hånell et al., 2020). The inclusion of marketing technologies in the business value chain, especially in the SME sector, not only makes it easier to extend the network of contacts but also makes it possible to do so without the need to face significant investments, as opposed traditional methods (Tolstoy et al., 2021). Export supported by online channels, also known as digital export, entails a robust reduction in entry costs and the presence of lower barriers to entry. It also encompasses simplified and fast sales and payment channels, which therefore bring significant benefits to SMEs wishing to export using DTs (Pezderka & Sinkovics, 2011; Sinkovics et al., 2013). It also appears that these DTs help to compensate for the lower physical presence in foreign SME markets than multinational or large companies with foreign subsidiaries (Dethine et al., 2020).

The tools to support digital export are divided into three basic types: *e-commerce*, *e-marketing*, and *e-business* (Dethine et al., 2020). The first group refers to the use of digital platforms for purchasing and selling goods and services transactions (Cassette et al., 2020; Dethine et al., 2020). The second relates mainly to the use of digital technologies for marketing and promo-



tion purposes. Finally, the third group concerns using digital tools to improve production processes and internal corporate organization (Dethine *et al.*, 2020; Mazzarol, 2015).

*E-commerce* helps to reduce distances and barriers to entry into international markets while increasing the sales channels of SMEs that, through digital platforms, are more able to reach foreign markets and obtain data and information about their activities in different countries. Having the possibility to get more easily data on global customers, as well as specific information about sourcing, delivery times, and inventory in stock, leads to increasingly efficient value and supply chains, provided that the companies involved can make the most out of such data (Astuti & Nasution, 2014; Dethine *et al.*, 2020). At the same time, reducing costs and distances can optimize SME business models and improve customer relations while responding efficiently to their needs.

*E-marketing* also has an impact on business relations with foreign partners. Studies show that SMEs prefer to adopt tools for their relationships with consumers rather than in their relations with other companies. They still prefer to avoid using technological tools in these contexts because they fear losing control and confidentiality of information, with obvious repercussions on their competitive advantage (Dethine *et al.*, 2020; Pergelova *et al.*, 2019).

Finally, *e-business* refers to everything that significantly impacts the internal business organization and is crucial for penetration into international markets, optimizing the acquisition of information in these markets. This involves using common databases or software, videoconferencing, and smart-working tools. They can reduce cultural distances while not entirely eliminating aspects of traditional communication, which still seems to play an important role in this digital age (Cassette *et al.*, 2020). Ultimately, these tools reduce uncertainty in the relationships between the various actors by improving communication and creating a kind of common language that represents the basis for sharing values (Dethine *et al.*, 2020). E-business is particularly important for international expansion as it reduces the risk of conflict due to misunderstandings, mitigating cultural differences and physical distances (Cassette *et al.*, 2020).

The diversification of sales channels (e.g., e-commerce vs. traditional) and the use of different technologies makes data collection and aggregation increasingly complex (Gijzen, 2013; Prüfer & Prüfer, 2020). Therefore, in a digital transformation context, the role of data mining and analysis is crucial. Information plays a valuable role, for example, in predicting purchases and indicating the direction to be taken in terms of marketing (Tajoli, 2020). This role of data is perhaps even more critical in the internationalization process as it can help to identify the particular preferences and characteristics of each market and thus guide the choices of corporate

strategic policy towards the countries that are to be reached (Bertello et al., 2021; Elia et al., 2021). SMEs have increasingly understood the key role of a data analysis strategy in extracting meaningful information to guide policy choices (Dam et al., 2019). These companies, therefore, need to develop specific data analysis knowledge to better manage this large amount of available information. It can help to identify and monitor current and future market trends and to reach different consumer segments by offering products and services aligned to their needs. Moreover, analyzing machine and component reports of domestic and foreign plants can help achieve better production efficiency in various areas, reducing waste and associated costs (Kien et al., 2020).

Other DTs, such as IoT, 3D printing, and blockchain, facilitate the management of domestic and international operations. Blockchain and IoT, for example, improve the coordination and integration of value chains (Elia et al., 2021). On the other hand, manufacturing technologies such as 3D printing help achieve higher productivity, which results in better performance, thereby increasing international competitiveness (Laplume et al., 2016; Murmura & Bravi, 2018; van Beveren & Vandebussche, 2010).

The *Internet of Things (IoT)* refers to the use of technology to connect objects and make them smart in the sense of being interconnected (Kramp et al., 2013). This technology is increasingly present and is mainly used by SMEs to improve the efficiency and organization of production systems in different countries. For example, using sensors for real-time monitoring allows for an increase in the controls on the productivity and quality of the production processes in the various plants. It also monitors the localization of the products, providing valuable data to optimize the production and logistics systems, thus responding to the needs of the actors upstream and downstream of the production chain better (Rachinger et al., 2019). These technologies allow consumption efficiency, which is then reflected in decreased production costs (D'Arpa, 2022). The use of sensors, therefore, can help to strengthen trade relations because, through real-time monitoring and correct data processing, it makes foreign markets less complex and more attractive, guaranteeing comprehensive centralized control.

*3D printing* is a technology that enables firms to create entire products from a drawing made with appropriate software tools (Frazier, 2014). The drawing is then transmitted to the 3D printer, which creates, layer by layer, the product in a single solution without the need to assemble multiple parts to build the finished product (ibid). This technology helps to reduce waste in the creation of the product since, by drawing on software, you can accurately predict and adjust the amount of material needed. Consequently, it allows the production wherever there is a 3D printing device. It is easy to think of the impact this technology can have on production and distribution models for SMEs, which will gain from a potentially facilitated



internationalization process. Access to a 3D printing device means that the end user can have direct and quick access to the product, which can be conceived and designed remotely (Akbari & Ha, 2020; Laplume et al., 2016; Strange & Zucchella, 2017). The most significant impact will therefore be on the much shorter supply chains. Thanks to the potential joint use of other technologies, such as artificial intelligence, it could lead to increasingly efficient mass customization (Mohr & Khan, 2015; Rehnberg & Ponte, 2018). If a future mass deployment of the 3D printer were to occur, like that of a smart-TV object in people's homes everywhere, barriers to entry to foreign markets and logistics and transportation costs would be significantly reduced if not eliminated (Chan et al., 2018; Rehnberg & Ponte, 2018; Steenhuis et al., 2020). The downside to this innovative technology could be the high risks of IPR infringements that have not yet been regulated by international governments (Mohr & Khan, 2015; Strange & Zucchella, 2017).

The *blockchain*, which is fundamental for rapid and secure data transmission, is a "shared and immutable register which facilitates the process of recording transactions and the traceability of goods in a commercial network" (Gupta, 2020, 3). This technology offers excellent expansion opportunities, but few studies are concerned with its adoption and potential effects on the internationalization of companies. The blockchain optimizes production and execution times and increases the transparency of transactions and, consequently, their reliability, thereby improving the perceived reputation of external actors (Gupta, 2020; Rakshit et al., 2022). However, this technology requires a large number of sellers and buyers to use it in order to operate to its full potential (Rakshit et al., 2022). When properly integrated into the production chain of the company, this technological tool allows for obtaining correct and truthful details that can offer considerable support to the strategic choices underlying a process of internationalization (ibid). For example, this technology can identify the location of the raw materials and track their transformation into a finished product. Such information could then be made available to all users and actors interested in knowing the origin of the raw materials and the various steps they undergo in the related production chain. Blockchain, like artificial intelligence, has endless applications; the role of SMEs is to identify the best use of this technology to gain competitive advantages in domestic and international markets.

*Artificial intelligence* (AI) encompasses several techniques, such as machine learning or deep learning, which aim to develop the machine's self-thinking and learning capabilities (Artificial Intelligence Observatory, 2022). Its uses are diverse, but it is now mainly adopted to support decision-making and business process automation (Cassette et al., 2020; Denicolai et al., 2021). This DT provides an opportunity to improve the flow of information between the different actors in the value chain and to optimize data collection and analysis. From an internationalization per-

spective, data from AI tools can provide relevant information about foreign markets, customers, and competitors within those markets and then direct business policy choices in those markets (Denicolai et al., 2021; Martín-Peña et al., 2020; Neubert, 2018). This is reflected in better awareness and knowledge of international markets and a potentially optimal allocation of SME resources.

Thus, DTs allow SMEs to undertake expansion into foreign markets without the need to grow through traditional approaches, which would be much costlier (Hånell et al., 2020; Raimo et al., 2021; Tolstoy et al., 2021). If properly organized and combined, such technologies can strongly impact SME internationalization and global value chains (Strange & Zucchella, 2017). For example, 3D printing coupled with IoT could bring the production process to maximum productivity and minimum waste levels, substantially impacting the company's balance sheet (Elia et al., 2021). Finally, studies show that SMEs see DTs supporting their internationalization strategies and processes, but the effects often tend to be indirect. In other words, it seems that SMEs do not adopt DTs for international expansion purposes but that they are, in practice, also helpful for such a purpose (Dutot et al., 2014).

## **5. SMEs and the difficulties they face while adopting digital technologies**

DTs are increasingly adopted to support the organizational processes of enterprises in every sector and size. However, their adoption is still complex and problematic. SMEs mainly perceive the associated difficulties. While these 4.0 technologies help these companies expand their contacts networks and reach foreign markets, they require financial and organizational investments (Casset et al., 2020; Elia et al., 2021; Tolstoy et al., 2021).

Academic contributions have recently highlighted some of the major challenges SMEs face in this digital transformation process, including limited financial and human resources and expertise, difficulties in reconfiguring business models, and issues related to specific institutional contexts (Denicolai et al., 2021; Luo et al., 2005; Simmons et al., 2016; Wolcott et al., 2008). In this context, SMEs still have too much to do with traditional business models, which constrain the adoption of new DTs, often identified as costly in terms of time and financial resources, as well as high technologically complex (Hånell et al., 2020).

Increasing awareness of the importance of the use of DTs is therefore crucial. SMEs should be supported not only from a financial but also from a technical knowledge point of view, first and foremost by enhancing the infrastructure underlying data communication and analysis and expanding the workforce's digital skills and knowledge (Ulas, 2019). Digital trans-

formation involves both the mere adoption and implementation of the different technologies and a change in the company's organizational structure to make the most out of the tools that these technologies offer (Cassette et al., 2020; Dethine et al., 2020; Salvi et al., 2021).

In general, the reduced access to specific resources, such as financial or technological, can create major barriers to the implementation of complex strategies such as internationalization (Stockdale & Standing, 2006). While digital export or the adoption of specific marketing technologies avoids certain investments and costs related to the expansion on foreign markets, such as the physical creation of foreign subsidiaries, others remain the same or even increase. This is the case of trade barriers, like tariffs, of transportation costs (Elia et al., 2021; Teltscher, 2002), and of the necessary revisions to branding and product marketing (Guercini & Runfola, 2015), but also costs related to market insecurity (Giuffrida et al., 2020).

Even the adoption of technology often perceived as less cost-intensive, such as online sales or e-commerce, requires business organization efforts to avoid being overwhelmed by orders (Elia et al., 2021). There is a need to create functional, fast, and user-friendly websites (Sinkovics et al., 2013; Sinkovics et al., 2007). Entering a foreign market, even simply through e-commerce, requires a stable and amplified network of contacts: delivery will be more complicated and will face higher costs and risks than delivery in the domestic market. Moreover, after-sales services will have to be targeted to international customers, with potentially very different requests and expectations (Elia et al., 2021; Lee, 2017). When comparing the situation of SMEs with that of large companies, it is clear that the latter has a privileged position in relation to the aspects that have just been highlighted. They already have a very extensive network of contacts on which they can rely, together with higher availability of resources to better address the internationalization process and related risks (Alon et al., 2019; Elia et al., 2021; Tolstoy et al., 2021). Barriers to DT adoption result from internal and external factors (Costa & Castro, 2021). The external factors identified in the literature refer to the environment in which SMEs operate, particularly policy measures, regulations, and political stability (Costa & Castro, 2021; Bauer & Schembera, 2020). It is noted that policies and their various instruments strongly impact SMEs' uptake of DTs (Ha, 2020). In countries with unstable political systems, companies are less inclined to invest in digital transformation. Part of the reasons is a lack of confidence in the markets, reflected in transaction security issues, impediments, and difficulties in accessing credit to cope with the costs of a digital transition (OECD, 2021).

Internal factors mainly relate to a lack of general awareness and competence in the field of DTs and digital transformation. Academic contributions dedicated to investigating the barriers to commercial technologies identify in the role of managers - especially in their technology-related experiences

- a factor that strongly influences the success of technologies adoption in the company in which they work (Costa & Castro, 2021; Chuang et al., 2017). Among the common barriers to the take-up of different technologies, the lack of human resources and skills remains a key and characteristic feature of SMEs. For manufacturing technologies, this common barrier is combined with the difficulty of recognizing a priori the value that such technologies can bring (Osservatorio IoT, 2022). A further factor that often hampers the successful implementation of DTs is the alignment of the objectives for the technological uptake by teams from different business areas (ibid).

In particular, IoT technologies face barriers mainly erected by suppliers, which, especially in an Italian context, seem to offer SMEs tools unsuited to their needs. IoT providers tend to develop technically excellent tools that are, in practice, too complicated in their daily use (Elia et al., 2021; Melnyk et al., 2018; Rachinger et al., 2019).

As regards the adoption of 3D printing by SMEs, the most concrete barrier appears to be financial (Jiménez et al., 2019; Kunovjanek & Reiner, 2019; Mehrpouya et al., 2019). Indeed, there is a need for substantial investment to implement this technology since it does not simply require the purchase of suitable machinery and raw materials for production but a drastic change in internal organization to adapt its production processes (Chan et al., 2018; Laplume et al., 2016; Rogers et al., 2018).

A key issue in understanding barriers to DT adoption is the technological readiness of companies. Readiness, mainly studied by the information systems stream of research, is often applied in those contexts where changes are needed (Shahrasbi & Paré, 2014). It can be discussed in several aspects, financial, business, culture, and technology. The latter is identified as the ability of a company to adopt new technology (Richey et al., 2007) in terms of skills, knowledge, and resources for its proper implementation (Alsheibani et al., 1997). The technological readiness to implement DTs is crucial for SMEs to compete in global and national markets (Chen et al., 2019; Weiner, 2009).

Despite its importance, a specific technology readiness index has not yet been developed for companies. The adoption and subsequent successful implementation of DT require human skills and knowledge about the technological aspect currently lacking in the market (OECD, 2021). This makes it difficult to adopt such technologies, creating even more pronounced complications about the proper use and exploitation of such technological resources (Costa & Castro, 2021). DTs are rightly considered corporate resources and, as such, if not correctly implemented at the organizational level, they may remain mere skills that will not turn into a competitive advantage (Barney, 1991; Dethine et al., 2020). Indeed, once adopted and implemented, DTs such as e-commerce bring even more significant chal-

allenges to SMEs. They no longer interact with known local competitors but with a competition that is defined as global, where it is often difficult even to identify who the direct competitors are (Costa & Castro, 2021; Dethine et al., 2020). However, if used correctly and promptly implemented at the organizational level, DTs offer data that can support the entry and survival of SMEs in the international market (Costa & Castro, 2021). SMEs that own these resources and can make the most of them for their own purposes are ready for the proper adoption of these technologies (Weiner, 2009).

However, we should bear in mind that the adoption of DTs and the choice among them is often not the result of a free choice by SMEs but the direct consequence of partnerships. SMEs wishing to expand their market abroad are often part of global value chains. To create and maintain the links necessary for their survival, they usually have to adopt the same technologies as their partners (Jean et al., 2010; Sanders, 2005).

## **6. DTs' adoption degree by SMEs**

The European Commission has created an index, the Digital Economy and Society Index (DESI), to monitor digitization in the countries of the European Union. According to DESI, Italian SMEs appear to have a lower level of digital transformation than the European average, despite many companies' efforts to introduce DTs during and after the pandemic. The main delays compared to the other European countries are found in their web presence, in the analysis of big data, and in a lack of general integration of the most advanced DTs (DESI, 2021). Thus, despite the efforts of the public administration who dedicated funds to increase digital investment, for about 63 percent of Italian SMEs, the digital infrastructure still appears to be a complicated issue to solve. Despite the better position in the 2021 DESI, which sees Italy ranking 20th and improving its performance by five positions compared to the previous year, there are still strong limits in adopting DTs. In Italy, the main barrier seems to be aligned with what is highlighted in the literature; in fact, it is a lack of specialized human resources and skills.

The most worrying figure in the DESI index is not so much the adoption of technology for online sales and purchases but the ability of companies to use DTs to create, extrapolate, and then analyze big data. As mentioned above, analyzing these data offers the possibility to optimize internal and external business processes, implying better cost management and resulting in competitive advantages that allow SMEs to compete in domestic and foreign markets (D'Arpa, 2022). In addition, a recent study prepared by the Digital Agenda Observatory (Osservatorio Agenda Digitale, 2021), shows a persisting digital divide between SMEs in Northern Italy and those in



the South. In fact, the best seven regions per DESI score are situated in the North, although in terms of the DESI index, they are still about 18 percent lower than in other European realities (Digital Agenda Observatory, 2021). Among the enabling DTs most adopted by Italian SMEs, the first places are dedicated to all those tools needed to ensure web presence and online sales, here identified as e-commerce (Ifis Bank, 2021). Only afterward are technologies such as the Internet of Things, 3D printing, blockchain, and artificial intelligence.

As regards the adoption of IoT, it is estimated that, since the pandemic, 44% of global companies have increased their investment in IoT. According to a study by the Hypothesis Group commissioned by Microsoft (2021) and conducted on a sample of large companies with more than 1,000 employees, 47 percent of manufacturing companies use IoT to improve quality and corporate compliance, while 45 percent claim to use them for industrial automation goals (Microsoft, 2021). In the United States, 81% of respondents state that they use IoT with other technologies, such as artificial intelligence, mainly for predictive maintenance purposes (67%). In contrast, the remainder uses IoT to improve consumer experience since this technological combination allows the development of skills such as facial or linguistic/verbal recognition. In addition, 74 percent of companies in the US use IoT as a physical technology to connect their production reality with a digital twin, virtual replicas of the physical world (Microsoft, 2021). Combining the two technologies has enabled these companies to reduce operating costs and optimize production efficiency by impacting the products' time to market.

In Europe, 91 percent of companies say they have adopted at least one IoT technology; however, the combination of this technology with others, such as digital twins, is even less implemented than in the United States (Microsoft, 2021). Regarding Italy, 95% of companies say they have heard about IoT tools and technologies; of these, only 58% have undertaken at least one project to adopt and implement these tools (Osservatorio IoT, 2022). However, the digital divide between companies of different sizes remains as marked for IoT as for other technologies. Indeed, while 73 percent of large companies have started at least one project to introduce such tools into their business processes, only 29 percent of SMEs state they have done so (ibid).

The 3D printing market grew by 21 percent in 2020 compared to previous periods and is expected to reach 27 billion in 2023 (Statista, 2022). A recent study by Hp and 3dpbm Research (Hp & 3dpbm Research, 2021) shows that 96 percent of the companies surveyed use this technology to speed up the introduction of new products to the market, thereby reducing the so-called time to market. This study highlights the dominant factors and motivations for the adoption of 3D printing, including the improvement of the sustainability of production processes, the possibility to produce specific parts at the consumer's request, and the ability of this technology to easily adapt to



fluctuations in market demand (ibid). A second study (Reichelt elektronik & OnePoll, 2021) on about 250 Italian and foreign corporate managers reported that nearly 80 percent of respondents said they already used 3D printing in production processes. These companies use this technology mainly to develop prototypes and small-scale production of specific products, spare parts, or medical products, such as prostheses. The most interesting fact is perhaps the impact on the supply chain. In fact, 45 percent of the Italian respondents consider using 3D printing to support internal production aimed at overcoming limits and delays in the event of external shocks such as those they have been exposed to in recent years (ibid).

Blockchain technologies, increasingly widespread, need to be adopted by a large number of users to bring the desired results (Blockchain & Distributed Ledger Observatory, 2022). Worldwide, there is an estimated 370 initiatives developed by companies of various sizes in this field. According to a recent study (Osservatorio Blockchain & Distributed Ledger, 2022), Italian companies are divided into two large groups: those that are still skeptical and therefore far from adopting these technologies and those that are already reaping up the benefits. Some 116 Italian SMEs have adopted blockchain technologies for their business activities, and there are currently 26 projects with international implications in this field (ibid). In line with the evidence from the academic literature, this technology is mainly implemented to improve transaction security and increase the transparency of the different steps of the company's production chain (Osservatorio Blockchain & Distributed Ledger, 2022).

Finally, the use of AI technologies is growing strongly at the global scale. It seems that companies have gradually increased their investment in these technologies, overcoming initial distrust, because of their clear organizational, productive and economic benefits (Piacentini, 2022). In 2022, the global adoption of artificial intelligence increased by four percentage points compared to the previous year, despite the fact that there is still a significant shortage of talent in this area - as we have seen, a characteristic barrier to the implementation of all DTs. Most companies say that they have implemented this technology to improve automation and safety in their manufacturing plants in both domestic and international markets (ibid). In this field, Italy has experienced an even greater adoption than the European average. In fact, the market has grown by more than 27 percent compared to 2021, even though there is still a strong digital divide in the adoption and implementation of artificial intelligence compared to the size of the company. If about 60 percent of large companies have adopted at least one AI project or tool, this is only true for six percent of SMEs (Piacentini, 2022). A recent study of companies in Lombardy confirmed that the companies in the region are oriented towards digitalizing production processes and are adopting artificial intelligence tools to achieve this goal (Osservatorio Artificial Intelligence, 2022).

## 7. Concluding remarks

The overview of the literature and the adoption trends of DTs presented in the current study confirm the role of these technologies as tools to support SME business processes, and their internationalization process is no exception. Although most academic literature seems to focus on other topics, mainly related to the determinants of the adoption of such technologies (Fosso Wamba and Carter, 2016; Pradhan et al., 2018; Gregory et al., 2019; Cassette), we highlight that there is nevertheless an increased interest in the international growth process (Denicolai et al., 2021; Magnani et al., 2021; Olejnik & Swoboda, 2012; Sinkovics et al., 2013).

We summarize below the main impacts of the adoption of DTs as highlighted by the current study.

*Table 1: SMEs' DTs' adoption impact*

E-commerce	IoT	3D Printing	Blockchain	Artificial Intelligence
Increases network of contacts	Optimizes coordination, integration and interaction of the value chain	Increases organizational performance	Optimizes coordination, integration and interaction of the value chain	Increases organizational performance
Reduces distances (physical and cultural)	Increases efficiency and organization of production systems – across and in different countries	Provides direct and fast access to the final product	Improves and increases data processing	Optimizes resources allocation
Reduces entry barriers	Optimizes product quality	Can be designed remotely	Fast, clear and secured transactions	Increases available information on
	and efficiency control			international and domestic activities
Increases sales channels	Optimizes consumption and costs efficiency	Reduces costs of logistics and transportation	Traceability of goods	Automation of production processes
Increases available information on international and domestic activities	Improves partners relationships	Reduces CO2 emissions (due to decreased transportation)	Optimizes production	Helps in decision-making processes
Data on procurement, delivery timing, and stock	Improves security in production facilities	Reduces barriers to entry in international markets	Increases firm's trust perception	

Improves and simplifies relationships with customers	Potential centralized control	Optimizes resources allocation and reduces production waste	Increases brand reputation	
<i>E-marketing:</i> improves upstream and downstream communication				
E-business:				
Increases information from both international and domestic markets				
Reduces inter-organizational cultural and physical distance				
Creates common language				
Reduces communication uncertainties				
Reduces conflictual risks				
Increases trust on the firm				

*Source: own elaboration*

Table 1 summarizes the current study's main findings, focusing on the impacts of these technologies on the growth of SMEs in foreign markets. This table summarizes the issues that are affected by each of the investigated technologies.

From an initial glance, it is clear how marketing technologies (e-commerce, e-marketing, e-business) result in tools facilitating the entry into new markets. Other technologies, on the other hand, appear to have a more significant impact on the organization of production systems and on global value chains. Therefore, the DTs that were taken into account seem to be relevant for the preparatory phase of the internationalization process. Clearly, the support these technologies offer for expansion in foreign markets does not stop at the preliminary preparation stage but is also a critical aid when this process is actually implemented. Figure 1 tries to summarize

this concept graphically, identifying the impacts on the internationalization process of the different DTs here considered.

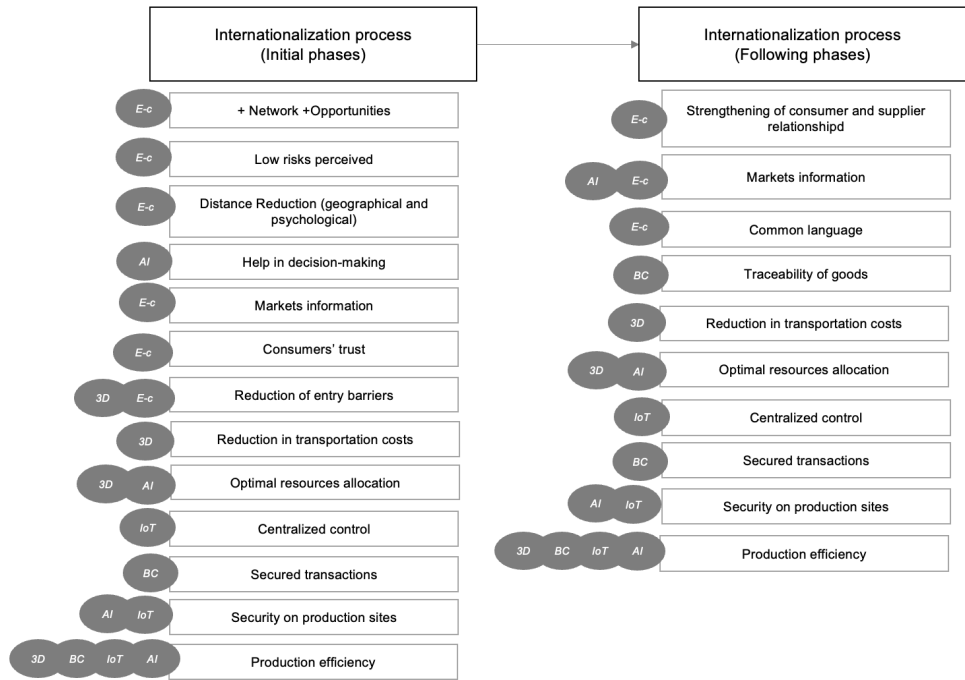


Fig. 1: DTs impact on SMEs' internationalization process

Source: own elaboration; Legend: E-c = e-commerce; 3D = 3D printing; IoT = Internet of Things; BC = Blockchain; AI = Artificial Intelligence.

Internationalization is a process that takes place as a result of a series of decisions taken by corporate management in a usually gradual manner (Cavusgil, 1980; Johanson & Vahlne, 1977). Even in cases where this is done more quickly, a more or less in-depth knowledge of the rules of the markets in which one decides to expand its business is essential (Anderson & Narus, 1990; Coviello & McAuley, 1999). In Figure 1, this process is greatly simplified by subdividing it into two phases to optimize the representation. This graphic reproduction aims to highlight the impacts of the various technologies in support of the initial phases of international expansion.

It should be noted that marketing technologies seem more likely to facilitate entry into foreign markets by, for example, reducing entry barriers (Cassette et al., 2020; Hånell et al., 2020). By implementing these technologies, the company will, for example, be able to promote online sales to global consumers. Another facilitation to the internationalization process by these technologies results in a decrease in geographical and cultural

distances between the country of origin and the markets where international expansion is intended to happen (Dethine et al., 2020). Apart from the potential need to revise product marketing to ensure that end consumers have a unified experience across multiple real and digital touchpoints (Zucchella & Magnani, 2019), online sales via digital platforms do not necessarily require to be tailored to the specifics of different markets (Elia et al., 2021). Such technologies can therefore be more conducive to reaching foreign markets. Other technologies, however, seem to have a greater impact on internal business organizations. Here we highlight the collection of data and information needed to optimize the allocation of company resources, support strategic decisions about international expansion, and improve the security of both transactions and domestic and foreign production plants (Denicolai et al., 2021; Martín-Peña et al., 2020; Neubert, 2018). If adequately implemented, almost all the technologies studied would achieve production efficiencies, resulting in competitive advantages in domestic and international markets (Astuti & Nasution, 2014; Dethine et al., 2020). To adopt IoT instruments, SMEs can plan to expand their market outside their home borders with the possibility of maintaining centralized control of productivity and production quality (D’Arpa, 2022).

The DTs explored in this study appear to have an impact not only during the early stages of the internationalization process but also when the company has already established its presence in foreign markets. By leveraging DTs, SMEs could strengthen their relationships with actors upstream and downstream in their production chain and create a common language through e-business tools to reduce misunderstandings and optimize communication between business areas, regardless of where they are based.

The overview of the uptake trends of digital technologies and the current literature on their impact on internationalization processes have highlighted that SMEs are aware of the strategic role these tools play in the internationalization process. However, there are some indications that this awareness is being challenged by factors that may complicate its adoption. These factors, or barriers, appear to be both internal and external (Cassette et al., 2020; Costa & Castro, 2021). The objective of Table 2 is to summarize the main factors outlined in the current study without claiming to be exhaustive.

*Table 2: Potential limits to SMEs’ adoption of DTs*

Internal Factors	External Factors
Technological Readiness	Tariff and non-tariff entry barriers
Limited I4.0 specific resources and capabilities	Transportation costs
Difficulties in reconfiguring business models	Difficulties in accessing credit

Difficulty in recognizing the value of a DT in advance	Global competitiveness
Product branding and marketing revisions required	Political instability
Increased market insecurity	DT-specific regulations
Team goals alignment across business areas	Different regulations in different countries
Initial investment costs	
Difficulties in accessing credit	

*Source: own elaboration*

The ability, interpreted as the set of human and technological resources, skills, and knowledge that a company demonstrates about a specific technology, represents its technological readiness (Richey et al., 2007; Shahrabi & Paré, 2014). SMEs must have the necessary resources and technical expertise to implement DTs properly. However, this type of undertaking is characterized by limited financial, human, and technical resources (Bellone et al., 2010; Cerrato & Piva, 2012; Freeman et al., 2012). While, as we have seen, DTs can support an optimal allocation of resources, they require technical and professional skills that are lacking in the market. In addition to these limitations, SMEs also face difficulties in assessing a priori the value that DTs could bring to their business organization, together with the issues they encounter in accessing credit (IoT Observatory, 2022). To be able to implement these technologies, it is necessary to make significant investments not only in introducing the appropriate human skills and technical resources, such as specific software and hardware but also in reconfiguring the business model to adapt its activities to the proper use of these tools. Some external factors, including regulations and policies, can be transformed from a barrier to an enabler supporting SMEs in their digital transformation (Ministero dell'Economia e delle Finanze, 2021). In the case of Italy, for example, the National Recovery and Resilience Plan (PNRR), part of the European Union's Next Generation program, has, among its various objectives, the objective of supporting SMEs to foster growth. It targets their digitalization, innovation, and internationalization. In particular, the Italian government has also identified a shortage of human skills as one of the main barriers to SMEs. A tax credit for Training 4.0 (Formazione 4.0) is available to help develop these skills (ibid). The incentives to invest in human capital have therefore been greatly enhanced.

The current study offers theoretical contributions at different levels. First and foremost, we contribute to the international entrepreneurship field by providing an overview of the roles that each digital technology plays in SMEs' internationalization process. Offering a simplified figure summarizing their impacts on SMEs' internationalization and specifying their effects on both the initial and following phases is aimed at emphasizing what we currently know while nourishing the interest for future studies in the field.



Similarly, we shed light on SMEs' difficulties and barriers when adopting the various DTs, contributing with a list of different internal and external factors rooted in the current literature. The latter is important both in terms of academic contribution and practical implications.

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