

THE IMPACT OF ENTREPRENEURIAL ECOSYSTEMS ON DIGITAL TRANSFORMATION: A MESO LEVEL ANALYSIS

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This work aims to study the impact of meso-level variables of entrepreneurial ecosystems (EEs) on digital transformation. Statistical analysis was used to evaluate the research hypotheses, based on multiple linear regression, with a sample of 172 organisations. The results show that actors from the meso dimension of EEs positively impact digital transformation through knowledge, discoveries, guidance, co-opetition, co-creation and

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stimulation of technological search. The contributions of this study are in bringing a more refined perspective of the incentives of society actors to digital transformation, besides awakening to their importance in organisational processes and showing that associations for the satisfaction of own interests can culminate in common benefits.

Keywords: Entrepreneurial ecosystems; digital transformation; cooperation.

Introduction

The entrepreneurial ecosystem (EE) encompasses the growth of individuals in various fields, the evolution of innovative business strategies, and the birth of fresh enterprises. It encompasses a network of interconnected players and elements that both foster and restrict entrepreneurial endeavours within a specific geographical region (Stam and van de Ven, 2021). A growing priority for policymakers in economies lies in fostering the entrepreneurial environment, a dynamic web of influences that foster and maintain local entrepreneurship (Roundy and Fayard, 2019). Within this intricate network, the nation's market characteristics and governmental regulations converge harmoniously with diverse societal actors, creating a favourable landscape. Consequently, Giudici *et al.* (2017) emphasise the pivotal significance of influential actors in orchestrating the collaborative endeavours of fellow network participants during a collective innovation endeavour.

The interplay of these elements takes place within the context of economic and social advancement, where incentives are directed towards fostering business expansion through knowledge sharing and technological innovation. This intricate interrelation is observed within the cultural, social, economic, and political milieu of regions that actively nurture and facilitate high-growth entrepreneurship (Spigel and Harrison, 2017). Hence, the interconnectivity within EEs encompasses mutual reliance, trustworthiness, empowerment of entrepreneurs, and mentorship to enhance market outcomes. Conversely, entrepreneurs may confront the task of managing a multifaceted network of stakeholders amidst individual and collective uncertainties (Gomes *et al.*, 2018).

The participants within the EE encompass various entities such as universities, clients, consultants, rivals, suppliers, and elements of the meso environment. They form a network of interactions between individuals and organisations, including financial intermediaries, universities, research institutions, suppliers, customers, multinational corporations, and governments (Colombo *et al.*, 2019). Consequently, the realms of entrepreneurship and digital transformation experience significant influence as digital technologies and entrepreneurial entities adopt innovative strategies to tackle seemingly insurmountable obstacles (George *et al.*, 2021). In light of its characteristics, the EE captures the interest of academia,

industry, and government alike, as it offers a framework for driving economic transformation through innovative ideas, products, services, and technologies (Colombo *et al.*, 2019). In line with this perspective, Cantner *et al.* (2021) suggest a transition within the ecosystem from an entrepreneurial system primarily focused on establishing new organisations to a greater emphasis on internal knowledge commercialisation and intrapreneurial endeavours, and vice versa.

According to Roundy and Fayard (2019), the dynamic nature of the entrepreneurial ecosystem enables entrepreneurs to identify, leverage, and reshape resources and opportunities. Conversely, Spigel and Harrison (2017) assert that thriving entrepreneurship within an ecosystem contributes to the accumulation of investment capital, skilled labor, and knowledge, particularly for high-growth ventures. Additionally, Acs *et al.* (2018) provide evidence supporting the influence of EE on economic growth. Endres *et al.* (2022) shed light on tools designed to streamline the integration within EEs, focusing on software solutions that centralise an organisation's innovation programs, stakeholders, and resources in a unified platform. On the other hand, Stam and van de Ven (2021) highlight the ambiguous nature of the EE concept and emphasise the importance of adopting a systemic perspective when considering the entrepreneurial context.

In exploring the connection between EEs and digital transformation, Stolze *et al.* (2018) investigate the performance of actors with regard to their digital mindset. They highlight the challenge of effectively utilising emerging digital technologies within the context of individuals' mindsets and skills, underscoring the importance of developing digital transformation initiatives accordingly.

Tijan *et al.* (2021) conduct a review of the drivers, success factors and barriers to digital transformation, which involves cooperation and awareness of the parties involved.

Continuing the discussion on EEs and digital transformation, Ivančić *et al.* (2019) delve into the progressive development of frameworks for digital transformation, encompassing methodologies and internal strategies within the operational ecosystem. In a related vein, Sjödin *et al.* (2021) delve into the exploration of organisational practices for cultivating artificial intelligence (AI) technological competencies and revolutionising business models to effectively incorporate AI into the digital integration of products and services. Hence, it becomes evident that research exhibits a multitude of perspectives on EEs, encompassing their associations with market outcomes, knowledge commercialisation, entrepreneurial empowerment, resource generation, enabling technologies, economic development, and systemic integration. However, the significance of studies focusing on the meso environment within EEs, specifically the direct contributions of its actors, is noteworthy, as they have a direct impact on factors essential for meeting organisational requirements, such as digital transformation. To

address the existing voids in the literature, our research endeavours to examine the meso-level variables of the EE (including collaborations with universities, consultants, competitors, customers, and suppliers) and their impact on companies' digital transformation. Empirically, we employed a multiple linear regression methodology to analyse the data. Our study introduces a novel model of the EE that focuses on investigating meso-level variables and their influence on digital transformation.

This academic study makes a significant contribution by offering a comprehensive understanding of how societal actors drive the momentum of digital transformation, encompassing the creation, utilisation, learning, and technological advancements. From an organisational perspective, it brings awareness to leaders, collaborators, and fellow entrepreneurs, encouraging them to incorporate technology in their operations and interactions with business partners. On a broader social scale, the study reveals that pursuing individual objectives through integration can lead to holistic outcomes that positively impact society as a whole.

Literature Review

Entrepreneurial ecosystems

In the past quarter-century, the divide between economics and life sciences has significantly diminished, resulting in valuable economic discoveries (Auerswald, 2015). One noteworthy bridge in this regard is the EE concept, which draws upon the ecosystem framework that has been employed in the field of biology for nearly a century (Audretsch *et al.*, 2019; Cavallo *et al.*, 2019). The pioneering work of James Moore (1993) represents a significant breakthrough in the adoption of the ecosystem metaphor within the realm of social sciences, particularly in the field of management (Brown and Mason, 2017; Malecki, 2018; Neumeyer and Santos, 2018; Roundy *et al.*, 2017). The integration of this metaphor into the field of entrepreneurship followed from the influential article by Cohen (2006), as well as the pivotal works of Isenberg (2010) and Feld (2012). Cohen (2006) defines an EE as an interconnected group of actors within a local geographic community who are dedicated to sustainable development by providing support and facilitation for new sustainable ventures. The early conceptualisation of the EE drew inspiration from closely related ideas that preceded it, albeit lacking the specific association with the ecosystem metaphor. These included Spilling's (1996) definition of an entrepreneurial system and Van de Ven's (1993) concept of an infrastructure for entrepreneurship (Alvedalen and Boschma, 2017; Stam, 2015). However, it was only in the last decade, particularly since 2016, that the term "entrepreneurial ecosystem" gained widespread usage, surpassing these related concepts. Although

these concepts are occasionally mentioned in EE literature (Malecki, 2018), they have not garnered the same level of attention and primarily appear in earlier publications, exerting a lesser influence (Alvedalen and Boschma, 2017).

Notwithstanding the growing scholarly interest, research on EEs has thus far lacked a unified definition and instead been characterised by a fragmented nature, with various authors approaching the topic in an ad hoc manner (Stam, 2015, p. 1765). This fragmentation is reflected in the lagging development of theoretical frameworks, which struggle to keep pace with the rapid surge in popular interest. Moreover, the absence of robust theoretical foundations and comprehensive empirical analyses hinders progress in investigating broader themes within the field (Spigel and Harrison, 2018). As a result, the field is frequently recognised as fragmented and lacking in theoretical development (Autio *et al.*, 2018; Cao and Shi, 2021). The absence of a universally accepted definition, as noted by Stam (2015), further emphasises this point. To address this lack of consensus and to provide clarity, we propose defining an EE as a dynamic community of diverse and interdependent actors who collaborate within an environment that fosters entrepreneurship. This ecosystem facilitates the self-sustainable processes of venture creation and growth through complex interactions among its members.

Hypotheses

Cooperation with universities

Establishing links between organisations and research centers entails employing strategies to gain competitive advantage, acquire resources, and access technological solutions. In this context, the monetisation of research is not solely reliant on the presence of technology transfer offices but also involves direct organisational funding of university research (Belitski *et al.*, 2019). Collaborative interactions among universities, organisations, and government entities play a crucial role in cultivating a sustainable EE, with universities serving as entrepreneurial catalysts in a knowledge-based society (Stolze *et al.*, 2018). Beyond disseminating knowledge, universities actively engage in commercialising their intellectual capital by establishing spin-off organisations within their premises (Audretsch *et al.*, 2019).

Within this dynamic environment, universities play a pivotal role by leveraging their scientific discoveries and technological advancements to forge stronger relationships with suppliers, employees, and customers. Extensive research has been conducted to identify strategies and approaches for selecting and implementing digital technologies that effectively drive organisations' digital transformation goals (Holmström, 2022). Simultaneously, organisations recognise the value of investing in universities to harness their potential for technological innovation, thereby fostering progress and enhancements in processes, products, and

services. Combining education with essential services, such as finance, can significantly enhance the performance of new ventures (Gonzalez-Uribe and Leatherbee, 2018). Hence, a noteworthy achievement lies in the seamless conversion of ideas and inventions into groundbreaking products and services, shaping the technology transfer and innovation processes that inherently possess disruptive potential (Audretsch *et al.*, 2019). Consequently, digital transformation has emerged as an imperative for every organisation, including universities, as they endeavour to unite societal actors, cultures, and technologies to foster adaptation, disruption, and sustainable market presence (Faria and Nóvoa, 2017).

Collaborations with organisations empower knowledge centres with valuable insights into the necessary capacity building, fostering professional employability and enhancing entrepreneurial and digital transformation skills. As emphasised by Stolze *et al.* (2018), the significance of university, organisation, and government interactions is evident in their collective efforts to co-create programs that facilitate technology transfer, education development, and the cultivation of an entrepreneurial mindset. From this standpoint, education adopts diverse methodologies, with educators and academic administrators leveraging systems and technologies to enhance their effectiveness in their roles. During times of global crises, universities have undergone significant changes in student–teacher interactions and the teaching–learning process, with digital transformation playing a pivotal role, particularly in the realm of academic entrepreneurship (Garcez *et al.*, 2022).

The evolution of open universities necessitates a continuous pursuit of integrating pedagogical and technological innovations, guided by research and the exploration of novel strategies to enhance quality (Cunha *et al.*, 2020). Universities play a crucial role in fostering the development of organisations' digital mindset (Stolze *et al.*, 2018), and with the abundance of data being managed, they possess the potential to educate specialists capable of effectively navigating and driving digital transformation (Guse and Mangiuc, 2022).

Woodcock (2018) highlights the subordinate role of academic work processes, which are increasingly influenced by digital technology. There is a risk of perceiving these transformations as detached and disconnected from the everyday academic work that universities heavily rely on. In terms of digital transformation, universities lag behind other sectors, likely due to inadequate leadership, cultural resistance to change, insufficient innovation, and limited financial support (Rodríguez-Abitia and Bribiesca-Correa, 2021). Instead of waiting for government directives and recommendations regarding capacity building for new technologies, universities should proactively take the initiative (Peshkova and Samarina, 2018). Thus, the first hypothesis of this study consists of the following:

H1: *Cooperation with universities and research centres has a positive impact on digital transformation.*

Cooperation with consultants

The scope of digital transformation extends beyond mere technological modernisation, encompassing the assessment and understanding of the socio-technological dimension by consultants. This includes examining individual actions, new process models, and the creation of business value. The advent of digitalisation significantly disrupts businesses and work environments (Diller *et al.*, 2020). Research literature emphasises the importance of integrating external knowledge sources, such as consultants, for the innovative success of organisations (Tran-topoulos *et al.*, 2017). In such a context, digital transformation necessitates the adoption of new business models, prompting disruptions, strategic recalibration, and the reevaluation of capabilities, structures, and cultures (Saarikko *et al.*, 2020).

The concept of digital strategy has gained significant attention across various sectors, although it is still in its early stages (Schallmo *et al.*, 2019). In this context, Guandalini's (2022) research emphasises the need for practical support, including the involvement of consultants, in comprehending the use of digitalisation for sustainability-related objectives. This involves the exploration of viable business ventures with the assistance of consultants who provide valuable insights into leveraging technology for product development, skill enhancement, and innovative ideas. This approach allows organisations to offer superior services, outperform competitors, and enhance operational agility. The process of digitalisation encompasses the identification and pursuit of market opportunities, necessitating investments and internal operational changes within organisations. These transformations involve the mobilisation of new resources and the implementation of specific capabilities to effectively manage them (Dethine *et al.*, 2020).

Taking a holistic view of the market and recognising the significance of tools that drive organisational excellence, consultants play a crucial role in leveraging digital transformation for the success of their clients. The effective management of digital transformation necessitates specialised IT skills, prompting organisations to seek out consultants who bring added value through their services and ensure long-term resilience for their clients (Oesterle *et al.*, 2022). By tapping into their expertise, consultants enable organisations to embrace digitalisation as a strategic ally, empowering them to navigate the evolving business landscape and stay ahead of emerging challenges.

The aim is to enhance the customer experience by implementing strategies and exploring new technologies. Consultants play a pivotal role in driving technological innovation and facilitating interactions between employees and customers

through novel mediation techniques (Christian, 2019). In this context, technology utilisation focuses on acquiring accurate information and streamlining organisational and societal activities in a seamless, efficient manner. The objective is to identify pertinent technologies and determine how they can be effectively integrated into organisational processes and business offerings (Saarikko et al., 2020). Systems for data access and network connectivity possess varying potentials for effectively assimilating external knowledge and subsequently realising economic gains through process innovation (Trantopoulos et al., 2017).

Hence, the consultant plays a pivotal role in fostering connections and implementing technologies to enhance problem-solving capabilities, improve process execution, cater to consumer demands, and continually explore technologies that provide a competitive edge. With the advent of digital transformation, professionals have transitioned from mere problem solvers to analysts and consultants who offer timely solutions in the face of complex economic and social contexts (Coman et al., 2022).

When organisations hire consultants to implement a management system, it ensures the adoption of defined objectives, coordination with stakeholders, and access to expertise that may be lacking within the client organisation (Chang et al., 2013). However, according to Endres et al. (2022), the use of innovation management software in conjunction with consultancy, aimed at facilitating the digitisation of innovation processes, may lead to a reduced adoption of such technology.

Thus, we present the second hypothesis of this study:

H2: *Cooperation with consultants has a positive impact on digital transformation.*

Cooperation with competitors

In order to drive innovation and gain a competitive edge, organisations can embrace certain characteristics such as fostering collaboration with customers, cultivating strong relationships with employees, and actively integrating into the community (De Massis et al., 2018). It is essential to recognise competition as a catalyst for continuous improvement, as it inspires organisations to adopt new technologies and strive for excellence. In today's dynamic business ecosystem, organisations that fail to acknowledge the transformative impact of digital business and adapt to the rapid coevolution among competitors are at risk of swift obsolescence (McKelvey, 2016).

In the realm of collaboration and competition, the concept of coopetition arises, which involves simultaneous cooperation and competition among organisations with the aim of mutual benefit through project realisation. While cooperation and

competition are often viewed as conflicting forces, they can coexist and even complement each other (Ricciardi *et al.*, 2022). Within business ecosystems, organisations gain valuable knowledge through coopetition, which enhances their absorptive capacity, leading to improved agility and performance (Riquelme-Medina *et al.*, 2022). Inter-organisational tensions arise in relation to servitisation and digitalisation, encompassing aspects such as platform-based coopetition, information overload, organisational identity, and data utilisation (Tóth *et al.*, 2022).

In the current context, strategic planning discussions revolve around redefining business practices, encompassing cooperation, and embracing digital transformation. This entails making choices regarding technologies, business models, and necessary investments. Digital transformation should be considered a crucial priority by top management, serving as a defining aspect of the overall business strategy, enabling organisations to gain an advantage in their transformation journey (Saarikko *et al.*, 2020). With the widespread adoption of computer and network applications, organisations are compelled to digitise their processes and offer innovative products, services, and business models to stay competitive in the market (Rodríguez-Abitia and Bribiesca-Correa, 2021).

Under the influence of competitive pressure, the dynamics of customer and partner interactions undergo significant changes, challenging traditional notions of distance and commercial transactions. The emergence of e-commerce, mobile shopping, and smart technologies introduces new contenders that pose a threat to established organisational dominance (Reinartz *et al.*, 2019). However, within this transformative landscape, the digital revolution also presents unparalleled opportunities for increased accessibility (Cunha *et al.*, 2020). To thrive in this multifaceted competition, it becomes imperative for stakeholders to not only acknowledge the ongoing changes but actively adapt and manage their positions within these evolving ecosystems (Reinartz *et al.*, 2019). The drive for collaborative projects in the realm of digital transformation is fueled by the potential for technological advancements to enhance organisational performance. Through the adoption of technologies that foster robust relationships, streamline processes, provide real-time information, and reduce costs, organisations are able to embark on collaborative innovation initiatives. This collaboration extends to market participants, including both competitors and partners, further reinforcing the link between digital transformation and increased operational efficiency (Abdalla and Nakagawa, 2021).

In the ever-evolving landscape of competition, the drive for technological advancements intensifies as organisations strive to enhance the value of their offerings and meet the ever-changing needs and desires of customers. Interestingly, even organisations equipped with internal resources for innovation projects sometimes opt to collaborate with their competitors, a strategic choice that comes with inherent risks but also brings about short and long-term benefits (Fernandez *et al.*, 2021).

As highlighted by Beninger and Francis (2021), the influence of competitors goes beyond traditional competition and extends to shaping the market itself. This shift from a competitive mindset to one of collaboration contributes to the resilience of all actors involved, resulting in mutual benefits and fostering a dynamic and thriving marketplace.

Therefore, we present the third hypothesis of this research:

H3: *Cooperation with competitors has a positive impact on digital transformation.*

Cooperation with customers

The modernisation of institutions and regulatory systems is imperative in order to effectively adapt to the ever-changing landscape driven by digitalisation (Lebedeva, 2019). Within this context, customers play an active role in EEs, utilising various channels such as social media, to express economic, social, and technological needs and expectations. Their aspirations for an enhanced quality of life serve as a catalyst for organisational entrepreneurship.

EEs are dynamically shaped by the everyday interactions of individuals, who collectively generate meaning, mobilise resources, and build infrastructure to support their ventures (Thompson *et al.*, 2018). It is within these ecosystems that new ventures thrive and emerge, driven by a commitment to developing and commercialising radically innovative products and services (Gomes *et al.*, 2018).

The integration of customers within a systemic environment, where their needs and demands are expressed, stimulates the development and adoption of technology, resulting in enhanced processes, products, and increased automation in daily activities. The active participation of customers in sharing economy platforms plays a pivotal role in the success of products, services, and organisations (Nadeem *et al.*, 2021). As information technologies continue to advance at a rapid pace, their impact permeates all aspects of life, necessitating technological revolutions across various domains (Peshkova and Samarina, 2018).

In order to provide increasingly effective solutions, organisations adapt by abandoning outdated practices and embracing technologies that enhance their capabilities, streamline employee workflows, and deliver satisfying experiences to customers. Among these technologies, AI emerges as a prominent tool, extensively utilised in organisational processes, opening up new possibilities for digital transformation while presenting challenges for managers to navigate (Holmström, 2022). Nevertheless, to fully leverage the potential of artificial intelligence, innovative business models are required, placing emphasis on agile customer co-creation and seamless integration within scalable ecosystems (Sjödin *et al.*, 2021).

Within this context, the co-creation of value emerges as a dynamic process encompassing collaborative interactions and exchanges between organisations and

their customers. Such collaborations yield continuous development and enhancements in products and services, ultimately optimising everyday practices. The co-creation of value is intricately linked to customers' active involvement and experiential engagement with products and services, encompassing emotional connections, rational behaviors, identification, absorption, and social connections (Ndhlovu and Maree, 2022). Notably, interactivity plays a significant role, particularly in the relationships between consumers, as well as between consumers and sellers, fostering social support and heightening consumers' intent to co-create brand value (Tajvidi *et al.*, 2021). Within this dynamic landscape, the customer experience assumes paramount importance, encompassing both the physical and emotional perceptions of the product and organisational attributes. Factors such as privacy, security, shared value, and reliability emerge as key determinants that shape customers' ethical perceptions, subsequently influencing their intentions to engage in value co-creation (Nadeem *et al.*, 2021). Consequently, digital transformation, characterised by the adoption of innovative digital technologies like mobile devices, cloud computing, blockchain, and the Internet of Things (IoT), emerges as a catalyst that enhances customer experiences and optimises organisational operations (Warner and Wäger, 2019).

The pursuit of providing exceptional customer perception stands as a fundamental objective for organisations, necessitating the integration of technological advancements that foster production excellence and enhance customers' purchasing capabilities. In this rapidly evolving landscape, the retail sector has witnessed a remarkable shift towards digitalisation, as online and offline channels converge to create sophisticated and personalised customer experiences (Hänninen *et al.*, 2019). However, challenges such as the absence of standardised practices, limited technological awareness, and insufficient cooperation among stakeholders impede the smooth progression of digital transformation in businesses (Tijan *et al.*, 2021). In response to this ever-changing landscape, organisations are compelled to adapt to the demands of digital transformation, embracing new business models that leverage technology to redefine their approach to customers, competitors, and suppliers. The goal is to curate experiences that foster strong relationships, recognition, well-being, and emotional connections. To maximise the impact of digital technology implementation, organisations must extend their focus beyond internal operations, reaching out to customers and partners, transforming services, and integrating processes (Ivančić *et al.*, 2019).

Thus, we present the fourth hypothesis of this research:

H4: *Cooperation with customers has a positive impact on digital transformation.*

Cooperation with suppliers

By examining the aftermath of failed innovations, one can conclude that the knowledge accumulated by an organisation undergoes transformation as a result of its past experiences. Inspired by the insights of these authors, our research endeavours to explore the significance of knowledge both prior to and following the occurrence of innovation failures. Consequently, our objective is to meticulously examine the influence of knowledge spillovers on the connection between organisational knowledge and innovation failures, while also assessing the impact of knowledge spillovers on the relationship between failed innovations and the organisation's future innovation capability.

Digital technology plays a pivotal role in this journey, as organisations are tasked with completely reimagining their business practices to facilitate learning through customer and supplier interactions (Carcary *et al.*, 2016). Advanced technologies like cloud computing and the IoT have the power to convert mundane entities and data into valuable information and knowledge, enabling the transformation of services (Ardolino *et al.*, 2018).

The advent of digital technology has a transformative impact on cultural, social, and technical aspects within organisations, leading to a need for cross-organisational technological initiatives like supplier IT integration and enhanced supply visibility (Garcez *et al.*, 2022; Yang *et al.*, 2021). Consequently, it becomes imperative to develop a well-defined digital technology roadmap for upgrading supply chain processes and information systems (Hartley and Sawaya, 2019). Within this context, database managers can leverage integrated software solutions to access crucial information pertaining to orders, product specifications, purchasing conferences, stock levels, and document control. Notably, in the realm of supply chain management, disruptive technologies such as robotic process automation, AI, and blockchain emerge as game-changers (Hartley and Sawaya, 2019).

The concept of digital transformation entails a comprehensive process that involves harnessing technological advancements, utilising digital tools, and adopting cultural changes to optimise and replace various elements. It encompasses an organisation's ability to adapt, respond, and position itself for success amidst rapid technological advancements (Guinan *et al.*, 2019). This prompts the pursuit of breakthroughs and the adoption of automation systems. Digital transformation manifests in manufacturing industries, ranging from simple transactions that connect suppliers and consumers to collaborative efforts with diverse stakeholders within organisations (Okano *et al.*, 2021). For instance, innovation management software can facilitate the consolidation of an organisation's innovation programs, stakeholders, and resources in a single platform, thereby fostering organisational ecosystems (Endres *et al.*, 2022). It is important to note that

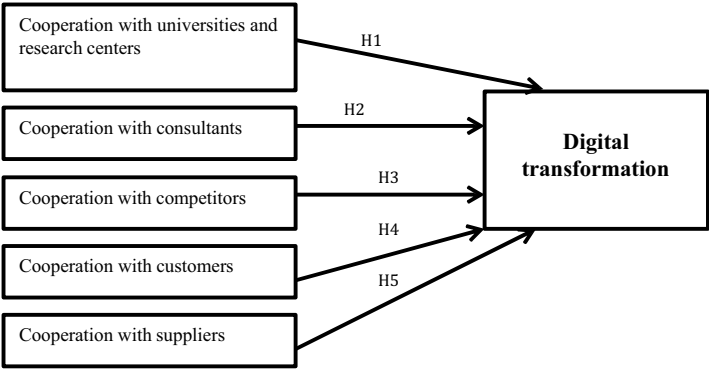


Fig. 1. Analysis model.

digitalisation does not render physical interactions and close personal relationships obsolete since suppliers and customers continue to serve as the intermediaries for engaging with digital service providers (Palmié *et al.*, 2022).

According to Abdalla and Nakagawa (2021), the importance of collaborative innovation among supply chain partners, including suppliers and customers, lies in its ability to enhance adaptability rather than efficiency in the context of digital transformation. As organisations navigate the integration of disruptive technologies, they are compelled to restructure their supplier ecosystems, potentially resulting in shifts in activity distribution and power dynamics. However, it is essential to recognise that fundamental trade-offs may arise, potentially hindering the realisation of the full value of these new technologies (Ozcan and Hannah, 2020). In this respect, the fifth hypothesis of this paper is:

H5: *Cooperation with suppliers has a positive impact on digital transformation.*

Figure 1 presents the conceptual model.

Methodology

Sample and data

To empirically validate the proposed conceptual research model, a rigorous sampling method was employed. We randomly selected a representative sample of 300 firms from a comprehensive database comprising 5000 Portuguese firms. This approach ensured a diverse and unbiased representation of the population under study. The selected firms were contacted through email, and a well-designed questionnaire was administered to gather data for analysis. Out of the 300 firms approached a total of 172 valid responses were received, indicating a satisfactory response rate (57.3%). The findings revealed that the sample consisted of firms

from various sectors. The manufacturing industry was prominently represented, with 94 organisations (54.7%) belonging to this sector. The trade sector accounted for 32 firms (18.6%), while the services sector comprised 28 enterprises (16.3%). This diverse representation allowed for a comprehensive analysis of the research model across different sectors, enhancing the generalisability of the study's findings. Furthermore, the majority of the organisations surveyed were classified as small and medium-sized enterprises (SMEs). Specifically, 122 organisations (70.9%) in the sample fell into this category. This high proportion of SMEs in the sample is noteworthy, as it reflects the significance of these firms in the Portuguese business landscape and their potential impact on the variables under investigation. The robustness of the sample, characterised by its random selection, adequate response rate, and diverse representation across sectors and organisational sizes, strengthens the validity and reliability of the study's findings.

Measures

Independent variables

To ensure the validity of the scale to assess the relevance of ecosystem partners for the implementation of the organisation's strategy were used in other studies.

All items were measured using 5-point Likert-type scales. Table 1 presents the summary of the independent variables, as well as the scales and their respective hypotheses. The mean scores of the two items comprising each variable were calculated to determine each independent variable (Universities and Research Centres, Consultants, Competitors, Customers and Suppliers).

Dependent variable

The variable alluding to digital transformation was measured through the importance of various technological solutions (Cloud Solutions, Big Data, IoT Technologies/Sensors, 3D Printing, Virtual Reality/Augmented Reality Technology, Robotics/Automation, Collaboration Tools, Business Intelligence and AI). All items were measured using 5-point Likert-type scales, and to determine the level of digital transformation, the scores of the nine items comprising this variable were averaged. These nine items showed a very high level of reliability with a Cronbach's Alpha of 0.871.

Control variables

As control variables, some characteristics of the firms were used, namely their size (number of workers), sector of activity and length of time in business.

Table 1. Relevance of partners for the implementation of your organisation's strategy.

Hypothesis	Item	Scale
H1	National Universities and Research Centres	1 - Not important to 5 - Extremely important
	International Universities and Research Centres	1 - Not important to 5 - Extremely important
H2	National Consultants	1 - Not important to 5 - Extremely important
	International Consultants	1 - Not important to 5 - Extremely important
H3	National Competitors	1 - Not important to 5 - Extremely important
	International Competitors	1 - Not important to 5 - Extremely important
H4	National Clients	1 - Not important to 5 - Extremely important
	International Customers	1 - Not important to 5 - Extremely important
H5	National Suppliers	1 - Not important to 5 - Extremely important
	International Suppliers	1 - Not important to 5 - Extremely important

Statistical methods

To examine the hypotheses under study, a total of six multiple linear regressions were conducted. These regressions aimed to analyse the relationships between the dependent variable and a set of independent variables. In the first five multiple linear regressions, the independent variables consisted of control variables, specifically partnerships with Universities and Research Centres, Consultants, Competitors, Customers, and Suppliers. Each regression focused on assessing the impact of one control variable while holding other factors constant. To further explore the influence of partnerships on the dependent variable, the sixth multiple linear regression included all control variables along with the five variables related to partnerships as independent variables. This comprehensive regression allowed for a more comprehensive understanding of the combined effects of these variables on the outcome of interest.

In order to assess the potential issue of multicollinearity among the independent variables, variance inflation factors (VIFs) were calculated. The VIF values provide insights into the extent to which the independent variables are correlated with each other. By examining these values, the researchers can identify any problematic levels of multicollinearity that may affect the reliability and interpretability of the regression results.

All statistical analyses and calculations were performed using IBM SPSS software, specifically version 28.0 for Windows, developed by IBM Corporation based in New York, USA.

Table 2. Descriptive statistics and correlation between variables (VIF on the diagonal).

	Average	DP	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Digital Transformation	2.64	0.97	ON										
(2) Manufacturing industries	0.55	0.50	0.116	2.945									
(3) Trade	0.19	0.39	-0.037	-0.525	2.386								
(4) Services	0.16	0.37	-0.012	-0.484	-0.211	2.436							
(5) SME	0.71	0.46	-0.176	-0.172	0.109	0.213	1.684						
(6) Time in business (years)	31.31	24.65	-0.128	0.270	-0.088	-0.277	-0.531	1.809					
(7) Universities and Research Centres	2.05	1.18	0.382	0.021	0.148	0.220	0.083	0.282	1.564				
(8) Consultants	2.48	1.20	0.287	0.035	0.118	0.059	0.097	0.251	0.499	1.707			
(9) Competitors	2.73	1.08	0.263	0.138	0.142	0.078	0.103	0.087	0.368	0.507	1.653		
(10) Customers	3.48	0.88	0.115	0.029	0.107	0.048	0.202	0.129	0.170	0.144	0.224	1.389	
(11) Suppliers	3.04	0.95	0.299	0.113	0.115	0.118	0.175	0.079	0.192	0.243	0.343	0.420	1.546

Results and Discussion

Table 2 presents a characterisation of the sample under study, namely the results concerning the descriptive statistics, the correlation between the variables and the assessment of multicollinearity through the VIF. It is observed that all VIFs are lower than 5, indicating the absence of multicollinearity between the variables.

Table 3 presents the multiple linear regression models to validate the hypotheses under study. Concerning the control variables, all models show a statistically significant impact of the activity sector, size and time of activity. The organisations belonging to the manufacturing industry have significantly higher levels of digital transformation than the other organisations; on the contrary, SMEs have lower average levels of digital transformation, and the longer the organisation has been in operation, the lower the level of digital transformation.

Regarding H1, *Cooperation with universities and research centres has a positive impact on digital transformation*, it is observed that the importance attributed to cooperation with Universities and Research Centres has a positive and statistically significant impact on digital transformation (Model 1: $B = 0.19$; $p < 0.01$; Model 6: $B = 0.24$; $p < 0.01$). These results allowed validation of this hypothesis.

As for H2, *Cooperation with consultants has a positive impact on digital transformation*, the results of Model 2 indicate that cooperation with consultants has a positive impact and with statistical significance on digital transformation (Model 2: $B = 0.21$; $p < 0.01$). This result allowed validating this hypothesis.

Regarding H3, *Cooperation with competitors has a positive impact on digital transformation*, it is observed in Model 3 that cooperation with competitors has a statistically significant positive impact on digital transformation (Model 3: $B = 0.17$; $p < 0.05$). This result allowed validation of this hypothesis.

As for H4, *Cooperation with customers has a positive impact on digital transformation*, in both models, it is found that cooperation with customers has a positive impact and with statistical significance on digital transformation (Model 4: $B = 0.23$; $p < 0.01$; Model 6: $B = 0.16$; $p < 0.05$). This result allowed validating this hypothesis.

Finally, in H5, *Cooperation with suppliers has a positive impact on digital transformation*, it is observed that in both models that cooperation with suppliers has a positive and statistically significant impact on digital transformation (Model 5: $B = 0.24$; $p < 0.01$; Model 6: $B = 0.23$; $p < 0.01$). These results allowed validating this hypothesis.

The analysis allowed the following understanding:

Within the EE, there exists a fervent pursuit of technological advancements aimed at fostering collaboration, enhancing outcomes, minimising expenses,

Table 3. Estimated multiple linear regression models.

(1)		(2)		(3)		(4)		(5)		(6)		
<i>B</i> (EP)	<i>p</i>	<i>B</i> (EP)	<i>p</i>	<i>B</i> (EP)	<i>p</i>	<i>B</i> (EP)	<i>p</i>	<i>B</i> (EP)	<i>p</i>	<i>B</i> (EP)	<i>p</i>	
Constant	2.47 (0.30)	0.000	2.5 (0.33)	0.000	2.45 (0.33)	0.000	2.56 (0.39)	0.000	2.17 (0.41)	0.000	1.61 (0.43)	0.000
Manufacturing industry	0.45 (0.23)	0.046*	0.59 (0.23)	0.011*	0.61 (0.23)	0.009**	0.62 (0.24)	0.010*	0.62 (0.23)	0.008**	0.51 (0.22)	0.024*
Trade	0.41 (0.26)	0.113	0.5 (0.26)	0.061	0.52 (0.26)	0.052	0.48 (0.27)	0.080	0.52 (0.27)	0.055	0.54 (0.26)	0.038*
Services	0.17 (0.27)	0.543	0.43 (0.27)	0.123	0.47 (0.27)	0.088	0.43 (0.28)	0.128	0.53 (0.28)	0.061	0.33 (0.27)	0.226
SME	−0.68 (0.17)	0.000**	−0.74 (0.18)	0.000**	−0.73 (0.18)	0.000**	−0.83 (0.18)	0.000**	−0.62 (0.18)	0.001**	−0.62 (0.18)	0.001**
Time in business (years)	−0.01 (0.00)	0.008**	−0.01 (0.00)	0.003**	−0.01 (0.00)	0.000**	−0.01 (0.00)	0.000**	−0.01 (0.00)	0.002**	−0.01 (0.00)	0.027*
Universities and Research Centres	0.29 (0.06)	0.000**									0.24 (0.07)	0.000**
Consultants			0.21 (0.06)	0.001**							0.05 (0.07)	0.469
Competitors					0.17 (0.08)	0.038*					0.06 (0.08)	0.489
Customers							0.23 (0.06)	0.000**			0.16 (0.08)	0.045*
Suppliers									0.24 (0.08)	0.002**	0.23 (0.08)	0.004**
<i>R</i> ²	24.0%		19.6%		15.8%		20.0%		18.6%		28.0%	
<i>F</i>	8.665**		6.691**		5.142**		6.876**		6.266**		6.255**	

Notes: ** $p < 0.01$; * $p < 0.05$; *B*: estimated coefficients; EP: standard error of the coefficients.

introducing novel business models, and upholding societal well-being. This ecosystem thrives on the synergy among various entrepreneurial actors and is particularly centered around regional entrepreneurship (Stam and van de Ven, 2021; Roundy and Fayard, 2019). In line with this, Gozman *et al.* (2018) emphasise that the global rise of financial technology stems from endeavours to deconstruct and reinvent traditional business models.

The meso environment within the systemic framework of the EE encompasses reciprocal influences and interferences, particularly concerning elements such as digital transformation. The convergence of different actors (Wang *et al.*, 2020) occurs with the aim of achieving objectives through scientific and technological advancements, involving the exchange of information, knowledge, and co-creation. Key components of this ecosystem include universities and research centers, which receive investments from organisations (Belitski *et al.*, 2019) to foster digital transformation and empowerment (Guse and Mangiuc, 2022). Within this context, universities have a mission to contribute to technological potential by nurturing professionals and fostering technological innovation. Universities play a strategic role in driving economic growth through the commercialisation of knowledge, facilitating knowledge transfer (Fuster *et al.*, 2019), and establishing a modern network system built upon the concept of digital production (Shashlo *et al.*, 2018).

However, contrasting viewpoints exist within the literature regarding the influence of universities on digital transformation. On one hand, universities play a crucial role in commercialising and disseminating knowledge (Fuster *et al.*, 2019; Audretsch *et al.*, 2019). They facilitate technology transfer, contribute to educational development, and foster an entrepreneurial and digital mindset (Stolze *et al.*, 2018). Recognising the need for adaptation, universities demonstrate flexibility in embracing interactivity and innovative teaching methods, utilising technology as a valuable ally (Garcez *et al.*, 2022). On the other hand, some scholars argue that universities are lagging behind in terms of technological advancements compared to other domains (Rodríguez-Abitia and Bribiesca-Correa, 2021). They may struggle to incorporate technology effectively into their daily operations (Woodcock, 2018), necessitating urgent efforts to catch up (Peshkova and Samarina, 2018). While digital transformation has garnered research attention, academic accomplishments in this area may be limited, possibly due to the ongoing development of the relevant constructs (Ivančić *et al.*, 2019).

Given the pressing need for organisations to receive technological support, various actors come forward to serve as partners, with consultants assuming the role of catalysts for innovation and technological strategy (Trantopoulos *et al.*, 2017). Additionally, the cognitive aspects of consultants are noteworthy in terms of their inclination towards digitalisation, encompassing traits such as

extroversion, openness to experience, and a low inclination towards neuroticism (Diller *et al.*, 2020). As a result, the consultant's influence on digital transformation lies in their ability to act as a mediator, fostering effective connections between the organisation, employees, and clients (Christian, 2019). This holistic approach contributes to the overall resilience and longevity of organisations (Oesterle *et al.*, 2022).

When it comes to organisational survival, some companies tend to adopt technologies without proper selection, resulting in a lack of differentiation from their competitors in the eyes of consumers (Grekul *et al.*, 2019). However, the competitor can also serve as a catalyst for organisational improvement, as they simultaneously compete and collaborate. With the advent of technologies that facilitate easier market access (Reinartz *et al.*, 2019), competition acts as a force of coevolution, prompting organisations to make adjustments in their customer engagement strategies (McKelvey, 2016). Thus, the impact of competition contributes to resilience and collective gains in the marketplace (Beninger and Francis, 2021), while also fostering participation in collaborative innovation initiatives focused on digital transformation, utilising technologies that optimise resource utilisation (Abdalla and Nakagawa, 2021).

The customer plays a significant role as a catalyst for digital transformation by driving demands for practicality in their daily lives, thereby providing the impetus for the emergence of new ventures (Thompson *et al.*, 2018). The active participation of customers not only ensures the survival of organisations but also enables them to create value for the market (Nadeem *et al.*, 2021). In this dynamic environment, information technologies serve as the driving force behind a technological revolution (Peshkova and Samarina, 2018), enabling organisations to effectively respond to market demands. Prominent technologies in this context include mobile devices, the IoT (Warner and Wäger, 2019), and AI (Holmström, 2022), which are instrumental in optimising the customer experience.

However, the adoption of certain technologies necessitates organisations to innovate their business models, highlighting the importance of co-creation with customers (Sjödin *et al.*, 2021) and the ability to embrace change (Ivančić *et al.*, 2019).

Furthermore, in terms of supplier partnerships, engagement in digital transformation entails incentivising the use and development of technologies that enhance supply operations monitoring and foster positive relationships with customer organisations. The advent of new digital technology processes prompts manufacturing organisations to adapt and undergo digital transformation (Okano *et al.*, 2021). In this context, digitalisation facilitates technological integration with suppliers, encompassing aspects like supply visibility (Yang *et al.*, 2021). The presence of digital transformation has also given rise to novel forms of interfirm

relationships, increasingly occurring within digital ecosystems and markets (Cennamo *et al.*, 2020).

Hence, the digitalisation of suppliers plays a significant role in driving the digitalisation of their customers' business models (Sjödin *et al.*, 2022). Consequently, the selection of appropriate supply chain technologies, including information retrieval, becomes crucial (Hartley and Sawaya, 2019). These technologies effectively transform business systems, providing organisational managers with valuable insights into stock levels and input supply (Hartley and Sawaya, 2019).

However, there exist divergent perspectives regarding the relationship between customers, suppliers, organisations, and digital transformation. While digital transformation yields positive organisational outcomes through enhanced interactivity (Okano *et al.*, 2021; Endres *et al.*, 2022; Palmié *et al.*, 2022), Abdalla and Nakagawa (2021) argue that collaboration between suppliers and customers does not necessarily amplify the impact of digital transformation in terms of production effectiveness and results.

In such a complex scenario, effecting changes in the organisational ecosystem to accommodate digitisation represents a formidable challenge, particularly due to the influence of legacy business models. These models often exhibit a lack of digital vision, are centred around product-centric value chains, and tend to prioritise organisation-centric profit formulas (Sjödin *et al.*, 2022).

Implications

Theoretical implications

This work holds significant theoretical value in elucidating the multifaceted functionalities of the EE at the meso level, as well as the diverse roles and challenges faced by its actors. It also carries implications that shed light on various factors such as co-creation, co-opetition, advisory services, knowledge commercialisation, customer experience, entrepreneurial and digital mindset, and the importance of network-oriented approaches. The concept of EE has emerged as a comprehensive framework for understanding entrepreneurial activities within specific regions and industrial sectors (Cantner *et al.*, 2021). Noteworthy for its systemic nature, it serves multiple purposes, including the conversion of knowledge and ideas into innovative outcomes, fostering entrepreneurial endeavours, promoting collaboration among actors for mutual benefits, facilitating the flow of information, and adapting to dynamic scenarios and the needs of the involved stakeholders (Shashlo *et al.*, 2018).

In this dynamic landscape, organisations play a pivotal role as they engage in interactions and exchanges with various collaborators. Within this context,

universities hold a significant position, actively participating in the realm of digital transformation. They contribute by undertaking agile activities, fostering a skilled workforce (Garcez *et al.*, 2022; Guse and Mangiuc, 2022), and exploring emerging technologies. This environment represents a transformative space where knowledge is effectively translated into profitability through the development of innovative products and processes, ultimately yielding positive organisational outcomes (Cantner *et al.*, 2021). It is worth noting that these endeavours take place in the face of challenges such as limited financial capital (Rodríguez-Abitia and Bribiesca-Correa, 2021) and, for some, a need to cultivate entrepreneurial and digital mindsets (Stolze *et al.*, 2018).

Within this realm of connectivity, organisations actively engage with customers, suppliers, and competitors in a collaborative process known as co-creation. Through this process, valuable insights are gathered concerning products, services, tool adoption, and the types of knowledge required. Entrepreneurship and digital transformation are fostered through co-creation efforts, all aimed at achieving positive outcomes (Stolze *et al.*, 2018). In this dynamic environment, changes in processes become imperative, leading to cost reductions, brand differentiation (Tajvidi *et al.*, 2021), customer satisfaction, and a favourable perception among the organisation's target audience.

An important player within this context is the concept of co-opetition, characterised by a combination of competition and cooperation with a mutually beneficial profile (Ricciardi *et al.*, 2022). This cooperative approach entails executing agreements for joint projects that enhance productivity, expand market reach, and establish barriers for potential new competitors. Digital transformation plays a crucial role in facilitating both co-creation and co-opetition, leveraging technologies that enhance connectivity among individuals and reshape relationships.

Nevertheless, the process of generating ideas and making decisions regarding these implementations, or any other form of change, is often fraught with challenges and apprehensions. The fear of making mistakes and uncertainties can hinder progress. Therefore, seeking guidance from consultants who possess an outsider's perspective on the challenges and a comprehensive understanding of the market can provide valuable insights and effective directions in both economic and social aspects. These directions often involve investments in technological advancements aimed at enhancing various aspects such as operational activities, systems, and service deliveries (Coman *et al.*, 2022). The expertise of consultants lies in their cognitive abilities and leadership skills, allowing them to offer informed recommendations and navigate the complexities of organisational transformation.

Practical implications

The significance of this study lies in its practical implications for fostering effective organisational performance within the realm of digital transformation, through collaboration among actors in EEs. Within this context, agents are actively engaging in technological adoption, practical and scientific education, and stimulating adjustments and discoveries in digitalisation. The EE serves as a unifying platform, bringing together the realms of education, science, and entrepreneurship to facilitate the generation, transfer, and commercialisation of knowledge, information, and technologies (Shashlo *et al.*, 2018). This interconnectedness has far-reaching implications for society as a whole, leading to advancements that enhance various aspects of everyday life, such as home achievements. These advancements optimise time, reduce costs, promote simplicity, and foster digital education. Notably, technologies like AI have a transformative impact on how value is created, delivered, and captured in consumer markets (Sjödín *et al.*, 2021). In the organisational context, the use of digital channels empowers customers with personalised services and provides them with comprehensive information, enabling more informed decision-making. These digital channels serve as a support system, offering assistance and a wealth of product and service-related information, thereby enhancing the customer experience and facilitating more confident choices.

In the realm of organisational productivity, the utilisation of software enables the identification of skill gaps, performance measurement, execution monitoring, real-time information transmission, enhanced agility in deliveries, and reduction of errors and expenses. Digital transformation constitutes an ongoing process of incorporating new digital technologies into the daily operations of an organisation, recognising agility as a central mechanism for strategic renewal of the business model, fostering a collaborative and cultural approach (Warner and Wäger, 2019).

Hence, it is crucial for organisations to acknowledge the nature of their operational systems as open and digital, requiring dependence, collaboration, and the need for cognitive and technological adaptations for interpretation, implementation, and management. The engagement of consulting advisory services induces transformative changes in organisational behaviours, as highlighted by (Dethine *et al.*, 2020), encompassing the integration of “digital” into operations and the development of relevant skills.

In relation to competition, organisations need to recognise the significance of adopting a fresh perspective that embraces differentiation and collaboration with competitors to drive improvements, facilitate exchanges, and reduce costs. Establishing alliances with distributors, customers, and competitors is motivated

by the organisational objective of maximising strategic value while minimising expenses, necessitating knowledge and technology sharing (Pathak *et al.*, 2020).

When considering scientific education, the modernisation of bureaucratic and didactic activities through technological advancements enhances the empowerment of human capital for the utilisation, enhancement, and development of technologies, thereby bridging the gap and overcoming barriers in knowledge dissemination. The process of digitisation inevitably brings about changes in the employment structure and educational landscape, contributing to the generation of new human capital resources (Peshkova and Samarina, 2018). Nevertheless, the educational sector continues to grapple with challenges rooted in traditional mindsets and insufficient investment in technological development (Rodríguez-Abitia and Bribiesca-Correa, 2021), demanding a decisive stance from universities and governmental as well as organisational investors.

Final Considerations

Through the utilisation of statistical analysis, the objective of this study is to examine the influence of EEs, with a particular focus on the meso level, on the process of digital transformation. Taking into account the systemic nature of this approach, the various components at the meso level are involved in both intra and inter-influences, wherein they mutually affect one another and modify the configurations of elements within the business environment. Within this dynamic, organisations are seen as recipients of these transformative impacts, leading to changes in how they conduct their business. This encompasses enhancing employee skills, boosting productivity, strengthening customer relationships, and adopting and implementing supportive tools, with a specific emphasis on digital technologies.

In this realm, actors fulfil various roles to enhance organisational performance, some through educational initiatives, while others provide support, innovations, and a drive for progress. As a result, collaboration with universities and research centres becomes vital for leveraging technologies to improve administrative efficiency, extend educational outreach, foster qualified human capital, and facilitate technological advancements that promote virtual connectivity and organisational advancement, addressing any existing digital deficiencies. When considering organisational adaptations, the role of consultants within the meso environment becomes prominent through their specialised expertise, multidisciplinary knowledge, and the provision of conceptual, human, and technical guidance. Within this supportive role, the concept of “integration” gains significance as it encompasses

raising awareness about digital transformation and offering guidance on adopting appropriate technologies to ensure effectiveness, agility, and a competitive edge.

On the other hand, competitors are not merely adversaries, but also sources of stimulation and collaboration, fostering exchanges, knowledge sharing, superior products, fair pricing, and external assessments for operational and technological improvements. Customer cooperation manifests in two ways: through their demands for well-being and through co-creation, where their ideas and active participation contribute to the excellence of products, services, and organisational processes. Consequently, the organisational market, driven by customer demands, experiences increased entrepreneurship and digital transformation. Suppliers, in their role within this ecosystem, harness technologies that promote transparency in processes and redefine procedures. This, in turn, motivates the search for technologies that facilitate efficient operations, provide a comprehensive overview of workflow, and enhance the relationship between suppliers and client organisations.

Hence, the initiatives undertaken by actors in the meso environment drive the implementation, enhancement, and advancement of technologies that shape the digital transformation landscape. These efforts lead to innovations in business practices, foster partnerships and collaborations, facilitate the absorption and dissemination of knowledge and technologies, and contribute to both economic and social development. However, these endeavours are often hindered by outdated paradigms and a lack of digital awareness. This study has identified its own limitations and shed light on the direct connection between digital transformation and organisational stakeholders, particularly in terms of their day-to-day activities and outcomes. As we look towards future research, it becomes evident that exploring EEs at the micro level, especially the competencies and skills required by entrepreneurs becomes crucial. This includes examining the trends in technological implementations within the production process, internal and external communication practices, and exchanges with business partners.

References

- Abdalla, S and K Nakagawa (2021). The interplay of digital transformation and collaborative innovation on supply chain ambidexterity. *Technology Innovation Management Review*, 11, 45–56, <https://doi.org/10.22215/timreview/1428>.
- Acs, ZJ, S Estrin, T Mickiewicz and S László (2018). Entrepreneurship, institutional economics, and economic growth: An ecosystem perspective. *Small Bus Economics* 51, 501–514, <https://doi.org/10.1007/s11187-018-0013-9>.
- Ardolino, M, M Rapaccini, N Saccani, P Gaiardelli, G Crespi and C Ruggeri (2018). The role of digital technologies for the service transformation of industrial companies.

- International Journal of Production Research*, 56(6), 2116–2132, <https://doi.org/10.1080/00207543.2017.1324224>.
- Audretsch, DB, JA Cunningham, DF Kuratko and M Mathhias (2019). Entrepreneurial ecosystems: Economic, technological and social impacts. *Journal of Technology Transfer*, 44, 313–325, <https://doi.org/10.1007/s10961-018-9690-4>.
- Autio, E, S Nambisan, LDW Thomas and M Wright (2018). Digital affordances, spatial affordances, and the genesis of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal*, 12(1), 72–95.
- Belitski, M, A Aginskaja and R Marozau (2019). Commercialising university research in transition economies: Technology transfer offices or direct industrial funding? *Research Policy*, 48(3), 601–615. ISSN 0048-7333, <https://doi.org/10.1016/j.respol.2018.10.011>
- Beninger, S and JNP Francis (2021). Collective market shaping by competitors and its contribution to market resilience. *Journal of Business Research*, 122, 293–303, <https://doi.org/10.1016/j.jbusres.2020.09.005>.
- Bouncken, R and R Barwinski (2020). Shared digital identity and rich knowledge ties in global 3D printing: A drizzle in the clouds? *Business Horizons*, 65(3), 329–339. ISSN 0007-6813. <https://doi.org/10.1016/j.bushor.2021.03.006>.
- Cao, Z and X. Shi (2021). A systematic literature review of entrepreneurial ecosystems in advanced and emerging economies. *Small Business Economics*, 57(1), 75–110.
- Cantner, U, JA Cunningham, EE Lehmann and M Mathias (2021). Entrepreneurial ecosystems: A dynamic lifecycle model. *Small Bus Economy*, 57, 407–423, <https://doi.org/10.1007/s11187-020-00316-0>.
- Carcary, M, E Doherty and G Conway (2016). A dynamic capability approach to digital transformation — A focus on key foundational themes, in *10th European Conference on Information Systems Management*. At: Evora, Portugal
- Cennamo, C, GB Dagnino, A Di Minin and G Lanzolla (2020). Managing digital transformation: Scope of transformation and modalities of value co-generation and delivery. *California Management Review*, 62(4), 5–16, <https://doi.org/10.1177/0008125620942136>.
- Chang, JYT, ETG Wang, JJ Jiang and G Klein (2013). Controlling ERP consultants: Client and provider practices. *Journal of Systems and Software*, 6(5), 1453–1461. ISSN 0164-1212. <https://doi.org/10.1016/j.jss.2013.01.030>.
- Chen, Y, I Visnjic, V Parida and Z. Zhang (2021). On the road to digital servitisation — The (dis)continuous interplay between business model and digital technology. *International Journal of Operations & Production Management*, 41(5), 694–722, <https://doi.org/org/10.1108/IJOPM-08-2020-0544>.
- Christian, SR (2019). Shifting needs for expertise: Digitized taskscapes in the Norwegian oil and gas industry. 6(2), 454–462. ISSN 2214-790X, doi:10.1016/j.exis.2019.03.006.
- Colombo, MG, GB Dagnino, EE Lehmann and S MariPaz (2019). The governance of entrepreneurial ecosystems. *Small Bus Economy*, 52, 419–428, <https://doi.org/10.1007/s11187-017-9952-9>.
- Coman, DM, CA Ionescu, A Duică, MD Coman, MC Uzlaui, SG Stanescu and V State (2022). Digitisation of accounting: The premise of the paradigm shift of role of the

- professional accountant. *Applied Sciences*, 12(7), 3359. <https://doi.org/10.3390/app12073359>.
- Cunha, MZBA, T Chuchu and E Maziriri (2020). Threats, challenges, and opportunities for open universities and massive online open courses in the digital revolution. *International Journal of Emerging Technologies in Learning*, 15, 191–204, <https://doi.org/10.3991/ijet.v15i12.13435>.
- De Massis, A, D Audretsch, L Uhlaner and N Kammerlander (2018). Innovation with limited resources: Management lessons from the German mittelstand. *Journal of Product Innovation Management*, 35(1), 125–146, <https://doi.org/10.1111/jpim.12373>.
- Dethine, B, M Enjolras and D Monticolo (2020). Digitalisation and SMEs' export management: Impacts on resources and capabilities. *Technology Innovation Management Review*, 10(4), 18–34, <https://doi.org/10.22215/timreview/1344>.
- Diller, M, M Asen and T Späth (2020). The effects of personality traits on digital transformation: Evidence from German tax consulting. *International Journal of Accounting Information Systems*, 37, 100455. ISSN 1467-0895. <https://doi.org/10.1016/j.accinf.2020.100455>
- Endres, H, S Huesig and R Pesch (2022). Digital innovation management for entrepreneurial ecosystems: Services and functionalities as drivers of innovation management software adoption. *Review Management Science*, 16, 135–156, <https://doi.org/10.1007/s11846-021-00441-4>.
- Faria, JA and H Nóvoa (2017). Digital transformation at the University of Porto. In *Exploring Services Science*, S Za, M Drăgoicea and M Cavallari (Eds.), IESS 2017. Lecture Notes in Business Information Processing, vol. 279. Cham.: Springer. https://doi.org/10.1007/978-3-319-56925-3_24.
- Fernandez, A, P Chiambareto, M Chauvet and J Engsig (2021). Why do MNEs both make and coopete for innovation? *Technovation*, 106. <https://doi.org/10.1016/j.technovation.2021.102313>.
- Fuster, E, A Padilla-Meléndez, N Lockett and AR del-Águila-Obraa (2019). The emerging role of university spin-off companies in developing regional entrepreneurial university ecosystems: The case of Andalusia. *Technological Forecasting and Social Change*, 141, 219–231, <https://doi.org/10.1016/j.techfore.2018.10.020>.
- Garcez, A, R Silva and M Franco (2022). Digital transformation shaping structural pillars for academic entrepreneurship: A framework proposal and research agenda. *Education Information Technology*, 27, 1159–1182, <https://doi.org/10.1007/s10639-021-10638-5>.
- George, G, RK Merrill and SJD Schillebeeckx (2021). Digital sustainability and entrepreneurship: How digital innovations are helping tackle climate change and sustainable development. *Entrepreneurship Theory and Practice*, 45(5), 999–1027, <https://doi.org/10.1177/1042258719899425>.
- Giudici, A, P Reinmoeller and D Ravasi (2017). Open-system orchestration as a relational source of sensing capabilities: Evidence from a venture association. *Academy of Management Journal*, 61. <https://doi.org/amj.2015.0573.10.5465/amj.2015.0573>.
- Gomes, LAV, MS Salerno, R Phaál, DR Probert (2018). How entrepreneurs manage collective uncertainties in innovation ecosystems. *Technological Forecasting and*

- Social Change*, 128, 164–185. ISSN 0040-1625. <https://doi.org/10.1016/j.techfore.2017.11.016>
- Gonzalez-Uribe, J and M Leatherbee (2018). The of business accelerators on venture performance effects: Evidence from start-up Chile. *The Review of Financial Studies*, 31(4), 1566–1603, <https://doi.org/10.1093/rfs/hhx103>.
- Gozman, D, J Liebenau and J Mangan (2018). The innovation mechanisms of fintech start-ups: Insights from SWIFT's innotribe competition. *Journal of Management Information Systems*, 35(1), 145–179, <https://doi.org/10.1080/07421222.2018.1440768>.
- Grekul, V, E Isaev, N Korovkina and T Lisienkova (2019). Developing an approach to ranking innovative IT projects. *Business Informatics*, 13, 43–58, <https://doi.org/10.17323/1998-0663.2019.2.43.58>.
- Guandalini, I (2022). Sustainability through digital transformation: A systematic literature review for research guidance, *Journal of Business Research*, Volume 148, Pages 456–471, ISSN 0148-2963. <https://doi.org/10.1016/j.jbusres.2022.05.003>
- Guinan, P, S Parise and N Langowitz (2019). Creating an innovative digital project team: Levers to enable digital transformation. *Business Horizons*, 62(6), 717–727. ISSN 0007-6813. <https://doi.org/10.1016/j.bushor.2019.07.005>
- Guse, GR and MD Manguic (2022). Digital transformation in Romanian accounting practice and education: Impact and perspectives. *The Amfiteatru Economic Journal, Academy of Economic Studies, Bucharest, Romania*, 24(59), 25.
- Hänninen, M, L Mitronen and S Kwan (2019). Multi-sided marketplaces and the transformation of retail: A service systems perspective. *Journal of Retailing and Consumer Services*, 49, 380–388, <https://doi.org/10.1016/j.jretconser.2019.04.015>.
- Hartley, JL and WJ Sawaya (2019). Tortoise, not the hare: Digital transformation of supply chain business processes. *Business Horizons*, 62(6), 707–715. ISSN 0007-6813. <https://doi.org/10.1016/j.bushor.2019.07.006>
- Hilmersson, FP and M Hilmersson (2021). Networking to accelerate the pace of SME innovations. *Journal of Innovation and Knowledge*, 6(1), 43–49, <https://doi.org/10.1016/j.jik.2020.10.001>.
- Holmström, J (2022). From AI to digital transformation: The AI readiness framework. *Business Horizons*, 65(3), 329–339, <https://doi.org/10.1016/j.bushor.2021.03.006>.
- Ivančić, L, VB Vukšić and M Spremić (2019). Mastering the digital transformation process: Business practices and lessons learned. *Technology Innovation Management Review*, 9(2), 36–51, <https://doi.org/10.22215/TIMREVIEW/1217>.
- Lebedeva, L (2019). Digital transformation in the socio-labor sphere: New challenges and opportunities. *World Economy and International Relations*, 63(12), 42–49, <https://doi.org/10.20542/0131-2227-2019-63-12-42-49>.
- McKelvey, B (2016). Complexity ingredients required for entrepreneurial success. *Entrepreneurship Research Journal*, 6(1), 53–73, <https://doi.org/10.1515/erj-2015-0053>.
- McLoughlin, K and J Meehan (2021). The institutional logic of the sustainable organisation: The case of a chocolate supply network. *International Journal of Operations and Production Management*, 41(3), 251–274, <https://doi.org/10.1108/IJOPM-11-2020-0773>.

- Mukhtar, U and T Azhar (2020). Inter-functional coordination to co-create value within integrated value chains for competitive supply chain. *Operations and Supply Chain Management: An International Journal*, 11–22, <https://doi.org/10.31387/oscm0400249>.
- Nadeem, W, M Juntunen, N Hajli and M Tajvidi (2021). The role of ethical perceptions in consumers' participation and value co-creation on sharing economy platforms. *Journal of Business Ethics*, 169(3), 421–441, <https://doi.org/10.1007/s10551-019-04314-5>.
- Ndhlovu, T and T Maree (2022). Consumer brand engagement: Refined measurement scales for product and service contexts. *Journal of Business Research*, 146, 228–240, <https://doi.org/10.1016/j.jbusres.2022.03.064>.
- Oesterle, S, A Buchwald and N Urbach (2022). Investigating the co-creation of IT consulting service value: Empirical findings of a matched pair analysis. *Electron Markets*, 32, 571–597, <https://doi.org/10.1007/s12525-020-00426-3>.
- Okano, M, SN Antunes and ME Fernandes (2021). Digital transformation in the manufacturing industry under the optics of digital platforms and ecosystems. *Independent Journal of Management & Production*, 12, 1139–1159, <https://doi.org/10.14807/IJMP.V12I4.1375>.
- Ozcan, P and D Hannah (2020). Forced ecosystems and digital stepchildren: Reconfiguring advertising suppliers to realize disruptive social media technology. *Institute for Operations Research and Management Sciences (INFORMS)*, 5(3), 193–217, <https://doi.org/10.1287/stsc.2020.1366>.
- Palmié, M, L Miehe, P Oghazi, V Parida and J Wincent (2022). The evolution of the digital service ecosystem and digital business model innovation in retail: The emergence of meta-ecosystems and the value of physical interactions. *Technological Forecasting and Social Change*, 177(C). <https://doi.org/10.1016/j.techfore.2022.121496>.
- Pathak, B, M Ashok and YL Tan (2020). Value co-destruction: Exploring the role of actors' opportunism in the B2B context. *International Journal of Information Management*, 52. <https://doi.org/10.1016/j.ijinfomgt.2020.102093>.
- Peshkova, G and A Samarina (2018). Digital economy and recruitment potential: Strategic interconnection and prospects. *The Education and Science Journal*, 20, 50–75, <https://doi.org/10.17853/1994-5639-2018-10-50-75>.
- Reinartz, W, N Wiegand and M Imschloss (2019). The impact of digital transformation on the retailing value chain. *International Journal of Research in Marketing*, 36(3), 350–366, <https://doi.org/10.1016/j.ijresmar.2018.12.002>.
- Ribeiro, MA, I Adam, AN Kimbu, E Afenyo-Agbe, O Adeola, C Figueroa-Domecq and AD Jong (2021). Women entrepreneurship orientation, networks and firm performance in the tourism industry in resource-scarce contexts. *Tourism Management*, 86. <https://doi.org/10.1016/j.tourman.2021.104343>.
- Ricciardi, F, A Zardini, W Czakon, C Rossignoli and S Kraus (2022). Revisiting the cooperation-competition paradox: A configurational approach to short- and long-term coopetition performance in business networks. *European Management Journal*, 40(3), 320–331, <https://doi.org/10.1016/j.emj.2021.07.002>.

- Riquelme-Medina, M, M Stevenson, V Barrales-Molina and FJ Llorens-Montes (2022). Coopetition in business ecosystems: The key role of absorptive capacity and supply chain agility. *Journal of Business Research*, 146, 464–476, <https://doi.org/10.1016/j.jbusres.2022.03.071>.
- Rodríguez-Abitia, G and G Bribiesca-Correa (2021). Assessing digital transformation in universities. *Future Internet*, 13(2), 1–17, <https://doi.org/10.3390/fi13020052>.
- Roundy, PT and D Fayard (2019). Dynamic capabilities and entrepreneurial ecosystems: The micro-foundations of regional entrepreneurship. *The Journal of Entrepreneurship*, 28(1), 94–120, <https://doi.org/10.1177/0971355718810296>.
- Saarikko, T, U Westergren and T Blomquist (2020). Digital transformation: Five recommendations for the digitally conscious firm. *Business Horizons*, 63. <https://doi.org/10.1016/j.bushor.2020.07.005>.
- Santoro, G, S Bresciani and A Papa (2020). Collaborative modes with cultural and creative industries and innovation performance: The moderating role of heterogeneous sources of knowledge and absorptive capacity. *Technovation*, 92–93, 102040. ISSN 0166-4972. <https://doi.org/10.1016/j.technovation.2018.06.003>
- Schallmo, D, C Williams and J Lohse (2019). Digital strategy: Integrated approach and generic options. *International Journal of Innovation Management*, 23. <https://doi.org/10.1142/S136391961940005X>.
- Scott, S, M Hughes and D Ribeiro-Soriano (2022). Towards a network-based view of effective entrepreneurial ecosystems. *Review Management Science*, 16, 157–187, <https://doi.org/10.1007/s11846-021-00440-5>.
- Shashlo, NV, GV Petruk and AA Korostelev (2018). Determinants of integration interaction among the subjects of the entrepreneurial innovation ecosystem of macro region. *Amazonia Investiga*, 7(13), 351–363.
- Sjödin, D, V Parida, M Palmié and J Wincent (2021). How AI capabilities enable business model innovation: Scaling AI through co-evolutionary processes and feedback loops. *Journal of Business Research*, 134, 574–587. ISSN 0148-2963, doi:1<https://doi.org/10.1016/j.jbusres.2021.05.009>.
- Sjödin, D, V Parida and I Visnjic (2022). How can large manufacturers digitalize their business models? A framework for orchestrating industrial ecosystems. *California Management Review*, 64(3), 49–77, <https://doi.org/10.1177/00081256211059140>.
- Spigel, B and R Harrison (2017). Towards a process theory of entrepreneurial ecosystems. *Strategic Entrepreneurship Journal*, 12. <https://doi.org/10.1002/sej.1268>.
- Stam, E (2015). Entrepreneurial ecosystems and regional policy: A sympathetic critique, *European Planning Studies*, 23(9), 1759–1769.
- Stam, E and A van de Ven (2021). Entrepreneurial ecosystem elements. *Small Bus Economy*, 56, 809–832, <https://doi.org/10.1007/s11187-019-00270-6>.
- Stolze, A, K Sailer and H Gillig (2018). Entrepreneurial mindset as a driver for digital transformation — A novel educational approach from university-industry interactions. In Paper presented at the Proc. Eur. Conf. Innov. Entrepreneurship, ECIE, pp. 806–813, 2018 September. Retrieved from www.scopus.com.

- Tajvidi, M, Y Wang, N Hajli and PED Love (2021). Brand value co-creation in social commerce: The role of interactivity, social support, and relationship quality. *Computers in Human Behavior*, 115. <https://doi.org/10.1016/j.chb.2017.11.006>.
- Thompson, T, J Purdy and M Ventresca (2018). How entrepreneurial ecosystems take form: Evidence from social impact initiatives in Seattle. *Strategic Entrepreneurship Journal*, 12. <https://doi.org/10.1002/sej.1285>.
- Tijan, E, M Jović, S Aksentijević and A Pucihar (2021). Digital transformation in the maritime transport sector. *Technological Forecasting and Social Change*, 170, 120879. ISSN 0040-1625. <https://doi.org/10.1016/j.techfore.2021.120879>
- Tóth, Z, A Sklyar, C Kowalkowski, D Sörhammar, B Tronvoll and O Wirths (2022). Tensions in digital servitization through a paradox lens. *Industrial Marketing Management*, 102, 438–450, <https://doi.org/10.1016/j.indmarman.2022.02.010>.
- Trantopoulos, K, GV Krogh, MW Wallin and M Woerter (2017). External knowledge and information technology: Implications for process innovation performance. *MIS Quarterly*, 41, 287–300, <https://doi.org/10.25300/MISQ/2017/41.1.15>.
- Wang, X, H van der Bij and W Dolfsma (2020). Knowledge sharing in inter-organisational teams: The role of the advice network and the substitutive role of the formal network in an R&D alliance. *Industry and Innovation*, 27(10), 1160–1185, <https://doi.org/10.1080/13662716.2020.1754171>.
- Warner, KSR and M Wäger (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. *Long Range Planning*, 52(3), 326–349, <https://doi.org/10.1016/j.lrp.2018.12.001>.
- Woodcock, J (2018). Digital labour in the university: Understanding the transformations of academic work in the UK. *TripleC*, 16, 129–142, <https://doi.org/10.31269/voll6iss1pp129-142>.
- Yang, L, B Huo, M Tian and Z Han (2021). The impact of digitalization and inter-organizational technological activities on supplier opportunism: The moderating role of relational ties. *International Journal of Operations & Production Management*. <https://doi.org/10.1108/IJOPM-09-2020-0664>.