

CHAPTER 5

THE TRANSFORMATIONAL IMPACT OF DIGITAL VENTURE ECOSYSTEMS ON ENTREPRENEURSHIP IN EUROPE

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ABSTRACT

The growing uses of digital technologies have been creating several new business opportunities. Recently, a new concept has emerged in the literature, the “digital entrepreneurship ecosystem” (DEE). However, it has been empirically understudied. Thus, this study aims to analyze the influence of DEE on entrepreneurial activity. The meta-organization theory was used as a perspective of analysis. A quantitative methodology was applied in a sample that includes data from 28 European countries through the generalized method of moments. It was concluded that the DEE pillars, informal and formal institutions, market conditions, physical infrastructure, human capital and talent and networking and support positively influence entrepreneurial activity. It was also found that the variables knowledge, creation and dissemination and finance have a negative impact on entrepreneurial activity. Several theoretical and empirical contributions are also left for the various stakeholders. The present study is original, as no known studies analyze the influence of DEE on entrepreneurial activity in European countries from the perspective of meta-organization theory.

Keywords: Digital entrepreneurship ecosystem; meta-organization theory; total early-stage entrepreneurial activity; European Index of Digital Entrepreneurship Systems; OECD; knowledge

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1. INTRODUCTION

Technological trends have been evolving over the past few years, with companies having to adapt quickly to the expectations of the markets and their customers. Currently, customers are increasingly identifying with new technological trends (e.g., social media, mobile services, internet of things, cloud computing, big data and robotics) and are incorporating them more and more into their daily lives. These technological trends have provided new ways of collaborating, designing products, organizing resources, as well as enabling them to meet complex supply and demand to develop new solutions and standards. This rapid technological evolution has significantly altered traditional business processes and models, requiring companies to reformulate their strategies in order not to lose competitiveness (Bharadwaj, El Sawy, Pavlou, & Venkatraman, 2013; Elia, Margherita, & Passiante, 2020; Markus & Loebbecke, 2013).

In this context, the exploitation of new digital technologies is one of the biggest challenges facing entrepreneurs, the government and society. No industry or organization is immune to this new paradigm, its effects and consequences (Jafari-Sadeghi, Garcia-Perez, Candelo, & Couturier, 2021). Currently, the concept of digital transformation refers to the disruptive or transformational implications of digital technologies on business and society (Hess, Matt, Benlian, & Wiesböck, 2020; Matt, Hess, Benlian, & Wiesböck, 2016; Nambisan, Wright, & Feldman, 2019). This concept does not refer only to innovative businesses, high-tech giants or digital start-ups. Digital transformation is a process that includes all types of companies and sectors as well as their stakeholders (Jafari-Sadeghi et al., 2021; Warner & Wäger, 2019). Concepts such as technology entrepreneurship, digital technology entrepreneurship and digital entrepreneurship (DE) often appear associated with digital transformation.

Technology entrepreneurship consists of the creation and development of new products that are based on R&D progress in a particular field. This is aimed at a global niche market (Clarysse, Bruneel, & Wright, 2011; Giones & Brem, 2017; Giones & Miralles, 2015). Digital technology entrepreneurship refers only to new products or services (creation of digital artifacts) based on information and communications technology (ICT). Digital technology entrepreneurship includes the production of intelligent devices, taking into consideration the “Internet of Things.” Thus, digital technology entrepreneurship admits the use of existing technologies and aims to validate a market, growth and attraction through a business that can be scaled (Bailetti, 2012; Giones & Brem, 2017). As far as DE is concerned, it consists of new services or products based on the internet, that is, the online environment (Biclesanu, Anagnoste, Branga, & Savastano, 2021). These services are usually run in the cloud, and use artificial intelligence or big data. Digital entrepreneurship has as a goal the high growth of the business, projecting to be the dominant company (with more market share) in a certain market segment (Giones & Brem, 2017; Wallin, Still, & Henttonen, 2016). More recently, the concept “digital entrepreneurial ecosystems” or “digital entrepreneurship ecosystem” (DEE) has emerged in the literature.

The definition of DE incorporates the DEE concept (Gorelova, Dmitrieva, Dedova, & Savastano, 2021). Thus, DEE provides the environment for entrepreneurial activities to be put into practice (Li, Du, & Yin, 2017; Spigel, 2017; Sussan &

Acs, 2017). Entrepreneurial or entrepreneurship ecosystems in business administration and economics are often used to explain the complex interactions between organizational stakeholders and individuals (Lopes & Franco, 2019). Therefore, an entrepreneurial ecosystem enables the sharing of production and innovation-oriented resources in high growth businesses (Gorelova et al., 2021; Lopes, Farinha, & Ferreira, 2019). According to Sussan and Acs (2017), the DEE is composed of two concepts, the entrepreneurial ecosystem and the digital ecosystem. According to these authors, the DEE consists of

digital entrepreneurship in the broader context of users, platforms and institutions, so that two biotic entities (users and agents) act in the individual agency and two abiotic components (digital infrastructure and digital platforms) form the external environment. (p. 571)

That said, studies about DE have focused on the particular characteristics of firms (Davidson & Vaast, 2010; Sambamurthy, Bharadwaj, & Grover, 2003), information systems (Du, Pan, Zhou, & Ouyang, 2018; Duan, Kotey, & Sandhu, 2022; Li et al., 2017), education and policy (Ping, Shuang-Wen, Shao-Bin, & Chun-Hui, 2017), economics (Richter, Kraus, Brem, Durst, & Giselsbrecht, 2017), innovation and management (Nambisan, 2017; Nambisan et al., 2019) as well as in strategy along with entrepreneurship disciplines (Warner & Wäger, 2019; Zaheer, Breyer, & Dumay, 2019). However, the external environment, or in other terms, the DEE, has been little studied (Du et al., 2018). More studies are needed that describe the characteristics and nature of DEE (Elia et al., 2020).

In this context, the present study aims to analyze the influence of DEE on entrepreneurial activity measured by total early-stage entrepreneurial activity (TEA). A quantitative methodology was used, with the unit of analysis being the 28 European countries in a period from 2018 to 2020. The results suggest that DEE pillars, informal and formal institutions, market conditions, physical infrastructure, human capital and talent and networking and support positively influence entrepreneurial activity as measured by TEA.

This study is original because studies on DEE are scarce, and there are no known studies that analyze the influence of DEE on TEA in European countries from the perspective of meta-organization theory. In this framework, concerning meta-organization theory, we consider DEE as a meta-organization. According to Du et al. (2018) and Gulati, Puranam, and Tushman (2012), a meta-organization is a collection of autonomous and independent individuals and organizations that are not connected through any employment relationship. Therefore, a DEE is a meta-organization because its stakeholders (research centers, technology parks or incubators, investors, and digital entrepreneurs) originate the creation of a coordinated network, and at the same time, its members have no employment relationship (Du et al., 2018).

This study contributes to the developing literature on the influence of DEE on TEA. Furthermore, we examine DEE from the perspective of meta-organization theory. Furthermore, we examine ASD from the perspective of meta-organization theory. Thus, we contribute empirically to the clarification of the definition of DEE. Recommendations were also formulated notably for policy-makers who need more data describing the structural conditions for efficient and effective DE at the country level. Thus, it is crucial to strengthen DEE and allow widespread access by countries and individuals to the digitalization conditions that underpin DEE.

On the other hand, as a consequence of digital transformation, organizations have to transform their traditional business models, equipping them with digital tools that promote business performance, boosting their competitiveness.

2. LITERATURE REVIEW

2.1. *Meta-organization Theory*

Meta-organizations are formal organizations where their members are also organizations (Ahrne & Brunsson, 2005; Corazza, Cisi, & Dumay, 2021). The members that make up meta-organizations have similarities, resulting from common goals, or achieved through results obtained through actions coordinated with each other, or even through activities carried out together. Thus, individual organizations seek to enter or create a meta-organization to simplify and increase cooperation by using the resources of a formal organization (Karlberg & Jacobsson, 2015). The organizations that are part of a meta-organization contribute dissimilar capacities and resources (Bazzanella, Bichler, & Schnitzer, 2022). Meta-organizations also aim to influence policy-makers for the benefit of all their members (Ahrne & Brunsson, 2005, 2008). Another objective of organizations in being part of a meta-organization is the social status they gain. Thus, the members of a meta-organization can have a similar status among members (Ahrne & Brunsson, 2008; Karlberg & Jacobsson, 2015).

On the other hand, joining a meta-organization usually represents a low cost because if the members wanted to develop the actions and activities individually, the costs would be much higher. However, the members of a meta-organization see their autonomy reduced, diminishing their own identity, which in turn may jeopardize their ability to influence in terms of individual organization (Ahrne & Brunsson, 2005; Karlberg & Jacobsson, 2015).

Generically, meta-organizations have two characteristics: (1) external boundaries that delimit one meta-organization from another; and (2) members have autonomous management (Gulati et al., 2012). Thus, they are managed democratic ecosystems where no member has a formal authority. However, collaboration and competition coexist, which gives rise to a pertinent field of investigation (Corazza et al., 2021; König, Schulte, & Enders, 2012). Although meta-organizations are a well-established field of research in the management and business literature (Bazzanella et al., 2022), they have been little studied in the context of DEEs. The meta-organization theory also makes it possible to better understand the organizational nature of social entities with different actors (Bazzanella et al., 2022; Garaudel, 2020). The meta-organization theory also makes it possible to better understand the organizational nature of social entities with different actors, as in the case of DEEs, which are usually composed of several actors.

With meta-organization theory, a DEE is considered an organization that aggregates key structural elements that can be designed (Gulati et al., 2012). Soon, the design of DEEs will be important today, as there are business leaders and policy-makers who aim to replicate the success of Silicon Valley (Du et al., 2018). Thus, meta-organization is considered a consistent theoretical lens

for exploring and studying a DEE in order to point to particular directions in its exploration (Du et al., 2018).

2.2. Digital Entrepreneurship Ecosystem

One of the premises of an entrepreneurial ecosystem is that it is self-organized, bounded in a certain territory, and there is no entity orchestrating or controlling it (Elia et al., 2020; Lopes & Franco, 2019; O'Connor, Stam, Sussan, & Audretsch, 2018). Thus, members of an entrepreneurial ecosystem are not governed by any formal authority and, as a rule, are fully autonomous (Li et al., 2017). In an entrepreneurial ecosystem, activities are designed according to the needs of the ecosystem members, and activities are adjusted by mutual agreement of the members (Elia et al., 2020; Lopes & Farinha, 2018). The entrepreneurial ecosystem has two pillars, agents and institutions (O'Connor et al., 2018; Song, 2019).

On the other hand, a digital ecosystem can be defined as a connected, self-organized, demand-driven set of agents. Each of the agents is proactive and responsible for their individual actions and their system (Boley & Chang, 2007; Song, 2019). Digital ecosystems are composed of two pillars, the users and the digital infrastructure (Dini, Iqani, & Mansell, 2011; Li, Badr, & Biennier, 2012). Thus, it can be stated that an enterprise ecosystem is made up of "enterprise species," and a digital ecosystem is made up of "digital species" (Li et al., 2017).

In this study, DEE is considered a meta-organization whose constituent members integrate a coordinated network. Some design elements can be included, where work is organized, and responsibilities and tasks are shared (Du et al., 2018; Gulati et al., 2012). It is an ecosystem where DE is developed, and DE emerges (Li et al., 2017). A DEE is composed of a set of motivating factors and complex objectives, which stimulate the participation of different members in the DEE. DEE members interact with each other through the use of digital technologies, and, as such, it can be considered a collective intelligence system (Elia et al., 2020).

The "digital entrepreneurial ecosystem" framework was proposed by Sussan and Acs (2017) and is composed of the concepts entrepreneurial ecosystem and digital ecosystem. According to Sussan and Acs (2017), the

DEE is the matching of digital customers (users and agents) on platforms in digital space through the creative use of digital ecosystem governance and business ecosystem management to create matchmaker value and social utility by reducing transactions cost. (p. 63)

The DEE is composed of four quadrants: (1) digital infrastructure governance; (2) digital user citizenship; (3) digital entrepreneurship; and (4) digital marketplace (DM).

2.1.1. Digital Infrastructure Governance (DIG)

DIG is the legitimization of digital infrastructure from the perspective of business ecosystems. It contemplates the governance and coordination that are needed to institute certain technological standards, which are shared and related to entrepreneurial activities in the DEE (Sussan & Acs, 2017). In this way, governance (policy) institutions play an important role in supporting private investments (North, 1990).

With the lack of appropriate legal frameworks, private organizations will not have sufficient incentives to invest in human or physical capital and adopt more modern and more efficient technologies (Acemoglu & Johnson, 2005; Song, 2019).

In order to legitimize an DEE, policy-makers can create rules through regulation, instrumentality and meaning manipulation, or they can follow the rules already in place (Autio & Thomas, 2018; Read, 2016). However, when legislating regulations, policy-makers have to be careful that they do not get too complex and hinder innovation (Sussan & Acs, 2017). Sussan and Acs (2017) recommend that in the principle of disruptive activities, the DIG should be more open, informal and transparent, inferring in the whole process of creating a sustainable DEE.

2.1.2. Digital User Citizenship (DUC)

The DUC contemplates the community of digital users who engage in online activities while respecting a given country's internet regulations and rules (Song, 2019). Thus, the DUC consists of the social and legal contract users who relate to and participate in the digital environment of business ecosystems, either formally or informally (Sussan & Acs, 2017).

In this context, regardless of their activities, users must have knowledge of ICT and can use them competently and consistently (Moraes & Andrade, 2015). That said, as digital citizens continuously collaborate with online content, they permanently leave digital traces, making safeguarding the issues of surveillance, privacy and intellectual property increasingly important and relevant to business activities (Mossberger, Tolbert, & McNeal, 2008; Rice & Sussan, 2016; Sussan & Acs, 2017).

2.1.3 Digital Entrepreneurship (DE)

DE consists of a combination of the ecosystems of entrepreneurial agents and digital infrastructure. A DE contemplates all involved agents, whatever the type of venture (corporate, government, social or commercial) that uses digital technologies (Song, 2019; Sussan & Acs, 2017). The entrepreneurs that compose a DEE may come from businesses that are based on radical or incremental innovation (Schumpeter, 1934) or incremental innovation (Kirzner, 2015). Thus, according to Song (2019), Schumpeterian entrepreneurs produce platforms. On the other hand, Kirznerian entrepreneurs create and develop, for the digital market, complementary commercial products for digital users.

In this framework, it can be stated that DE can be present in all economic, social and political activities. Thus, DE needs to be supported by an open DIG. In this way, entrepreneurs can put their ideas into practice. An institutional environment that is transparent, open and entrepreneur-friendly encourages new entrepreneurs to enter a market (Sussan & Acs, 2017).

2.1.4 Digital Marketplace (DM)

DM contemplates the combination of agents and users within the context of both ecosystems (Sussan & Acs, 2017). Thus, the DM proposes a market with a set

of incentives for digital agents and users. The DM assumes a quasi-governance role in protecting privacy, enforcing ownership, ensuring accuracy and controlling access across all components of a digital ecosystem. The DM is always dependent on the DE and DUC for value creation (Song, 2019).

Value creation in DM encompasses entrepreneurial activities from the non-profit, for-profit and government sectors. Thus, the effects of these entrepreneurial activities are used by users. Therefore, e-commerce, e-education, e-transport, e-government, e-health, as well as businesses that are based on electronic social networks (e.g., Twitter, Uber and Facebook) fall under DM (Song, 2019; Sussan & Acs, 2017). According to Sussan and Acs (2017), the constant and frequent co-creation of value between users and entrepreneurial agents in DM can contribute to developing a sustainable DEE.

2.3 Digital Entrepreneurial Ecosystem and TEA

According to Autio, Szerb, Komlósi, and Tiszberger (2020), the DEE comprises the general framework conditions and the systematic framework condition. The general framework conditions are the country-level conditions that regulate entrepreneurial activities by providing trade-offs at the social and economic levels. They encompass culture and informal institutions, formal institutions and regulations, market conditions and physical infrastructure. The systematic framework condition is the resources available for firms to convert opportunities into entrepreneurial activities at the different stages of life (stand-up, start-up and scale-up stage). They include human capital and talent; knowledge, creation and dissemination; finance; and networking and support.

In terms of the pillars of the general framework conditions, national culture is considered an important formal institution influencing entrepreneurship and economic development (Autio, Pathak, & Wennberg, 2013) but also entrepreneurship and innovation (George & Zahra, 2002). According to Hofstede (2001), culture is “the collective programming of the mind that distinguishes the members of one group or category of people from another” (p. 9). Based on Hofstede’s framework, four dimensions were identified in which national culture positively influences entrepreneurial activity: proximity to power, high individualism, aversion to uncertainty and high masculinity (Kreiser, Marino, Dickson, & Weaver, 2010; Shneor, Metin Camgöz, & Bayhan Karapinar, 2013). Thus, informal institutions drive the relationship between knowledge capital and entrepreneurship (Sahasranamam, Nandakumar, Pereira, & Temouri, 2021). Thus, the following hypothesis was formulated:

H1. A culture and informal institutions have a positive effect on entrepreneurial activity in digital entrepreneurship ecosystems.

In addition to culture as an informal institution, the formal institutions that economically define the “rules of the game” of Schout (1991) in terms of formal regulatory rules (taxes, competition regulations, labor regulations, etc.) can affect entrepreneurial activity (Boudreaux & Nikolaev, 2019; Estrin, Korosteleva, & Mickiewicz, 2013). In this way, the market mechanisms that allow it to function

efficiently, eliminating market failures and administrative intransigence, create an environment that allows the creation of businesses and facilitates the absorption of the risks inherent to self-employment (Fuentelsaz, González, Maícas, & Montero, 2015; Young, Welter, & Conger, 2018). An environment of high institutional quality characterized by a stable monetary and fiscal policy, controlled administrative, and social and financial costs makes entrepreneurs face lower costs when starting a new business (Soto, 2000). On the other hand, these environments are market oriented, reducing state intervention and allowing for an efficient allocation of entrepreneurial performance to more productive sectors (Boudreaux, Nikolaev, & Holcombe, 2018; Gwartney, Lawson, & Norton, 2008). Thus, formal institutions such as property rights, labor, business and fiscal freedom, government and societal attitudes drive entrepreneurial activity (Álvarez, Urbano, & Amorós, 2014; Nikolaev, Boudreaux, & Palich, 2018). In this context, the following hypothesis was formulated:

H2. Better quality formal institutional environments positively influence new business creation in digital entrepreneurship ecosystems.

In addition to informal and formal institutions, market conditions can influence or inhibit entrepreneurial activity (Guerrero, Liñán, & Cáceres-Carrasco, 2021). According to Bruton, Ahlstrom, and Li (2010), cultural and social environments are determinants for individuals to create their own business. In the phase of entrepreneurial opportunity exploration and decision-making, macro-environmental conditions such as new technologies, market competition, regulation, socioeconomic conditions and access to financial and non-financial resources can create and change the behavior of individuals and the way they recognize opportunities (Ahmad & Hoffmann, 2008; Fuentelsaz et al., 2015; Liñán & Fayolle, 2015). The dynamism of markets can also create favorable conditions for self-employment (Rotefoss & Kolvereid, 2005) by reducing entry barriers to new business creation and facilitating the evolution of entrepreneurial activity into more advanced stages (Guerrero et al., 2021). Thus, the following hypothesis was formulated:

H3. Favourable market conditions positively affect entrepreneurial activity in digital entrepreneurship ecosystems.

Physical infrastructure is related to large capital investments, referring us to large-scale, high-spending projects that can be a barrier to entry for new firms (Aschauer, 1989). However, it is important to distinguish investment in physical capital from investment in infrastructure, as the former is made by companies, and a new company has difficulties supporting it. The second is an investment that, because it is large scale, requires high financial capital and is irreversible, is usually carried out by the public sector, being assumed as a natural monopoly, with the benefit being externalized to all (Audretsch, Heger, & Veith, 2015). According to Bennett (2019), physical infrastructures facilitate the transportation of goods and people, such as airports, energy and water distribution, support the supply of essential sectors (education, health, etc.) and facilitate the production of goods and the provision of services (industrial parks, shopping malls, etc.). Thus, investment in physical infrastructure, not only at the level of road and

rail infrastructure, as well as broadband internet, although expensive, reduces the barriers to entry for new businesses because it facilitates connectivity, the speed of knowledge flow and sharing of ideas, essential to transforming entrepreneurial opportunities into new businesses (Audretsch et al., 2015). Therefore, investment in infrastructures is essential to create a suitable environment for the creation of new businesses. In this context, physical infrastructure, by allowing an increase in connectivity between people and facilitating the recognition of entrepreneurial opportunities, especially the activities of creating new businesses, is positively related to entrepreneurial activity (Audretsch et al., 2015). The following hypothesis is formulated:

H4. Adequate physical infrastructure positively affects entrepreneurial activity in digital entrepreneurship ecosystems.

Human capital measures the level of education and skills of individuals (Rees, 1965). It can be general or specific. The general human capital refers to educational qualifications, and the specific human capital of entrepreneurs refers to business skills, knowledge and experience (Marvel, Davis, & Sproul, 2016; Sahasranamam & Nandakumar, 2020). The general human capital has positive effects on the initiation of entrepreneurial activity and business performance due to the ability and ease of integrating knowledge of new situations, allowing to explore opportunities (Estrin, Mickiewicz, & Stephan, 2016; Unger, Rauch, Frese, & Rosenbusch, 2011). Although the identification of new business opportunities, the ability to manage the risk of entrepreneurial activity and obtain the resources necessary for business performance are positively related to general human capital, it is often necessary to have other types of more specific knowledge and previous experience in business creation (Unger et al., 2011). Specific human capital involves these skills and sensitivity in identifying new entrepreneurial business opportunities, drawing up appropriate business plans, being proactive and seeking solutions to overcome the difficulties of setting up a new business (Sahasranamam & Nandakumar, 2020). Usually, these skills and competencies are not valued in jobs with other companies, but they are essential for entrepreneurial activity. The higher the human capital, the higher the possibility for individuals to identify and explore entrepreneurial opportunities (Autio & Acs, 2010; Mickiewicz, Nyakudya, Theodorakopoulos, & Hart, 2017). According to Kim, Aldrich, and Keister (2006), even if entrepreneurs do not have sufficient financial capital, they can create successful entrepreneurial activities when they have higher levels of human capital. Thus, specific human capital positively influences entrepreneurial activity (Sahasranamam & Nandakumar, 2020). The following hypothesis has been formulated:

H5. Higher levels of human capital and talent positively influence entrepreneurial activity in digital entrepreneurship ecosystems.

Organizational knowledge creation consists of making available and extending the knowledge created by individuals and connecting this knowledge to the organization's knowledge system (Nonaka, Toyama, & Konno, 2000).

The theory of knowledge creation describes the firm as the entity that actively creates knowledge (Nonaka, 2009). According to this author, there are four processes of knowledge creation: internalization, externalization, socialization and combination. The internalization process makes the transition from explicit to tacit knowledge through the absorption of knowledge by demonstration, that is, learning by doing (Nonaka et al., 2000). The externalization process articulates tacit knowledge in an explicit form to be understood by all. The socialization process is the extension of knowledge to external networks forming alliances in which there is a shared experience and joint activities with consumers, suppliers, competitors, among others (Nonaka, 2009). And the combination process converts the explicit knowledge (internal and external) into more complex and systematized knowledge. This process of knowledge creation is an important way for new entrepreneurs to be driven to develop new products and marketing activities (Nonaka & Toyama, 2005). Knowledge spillovers involve intensive and extensive knowledge activities (Li, Huang, & Tsai, 2009). Knowledge spillovers, R&D agreements and joint patents are voluntary knowledge transfer (Hall & Sena, 2017). On the other hand, entrepreneurial businesses actively seek knowledge globally and in local ecosystems (Audretsch & Belitski, 2017; Spigel, 2017). Thus, research units, universities and public research centers play an important role in creating exploratory knowledge (Belitski & Heron, 2017; Guerrero, Urbano, Fayolle, Klofsten, & Mian, 2016). However, if collaboration costs and R&D investment are high or if entrepreneurial businesses have limited resources, there is weak participation of entrepreneurs seeking knowledge at external and global levels through knowledge spillover (Belitski, Caiazza, & Lehmann, 2021). In this context, the following hypothesis was formulated:

H6. Higher levels of knowledge, creation and dissemination positively influence entrepreneurial activity in digital entrepreneurship ecosystems.

The finance pillar captures the sources of finance for new entrepreneurial activities. Firstly, entrepreneurs tend to rely on personal financial resources, then on family and friends and finally on external capital funding, namely venture capital, business angels, banks, external investors, among others (Berger & Udell, 2003; Block, Colombo, Cumming, & Vismara, 2018). Financial constraints can be an impediment to entrepreneurial activity and limit the growth and survival of new businesses (Brown & Earle, 2017). Thus, individuals with access to different sources of finance tend to be more likely to be entrepreneurs (Gentry & Hubbard, 2004; Howell, 2019; Leitch, Welter, & Henry, 2018). On the other hand, the perceived high access to finance can directly influence entrepreneurial activity (Luc, 2018). Thus, the following hypothesis was formulated:

H7. The easier the access to funding sources, the higher the entrepreneurial activity in digital entrepreneurship ecosystems.

Entrepreneurship ecosystems are led around the creation of networking and organizational support. The state, universities and public-private partnerships can play this role and provide the essential resources for developing entrepreneurial

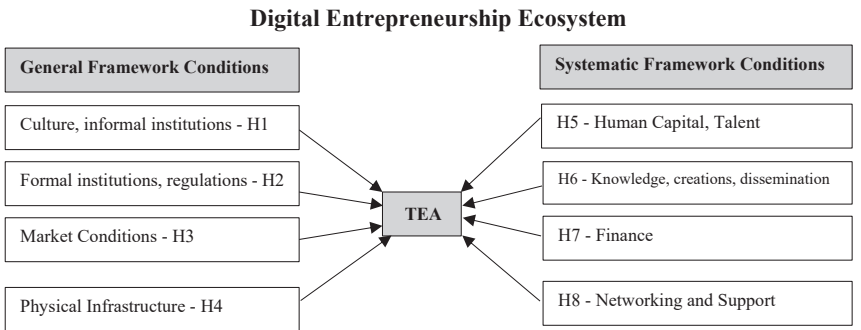


Fig. 5.1. Theorical Model.

activity (Gibbs, Singh, Butler, & Scott, 2018). Networking and support in terms of entrepreneurial activity can be at the level of training, marketing, business and finance (Zin & Ibrahim, 2020). Appropriate support systems and stable networking networks enable the provision of information and resources to create new businesses (Lopes et al., 2019; Lopes & Franco, 2019). Business ecosystems that promote entrepreneurial activity include leadership, capital and consumer markets, and culture adapted to the local reality (Isenberg, 2010). On the other hand, traditional networking networks (e.g., family-based) may explain the different patterns of entrepreneurship. Thus, the following hypothesis was formulated:

H8. Higher levels of networking and organizational support positively influence entrepreneurial activity in digital entrepreneurship ecosystems.

Taking into account the hypotheses formulated, the following theoretical model is presented (Fig. 5.1):

3. DATA AND METHODOLOGY

3.1. Sample

The sample of this study consists of the 28 European countries and a period from 2018 to 2020. The period and countries considered were due to data availability in the European Index of Digital Entrepreneurship Systems (EIDES) (Autio, Szerb, Komlósi, & Tiszberger, 2018, 2019; Autio et al., 2020), with only three annual reports. The dependent variable of this study is TEA, and was collected by the National Expert Survey of the GEM (2021). TEA as a variable explained by the DEE pillars was used by Jafari-Sadeghi et al. (2021), Aminova, Mareef, and Machado (2020), and Du and O'Connor (2018). The independent variables are the eight pillars of DEE: culture and informal institutions, formal institutions and regulations, market conditions and physical infrastructure, human capital and talent; knowledge, creation and dissemination; finance; and networking and support. The acronyms, measures and sources of the dependent and independent variables are shown in Table 5.1.

Table 5.1. Dependent and Independent Variables.

Variables	Acronyms	Measures	Source
Dependent			
Total early-stage entrepreneurial activity	TEA	Percentage of 18–64 population who are either a nascent entrepreneur or owner–manager of a new business	GEM
Independent			
Culture and informal institutions	Informal_Inst	(1) Social desirability and acceptance of entrepreneurship, efficiency of legal framework, corruption (2) Population attitude toward start-up risk (3) Corporate governance, reliance on professional management, willingness to delegate authority	EIDES
Formal institutions and regulations	Formal_Inst	(1) Rule of law, private property protection (2) Ease of start-up (regulation) (3) Government effectiveness in terms of services and taxation	
Market conditions	Market	(1) Local, domestic market conditions, urbanization (2) Ease of entry to local market (market dominance, exploiting business opportunities)	
Physical infrastructure	Physical_Infra	(3) Internationalization (1) Electricity infrastructure (access and quality) (2) Transport infrastructure (quality and efficiency of service)	
Human capital and talent	Human_Cap	(1) Quality of education system, education level of population, entrepreneurial education (2) Advanced education, quality of university education, STEM education, entrepreneurial skills, entrepreneurship education (3) Lifelong learning, labor market conditions, mentoring, serial entrepreneurs	
Knowledge, creation and dissemination	Knowledge	(1) Skillset of graduates, efficient use of talent, professionals and researchers (2) Quality of research institutions, technology and knowledge transfer (science in schools) (3) Research and innovation capacity (R&D), knowledge absorption, university–industry collaboration	
Finance	Finance	(1) Availability of credit, SME finance (2) Early-stage entrepreneurial finance, VC availability, business angels (3) Later stage finance, private equity financing	
Networking and support	Net_Support	(1) Attitudes toward entrepreneurs (2) External support for start-ups, networking (3) Clusters and value chain development	

3.2 Methods

Given the sample is a panel data, the quantitative methodology of Jafari-Sadeghi et al. (2021). We used the generalized method of moments (GMM) method, with fixed cross-section and cross-section weights instruments to estimate the theoretical model.

The GMM method is widely used in samples composed of dynamic data panels because it is consistent and asymptotically normal over large samples, requiring no specification of the distribution of error terms (Greene, 2020; Hall, 2007). GMM becomes efficient since it corrects the heteroscedasticity and autocorrelation problems typical of this type of samples. On the other hand, it allows controlling for unobserved specific effects at the country level and non-stationary variables.

Taking into account the theoretical model of this study, equation 1 was defined:

$$Y_{it} = \beta_1 Y_{it-1} + \beta_2 Z_{it} + \mu_{it} + e_{it}$$
 (1)

where Y_{it} is the TEA as a measure of entrepreneurial activity; Y_{it-1} is the lagged TEA variable for the country i in the period $t - 1$; Z represents the independent variables concerning the eight pillars of DEE; μ are the unobserved effects at the country level; and e is the error term. Y_{it-1} is correlated with μ_{it} leading to heteroscedasticity problems due to unobserved effects at the country level. Heteroscedasticity problems are overcome by introducing the first differences of the variables, resulting in equation 2:

$$Y_{it} - Y_{it-1} = \beta_1 (Y_{it-1} - Y_{it-2}) + \beta_2 (Z_{it} - Z_{it-1}) + (e_{it} - e_{it-1})$$
 (2)

To overcome the autocorrelation problems between Y_{it-1} and e_{it} with the independent variable Z . The eight pillars of DEE were used as instrumental variables, assuming that the time-varying errors have 0 means, there is no correlation between the error terms, there is no correlation between the lagged independent variables and the future error terms. A statistical analysis of the dependent and independent variables was carried out (Table 5.2), and the stationarity of the panel data was verified using the unit root test (Table 5.3).

Table 5.2. Statistical Description of the Variables.

Variables	Mean	SD	Minimum	Maximum	N
TEA	8.41	3.3456	1.9	15.6	48
Informal_Inst	49.802	26.3074	16.6	100	84
Formal_Inst	48.054	18.709	20.3	100	84
Market	52.274	24.8264	7.7	100	84
Physical_Infra	53.16	16.8774	19.8	100	84
Human_Cap	50.46	19.997	21.9	100	84
Knowledge	48.236	20.2146	21.5	95.4	84
Finance	49.992	18.3053	19.2	98.2	84
Net_Support	49.852	16.315	21.9	98.6	84

4. RESULTS

Table 5.2 contains a statistical analysis of the dependent and independent variables.

Table 5.3 shows the results of the unit root tests, having used three tests: Levin, Lin, and James Chu (2002), Breitung (2000) and Im, Pesaran, and Shin (2003). The unit root is confirmed for all variables (dependent and independent) for a significance level of 1%, 5% and 10%.

The results of the GMM estimation of the model are shown in Table 5.4. As described above, we use the Arellano–Bond estimator, introducing the one-year lagged TEA. The AR(1) p -value is 0.000, and, as such, we reject the H_0 that there is no autocorrelation of the error terms for a significance level of $p = 0.000$. The AR(2) test is more important because it allows for detecting levels of autocorrelation and, as such, validating the quality of the GMM estimator (Mileva, 2007). The p -value of AR(2) is higher than 0.10. Thus, we can conclude that there is no second-order autocorrelation (Ben Lahouel, Gaies, Ben Zaied, & Jahmane, 2019). The p -value of the Hasen test is higher than 0.10, meaning that the model is well specified and that there is no evidence to reject the quality of the instrumental variables used in the model (Hayashi, 2011).

All independent variables are statistically significant. Culture and informal institutions, formal institutions and regulations, market conditions, physical infrastructure, human capital and talent and networking and support have a positive influence on entrepreneurial activity measured by TEA in DEE, confirming $H1$ – $H5$ and $H8$. The variables knowledge, creation and dissemination, and finance negatively impact entrepreneurial activity in DEE, rejecting $H6$ and $H7$.

Table 5.3. Panel Unit Root Tests.

	Levin, Lin, and Chu (2002) - Adjusted t^*	Breitung (2000) - Lambda (Statistics)	Im, Pesaran, and Shin (1997) t -tilde-bar (Statistics)
TEA	29.609**	−1.8512**	−1.567**
Informal_Inst	−1.8762**	−1.7454**	−1.6934**
Formal_Inst	−2.1254***	−1.5654*	−1.6609*
Market	−17.3686**	−1.9645***	−1.5606***
Physical_Infra	−4.8706**	−1.9785 **	−1.9832 **
Human_Cap	−5.5879**	3.7537*	−1.4899*
Knowledge	−21.3604***	−1.3564*	−1.7534*
Finance	−33.9970**	−3.5489**	−1.9543**
Net_Support	−6.8912**	−1.6479**	−1.5532**

Source: Own elaboration.

Notes: (i) ***, **, * Mean stationarity significant at 1%, 5% and 10%; (ii) the null hypothesis (H_0) is always all data panels contain a unit root; (iii) in the case of the Im et al. (1997) test, we have used the time trend for all variables and the time trend and subtracted cross-sectional means for PO, PC and TEA. In the case of the Levin et al. (2002) test and Breitung (2000) test, we have used a time trend for all variables.

Table 5.4. Results of GMM Estimation. Dependent Variable: TEA.

Variables	Coefficient
TEA (−1)	0.9960 (0.0678)**
Informal_Inst	0.2165 (0.5287)***
Formal_Inst	0.3766 (1.0176)***
Market	0.7531 (3.,0418)*
Physical_Infra	0.0540 (0.3651)***
Human_Cap	1.4535 (4.2323)*
Knowledge	−0.2219 (−0.6160)***
Finance	−0.4921 (−2.1242)**
Net_Support	1.0891 (3.0413)*
AR (1)	0.9236
p-value (AR1)	0.0000
AR (2)	0.3295
p-value (AR2)	0.8778
p-value (Hasen test)	0.4344
Obs.	29
Cross-sections included	16
Period included	3

Source: Own elaboration.

Note: * $p < 0.01$; ** $p < 0.05$; *** $p < 0.10$. Standard errors are shown in parentheses. All models are estimated by GMM method using the Arellano–Bond estimator. All models include fixed effects.

5. DISCUSSION AND CONCLUSIONS

Digital transformation implies a disruption of traditional businesses by equipping them with innovative technologies that affect incumbent companies and create an enabling environment for the creation of new companies (Jafari-Sadeghi et al., 2021). Inherent in the digital transformation of organizations have emerged new concepts such as technology entrepreneurship, digital technology entrepreneurship and digital entrepreneurship. On the other hand, the digitalization trend has transformed the dynamics of start-ups in the last decade, leading to the adoption of new innovations to support entrepreneurial opportunities, accelerate entrepreneurial activity and create an innovative environment (Autio et al., 2020). Digital transformation also enables the performance of existing functions in a more efficient, effective and different (Autio, Nambisan, Thomas, & Wright, 2018).

The pillars of DEE are divided into two groups: general framework conditions and systemic framework conditions. We conclude that the DEE pillars of informal and formal institutions, market conditions, physical infrastructure, human capital and talent and networking and support have a positive

influence on the entrepreneurial activity as measured by TEA in DEE. In terms of culture and informal institutions, culture positively influences entrepreneurial activity and drives the relationship between knowledge capital and entrepreneurship (Sahasranamam et al., 2021; Shneor et al., 2013). Thus, in a culture of social acceptance of entrepreneurship, the population's positive attitude toward the risk of starting a new business and professional management that allows delegating responsibilities favor entrepreneurial activity (Kreiser et al., 2010; Shneor et al., 2013). Formal institutions and regulations can also enable entrepreneurial activity when a rule of law has reduced state intervention, effective regulation of property rights and efficient government performance (Boudreaux & Nikolaev, 2019). These conditions allow eliminating market failures and accepting the risk of starting a new business (Boudreaux et al., 2018; Fuentelsaz et al., 2015; Young et al., 2018). Market conditions also influence the entry of new entrepreneurs. Internationalization, ease of access to the local market, regulatory and domestic market conditions, as well as existing macroeconomic conditions can allow entrepreneurs to identify opportunities for new business creation by changing their behavior (Ahmad & Hoffmann, 2008; Liñán & Fayolle, 2015). These market conditions can be improved if there is adequate physical infrastructure, including quality access to electricity and an efficient transport structure that facilitates the transportation of goods and people, and access to health care and education (Audretsch et al., 2015). Thus, investment in physical infrastructure is essential to create a suitable environment for the creation of new businesses, facilitating the recognition of entrepreneurial opportunities and reducing entrepreneurs' fear of failure (Bennett, 2019).

At the level of systematic framework conditions, human capital and talent underpinned by a quality education system, entrepreneurial education, higher levels of schooling, entrepreneurial skills and competencies, previous experiences in new business creation and lifelong learning drive new business creation (Marvel et al., 2016; Sahasranamam & Nandakumar, 2020). It is highlighted that the skills and competencies of the entrepreneurs that integrate the specific human capital are essential for detecting new entrepreneurial opportunities and creating their own business, being little valued when the worker is inserted in a company (Lopes & Franco, 2019). Also, entrepreneurs' networking and support networks based on attitudes toward entrepreneurs and support of start-ups positively influence entrepreneurial activity (Zin & Ibrahim, 2020). The state, universities and public-private partnerships can create ideal conditions for adequate networking and support to boost entrepreneurial activity (Gibbs et al., 2018; Spigel, 2017).

Still, regarding the systematic framework conditions, this study concluded that the knowledge, creation and dissemination variable has a negative impact on entrepreneurial activity. The measures of knowledge, creation and dissemination encompass skills, the use of entrepreneurs' individual talent, the quality of R&D institutions, knowledge transfer, research and innovation capacity, and collaboration between firms and universities (Autio et al., 2020). The firm is an entity that actively creates knowledge, and this creation can occur through internalization, externalization, socialization and combination (Nonaka, 2009). There is evidence that research units, universities as well as public research centers play

an important role in the creation of exploratory knowledge (Belitski & Heron, 2017; Guerrero et al., 2016). However, the negative impact of knowledge creation and dissemination on entrepreneurial activity may be due to the barriers inherent in these processes such as the high costs of collaboration between different stakeholders and the high investment in R&D to create innovative knowledge and promote its outsourcing, which inhibits the participation of entrepreneurs at early stages of entrepreneurial activity (Belitski et al., 2021). Alternatively, entrepreneurs systematically seek knowledge at the global level and in local ecosystems (Audretsch & Belitski, 2017; Lopes et al., 2019).

A negative impact of the finance variable on entrepreneurial activity was also found. The finance variable is measured by the availability of entrepreneurial finance through access to credit, ventures capital, business angels and, at a mature stage of entrepreneurial activity, private equity. However, constraints in access to finance limit, at an early stage of entrepreneurial activity, the creation of new businesses and, at an expansion stage, the growth and survival of firms, having a negative impact on entrepreneurial activity (Berger & Udell, 2003; Block et al., 2018; Brown & Earle, 2017). Easy access to different sources of finance tends to positively influence the detection of entrepreneurial opportunities, as well as the creation of new businesses (Howell, 2019; Leitch et al., 2018; Luc, 2018).

Entrepreneurial ecosystems are meta-structures that generate tensions between resources of heterogeneous organizations in which participants have self-organizing properties (Iansiti & Levien, 2004). The introduction of digital entrepreneurial ecosystems may be disruptive moderately or, more drastically, a bleeding edge. First, incorporating digital technologies in the entrepreneurial process promotes knowledge diffusion. It facilitates cooperation and resource integration, leading to a total or partial transformation and reconfiguration of value chains (Zahra, Liu, & Si, 2022). This may entail creative destruction of the value chain and reconstruction of the value chain. Then the self-organization of actors participating in digital entrepreneurial ecosystems are imposed by tensions that motivate participants to self-organize around their structure without external intervention. This often implies breaking with existing networks and creating new forms of cooperation that initially have a very high cost for participants imposed by the need for change. This self-organization can lead to the creation, recreation and destruction of organizations on small and large scales depending on the level of change that the structure must undergo to self-organize. Once stable, the self-structure generates opportunities for innovation, the possibility of playing multiple roles in the network, interconnectivity and the ability to absorb external disruptions. Finally, digital entrepreneurial ecosystems allow geographically distinct audiences to connect, extend the ecosystem network, increase its permeability to new entrepreneurial activities and introduce radically innovative business models (Zahra et al., 2022). This permeability breaks the traditional barrier to entry into a new industry, increases the digitization of companies and raises skilled human capital. However, participants in digital entrepreneurial ecosystems face important challenges such as the need to access non-restricted sources of finance; higher investments in human capital specializing in digital technologies and investments in robust digital platforms challenges that can be a barrier

to business creation and recreation. On the other hand, since digital entrepreneurial ecosystems are so disruptive and can incorporate bleeding-edge processes to remain sustainable without external interference, concerns arise about protecting the privacy of participants, the efficiency of digital platforms, fostering competitiveness and competition outside digital platforms and the security of digital infrastructure, which are increasingly valued today (Song, 2019).

6. THEORETICAL AND PRACTICAL IMPLICATIONS

6.1 Contributions to Theory

With this study, we examine DEE and TEA from the perspective of meta-organization theory. DEE is an emerging topic in the literature and needs further study (Du et al., 2018; Elia et al., 2020). DEE is a collection of autonomous individuals and organizations and is, therefore, a meta-organization. Thus, firstly, this study contributes empirically to the development of the literature on meta-organizations, as most studies are conceptual lacking empirical evidence (Ahrne & Brunsson, 2005; Gulati et al., 2012; Puranam, Alexy, & Reitzig, 2014). Second, the results of this study provide empirical support for the clarification and substantiation of the DEE concept. Third, this study further contributes to the development and growth of the literature on the influence of DEE on entrepreneurial activity as measured by TEA and to the framing of entrepreneurship in DEEs as suggested by Sussan and Acs (2017). There are many studies on digital entrepreneurship, however, they focus only on the level of firms (Davidson & Vaast, 2010; Sambamurthy et al., 2003), neglecting their context, that is, the DEE. And finally, this study brings new empirical contributions to literature by bringing together the three concepts: meta-organization, DEA and entrepreneurial activity.

6.2 Contributions to Practice

From this study, we can infer a number of practical implications at the general and specific levels. At the general level, policy-makers need more data describing the framework conditions for efficient and effective digital entrepreneurship at the country level. On the other hand, there is a need to strengthen DEE and enable widespread access of countries and individuals to digitalization conditions. As a consequence of digital transformation, organizations have to transform their traditional business models, equipping them with digital tools that promote their business performance. Finally, there has to be an improvement in knowledge management, especially the relationship of knowledge with technology and its impact on digital entrepreneurship. This implies that individuals become more involved with private companies and state organizations, lowering the barriers to the creation and transfer of knowledge associated with digital transformation.

In specific terms, given the digitalization conditions, the entrepreneurial culture as an informal institution should be strengthened by creating networking networks, forums and meetings of entrepreneurs (Sahasranamam et al., 2021). On the other hand, policies supporting entrepreneurial activities must be adapted

to the cultural environment. In risky environments, market conditions must be created that mitigate the barriers to the creation of new businesses. In environments with less economic freedom, investment in human and financial capital can be effective in promoting entrepreneurship (Boudreaux & Nikolaev, 2019; Sahasranamam & Nandakumar, 2020). As the access to external financing is one of the greatest obstacles to the creation of new businesses (Howell, 2019), new financing policies should be adopted that value entrepreneurial opportunities and allow a more equal access to financing. The concession of subsidies and funds to start-ups, the promotion of entrepreneurial ideas competitions and the measurement of the new business risk incorporating the valorization of the general and specific human capital of the entrepreneurs could be some suggestions to improve access to financing by entrepreneurs.

7. LIMITATIONS AND FUTURE RESEARCH DIRECTIONS

Concerning limitations, currently available data on DEEs is still limited. There are only available data (DEE measures) for 28 countries in Europe and for three years (2018–2020) published by EIDES. In addition, the data is aggregated into eight pillars, and their disaggregation by the measures that make up the pillars is not yet known. The short time span of the data limits the composition of more robust samples that would allow more complex statistical analysis and allow a deeper understanding of the EEDs. On the other hand, TEA statistics are not collected every year for all countries. The diffusion of an entrepreneurial culture implies a systematic monitoring of entrepreneurial activity. Moreover, despite the context of the DEEs, there are still not enough statistics on the technological TEA that would be the ideal dependent variable to be explained by the DEE measures.

Currently, there is still no consensus on the conceptual framework of EEDs, and further studies are needed to deepen the knowledge. Thus, systematic literature reviews or bibliometric analyses are needed in order to understand the trend of the development of EEDs and further research on EEDs, namely at the empirical level, in order to identify more relevant constructs, allowing for a more rigorous and robust definition of EED (Elia et al., 2020).

All countries should still universally measure the variables that make up a DEE, broadening the spectrum of studies in this field. Comparing DEE performances and traditional regional innovation ecosystems should also be considered, as well as exploring the evolution of DEE elements and their real effects on firms (Torres & Godinho, 2021). On the other hand, it is necessary to study DEE on other theories and disciplines such as information systems, marketing, political science, regional planning and development, and economics. DEEs should also be analyzed from the sustainability point of view due to the sustainable goals to be achieved by countries in the coming years. The study on DEEs can also focus on open innovation and digital economy to enable businesses with fast and scalable growth. Also, future studies on DEEs should also analyze the impact of culture, digital market, digital entrepreneurship, DUC, economic development on digital infrastructure governance and legal systems (Sussan & Acs, 2017).

Finally, longitudinal measurement of technological TEA at the level of countries and regions as well as the analysis of its influence on DEEs will allow new and important contributions to the literature on DEEs. In addition, it will also allow inferring a set of practical implications essential for the decision-making of state and private policy-makers and greater co-creation and spillover of innovation by stakeholders involved in DEEs.

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