THESIS SUMMARY

Viktoriia Semenova

**Embracing Technological Advancements:
Blockchain as a Driver for Innovation and Dynamic Capability Development**

Ph.D. dissertation

Supervisor:

Dr. Habil. Szabolcs Szilárd Sebrek, Ph.D.

Budapest, 2024

Department of Strategic Management

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I. Research background and justification of the topic

New technologies have been recognised as an objective factor that exerts a significant influence on innovation, entrepreneurial opportunities, actions, and results (Nambisan, 2017). Technologies open up opportunities for innovation activities in traditional sectors and offer new avenues for startup companies (Chen, 2018; Massey et al., 2017). Meanwhile, knowledge on new technologies is often vague and hard to quantify; this is applicable to blockchain technology, whose value remains uncertain for business and society (Frizzo-Barker et al., 2020). Moreover, the widespread scepticism and negative discourse surrounding blockchain technology have inspired us to delve deeper into its complexities.

Scholars have increasingly focused on the organisational implications of blockchain technology and the different uses of blockchain technology since 2014 (Casino et al., 2019; Ozdagoglu et al., 2020; Wamba and Queiroz, 2020). The research works have concentrated on various aspects, including comprehending how blockchain affects business practices, as exemplified by Frizzo-Barker et al. (2020) and Tönnissen et al. (2020), its impact on business models (Morkunas et al., 2019; Weking et al., 2020), its influence on entrepreneurship and innovation (Chalmers et al., 2021; Chen, 2018), and its effects on the capabilities of enterprises, as explored in studies by Gupta et al. (2023), Meier et al. (2023), Pattanayak et al. (2023), and Quayson et al. (2023). However, studies have yet to investigate the direct effects of blockchain technology on the capabilities of startups. The purpose of the dissertation is to bridge the gap in innovation research pertaining to the managerial aspects of technology implications, particularly within the context of early-stage businesses, and examine how emerging companies leverage technology advantages in their day-to-day operations. We endeavoured to explore specific instances illustrating how businesses confront the hurdles linked to blockchain while effectively capitalising on its strengths. Furthermore, the focus extended to assessing its practical applications and potential influence across various sectors.

As we commenced our research at the end of 2019 and the beginning of 2020, there was a growing shift towards a more mature and realistic understanding of blockchain's capabilities and limitations. This technology has presented smaller companies with a chance to address specific customer demands and compete with established industry leaders in clearly defined specialised sectors through the development of innovative products and processes. The evolution of blockchain technologies has led to the establishment of new firms, marked by continuous entries and exits in the field. The limited research on how blockchain technologies impact early-stage companies and their capabilities could potentially result in overlooked growth opportunities for various market participants and contribute to an innovation deficit in early-stage ventures. Additionally, entrepreneurs might develop blockchain-based startups without a comprehensive understanding of market needs and dynamics, leading to ineffective business models. Allocating resources to

blockchain projects without a solid research foundation can result in the mismanagement of time, capital, and resources. Thus, examining new technologies and the development of dynamic capabilities within organisations can provide valuable insights into the strategies these companies employ to create innovative solutions. This is not only essential for their individual success but also for fostering innovation within the wider business environment.

The dissertation comprises a collection of related papers. Three articles have been published in peer-reviewed journals, and one paper has been submitted to a peer-reviewed journal. Table 1 exhibits the papers that have been incorporated into the dissertation.

Table 1. Overview of the papers and the journals' rankings.

Article / Year of publication	Title	Authors	Journal	MTA[1]	WoS indexed journal	SJR[2]
Article 1 (2020)	Technology adoption theories in examining the uptake of blockchain technology in the framework of functionalist and interpretive paradigms.	Viktoriia Semenova	Vezetéstudomány / Budapest Management Review[3]	B	-	-
Article 2 (2023)	Exploring the profile of innovative enterprises in high-tech manufacturing sectors: The case of the regions of Madrid and Catalonia in 2016.	Dr. Betsabé Pérez Garrido, Viktoriia Semenova, Dr. Szabolcs Szilárd Sebrek	Regional Statistics		ESCI[4]	Q1/D1 (0.65)
Article 3 (2023)	The interaction of actor-independent and actor-dependent factors in new venture formation: The case of blockchain-enabled entrepreneurial firms.	Viktoriia Semenova, Dr. Szabolcs S. Sebrek, Dr. Betsabé Pérez Garrido, Andrea Katona, Dr. Gábor Michalkó	Acta Oeconomica	C	Economics SSCI[5] (Q4) Impact Factor: 0.939	Q3 (0.23)
Article 4	Blockchain technology and the evolution of dynamic capabilities in early-stage ventures.	Viktoriia Semenova, Dr. Szabolcs S. Sebrek, Dr. Philip T. Roundy	Submitted to the journal			Q1

[1] *In the list of the competent committee of Section IX of the Hungarian Academy of Sciences (MTA).*
[2] *The SCImago Journal Rank.*
[3] *Rating A is valid from the 1st of June 2023.*
[4] *The Emerging Sources Citation Index (ESCI) includes high-quality, peer-reviewed publications of regional importance and in emerging scientific fields.*
[5] *Social Sciences Citation Index (SSCI).*

II. Research gaps, aims and questions

Table 2 presents a summary of the research aims and questions delineated in the examined papers.

Table 2. Summary table of research aims and questions.

	Research aims	Research questions
Article 1	**RA₁** To review the technology adoption models being recently applied in relation to blockchain technology implementation in supply chains. **RA₂** To explore the adoption process of blockchain technology and the main factors influencing the adoption behaviour of supply chain practitioners and compare the results of existing studies on blockchain acceptance with academic works carried out within the functionalist and interpretive paradigms.	**RQ₁** *What major technology adoption theories and models have been applied in relation to blockchain technology?* **RQ₂** *How do they contribute to explaining the adoption process of blockchain?*
Article 2	**RA₁** To investigate the innovation behaviour and degrees of innovation performance (i.e., radical, continuous, or no product innovation) associated with the geographic location of enterprises and firm-specific factors such as size, technological development, R&D expenses, and researcher wages. **RA₂** To examine the profile of innovative companies from the high-tech manufacturing sector through the application of two types of discrete choice models: a mixed-logit model and a multinomial logit model.	**RQ₁** *How do firm attributes affect the degree of product innovation performance in high-tech manufacturing companies located in two distinct Spanish regions?* **RQ₂** *What is the difference between the research results obtained using the multinomial logit and mixed logit models?*
Article 3	**RA₁** To understand the interaction of actor-independent and actor-dependent factors in the process of new firm formation. **RA₂** To examine activities that constitute the shaping of external enablers and new venture ideas by applying the DCs framework.	**RQ₁** *How do entrepreneurial agents make use of the potential provided by external enablers?* **RQ₂** *What are the key microprocesses that are associated with integrating those enablers into developing new businesses?*
Article 4	**RA₁** To explore the use of blockchain technology for promoting business development. **RA₂** To analyse the impact of blockchain on micro-level actions that constitute the process of dynamic capability development in the context of early-stage firms.	**RQ₁** *How do early-stage firms leverage blockchain technology to support their activities in dynamic and uncertain environments?* **RQ₂** *What effect does blockchain have on early-stage firms' dynamic capabilities in generating business value?*

In the first article, the primary objective was to examine the process of adopting blockchain technology and the key factors that impact the adoption behaviour of supply chain professionals. Given that earlier research on blockchain applications has primarily centred on the domain of supply chain management (Hughes et al., 2019; Wamba and Queiroz, 2020), I conducted a literature review to ascertain the organisational theories that have been recently applied in the implementation of blockchain technology in supply chain contexts. As highlighted by Baum and Haveman (2020), organisational theories can play a substantial role in enhancing our comprehension of emerging phenomena. Hence, the subsequent research questions have been devised: *What major technology*

adoption theories and models have been applied in relation to blockchain technology? How do they contribute to explaining the adoption process of blockchain? to gain insight into how the organisations harnesses blockchain technology.

The second article presented a literature review on the various types of innovation, specifically focusing on product innovation with varying levels of novelty. We explored the profile of innovative firms in terms of the degree of novelty in the high-tech manufacturing sector. Our examination focused on the likelihood of product innovation in relation to firms' geographic location and specific characteristics, including R&D expenditures, technological development, company size, and researcher compensation. Hence, the following research questions have been raised: *How do firm attributes affect the degree of product innovation performance in high-tech manufacturing companies located in two distinct Spanish regions? What is the difference between the research results obtained using the multinomial logit and mixed logit models?* Since innovation performance is shaped by various contributing factors, our objective was to address the knowledge gap related to the limited understanding of how firm attributes impact firms' innovation output.

As revealed in the first article, the existing studies on blockchain technology have predominantly focused on large corporations, especially within the context of established supply chains (Kamble et al., 2019; Koh et al., 2020; Kumar et al., 2022; Pattanayak et al., 2023). However, a wide range of technologies, including blockchain, have stimulated discussion about how the latter phenomenon facilitates entrepreneurial activities and outcomes. Despite the fact that blockchain presents advantages for early-stage ventures, there is a shortage of research addressing the long-term consequences of blockchain implementations and the technology's evolution within different temporal and contextual settings (Holm et al., 2020). Hence, both the third and fourth articles are focused on studying the implementation of blockchain in early-stage firms.

In the third article, we found that there is a gap in entrepreneurial literature regarding the examination of how entrepreneurs identify external enablers and the role of entrepreneurs' knowledge, experience, and networks in recognising and harnessing the mechanisms of external enablers across the entire venture creation process. Our aim was to acquire a better understanding of how blockchain technology has the potential to trigger the creation of new ventures and explore the activities of founders and entrepreneurial teams in this process. This research extends the scope of the dynamic capability perspective to the realm of small business management. We have combined the existing literature on external enablers, blockchain technologies, and dynamic capabilities to examine the following questions: *How do entrepreneurial agents make use of the potential provided by external enablers? And what are the key microprocesses that are associated with integrating those enablers into developing new businesses?* This study adds to the relatively narrow research stream (Corner and Wu, 2011; Newbert, 2005; Sapienza et al., 2006) that is dedicated to the investigation of

dynamic capabilities and dynamic managerial capabilities in the context of emerging ventures and contributes to the body of literature on the commercial applications of blockchain technologies.

The utilisation of blockchain technologies in entrepreneurial practices is the central theme of an emerging, yet expanding, body of research (Chalmers et al., 2021; Kher et al., 2020; Park et al., 2020). Amidst uncertainty, volatile conditions, and fierce competition for survival, early-stage enterprises, as they expand, must cultivate dynamic capabilities that empower them to strategically align their resources with shifting market needs. Nevertheless, the processes through which young firms acquire these dynamic capabilities and how emerging technologies can facilitate their development remain uncertain.

In the fourth article, we delve into the examination of how blockchain technologies contribute to the enhancement of dynamic capabilities in early-stage, high-tech ventures. The objective was to investigate the impact of blockchain on the capabilities and development of Hungarian early-stage blockchain-based companies while addressing two questions: *How do early-stage firms leverage blockchain technology to support their activities in dynamic and uncertain environments? What effect does blockchain have on early-stage firms' dynamic capabilities in generating business value?* As we examine these questions, we contribute to the growing body of research related to the microfoundations of dynamic capabilities, as articulated by Teece (2007), exploring the fundamental processes by which blockchain technologies are utilised to promote the development of sensing, seizing, and transforming capabilities that add value to startup operations. Analysing the microfoundations of the dynamic capabilities of startups is still a big research gap. Startups, as new and fast-growing organisations, often face rapid changes and uncertainty in their markets and need to develop their dynamic capabilities to stay ahead of the competition and achieve success.

To sum up, the examination of blockchain technology in the fields of innovation, entrepreneurship, strategic management, and organisational dynamics highlights its crucial impact on contemporary business environments. Despite recognition of blockchain's transformative potential in existing literature, significant research gaps persist. Identifying these gaps underscores the necessity for further exploration into the intricate relationships between technology adoption, innovation, and organisational processes. By delving into these intersections, we attempt to elucidate how nascent technologies such as blockchain drive the development of dynamic capabilities in fledgling companies. As we study these unexplored realms, we not only contribute to academic discourse but also offer practical insights essential for guiding businesses towards sustainable growth and competitive advantage in the digital age.

III. Methodology

Table 3 provides a summary of the research methodology, data collection, and data analysis conducted in all four papers.

Table 3. Research methodology used in each article.

	Data collection	Sampling	Data analysis
Article 1	**Qualitative methodology:** systematic literature review. Two citation databases: Web of Science and Scopus. The search terms: "*blockchain*" AND "*adoption theory*" AND "*supply chain*".	Eight publications out of twenty were selected for further analysis. *Exclusion criteria*: the application of economic or informatic theories; articles that explored other fields rather than the supply chain area; articles without full availability, duplicate papers, or articles published in low-ranked journals.	Literature review analysis. Grouping of the data according to the theories and paradigms applied.
Article 2	**Quantitative methodology:** two discrete choice models: a logit model and a mixed logit model. Data source: the Technological Innovation Panel (*PITEC*) database constructed by the Spanish National Statistics Institute.	Data from 2016 (the last year of the database), containing 12,849 firms. *Two filters* were used: 1) firms from high-tech manufacturing sectors in **Spain**, reducing our sample to 323 firms, 2) firms with corporate headquarters located in Madrid or Catalonia, reducing our final sample to 212 firms.	2 methodological approaches for analysis: *a multinomial logit model and a mixed logit model.* The application of the mlogit package in the statistical software R.
Article 3	**Qualitative methodology:** case study method. Data sources: semi-structured interviews and archival resources (e.g., white papers, social media posts, press announcements).	Four **Hungary**-based start-ups from the financial services, cryptocurrency trading, crypto asset management, energy, information technology, and identity industries.	Analysis of each individual case, followed by comparison across cases.
Article 4	**Qualitative methodology:** multiple case study method. Data sources: semi-structured interviews, archival data (e.g., white papers, presentations, firms' websites, YouTube interviews, media articles, and news sources), and direct observation. Data collection: January 2020 – January 2023	Five **Hungary**-based start-ups from the urban farming, energy, insurance, information technology and services, and health industries.	Thematic analysis using ATLAS.ti. During the coding process, we used pre-established codes.

In the first article, a systematic literature review methodology was employed, as it proved effective in extracting valuable insights and revealing practical implementation and conceptual frameworks within available sources (Hart, 1998). The article centres on an analysis of the literature concerning various technology adoption theories related to how users perceive and apply blockchain technology within the context of supply chains. In June 2020, relevant research studies were sought

in two prominent and competitive citation databases, namely Web of Science and Scopus. The search criteria employed in these databases included the terms "blockchain" AND "adoption theory" AND "supply chain" to retrieve the available publications. As a result of the search, a total of eight high-quality publications were identified for in-depth analysis. This selection comprised seven papers that employed at least one of the technology adoption theories and one article that applied the sensemaking theory. The data extracted from these articles was organised according to the theories employed, the core constructs were scrutinised, and the results were consolidated.

In the second article, quantitative research was conducted to study the innovation profiles of Spanish high-tech manufacturing enterprises. Our data comes from the Technological Innovation Panel (PITEC) database created by the Spanish National Statistics Institute. The data includes a large sample of Spanish companies and offers details on their innovation-related activities, characteristics, and developmental indicators. In this study, 12,849 companies were represented by data from 2016, the database's last year, and two filters were applied. First, we narrowed down our sample to 323 companies by choosing businesses from high-tech manufacturing industries. Second, we limited our final sample to 212 companies by selecting those having corporate headquarters in Madrid or Catalonia. We employed two discrete choice models (Cao, 2021; McFadden and Train, 2000; Train, 2003) to describe organisational behaviour. Discrete choice models are the most effective method for determining how a firm's innovation decisions affect innovation novelty (Barbosa et al., 2013). The multinomial logit model, in contrast to the mixed logit model, assumes that all organisations have homogenous preferences for each attribute, failing to account for the heterogeneity across businesses. Mathematically, it means the estimation of fixed effect parameters in the model. The mixed logit model overcomes the three limitations of standard logit models by permitting random taste variation, unlimited substitution patterns, and correlations in unobserved factors over time (Train, 2003). This flexible computational approach allows for the simultaneous capture of homogeneous (via fixed effects) and heterogeneous (via random effects) preferences. As suggested by Train (2003), a given variable is specified as a fixed or random parameter at the researcher's discretion. Previous studies found that organisational size (Greve, 2011; Li et al., 2020) and the scientific activities of the research team (Giarratana, 2004; Sebrek, 2020; Spithoven et al., 2010) had a significant impact on the firm's performance. Regarding the earlier findings, we defined research salary and firm size as random variables. The performance of product innovation at the selected enterprises is represented by the dependent variable. PITEC data report whether a company developed no new products, undertook incremental innovation involving novelty exclusive to the firm, or engaged in radical innovation, indicating the firm's ability to create products new to the global market (Laursen and Salter, 2006) and therefore demonstrating the highest degree of performance.

In the third and fourth articles, an exploratory qualitative research design that was grounded in the case study approach was adopted. Table 4 provides details about the blockchain-based companies investigated in the third and fourth articles. Qualitative data is especially well-suited for analysing the complex processes involved in the development of dynamic capabilities because of its depth and flexibility (Graebner et al., 2012; Ozcan and Gurses, 2018). The utilisation of the case study method aligns with our research objectives as it enables a thorough exploration of processes within a context that is rich in detail and complexity (Ozcan et al., 2017). Recent research indicates that the case study methodology is highly appropriate for identifying the factors that drive entrepreneurial businesses to adopt blockchain technology, understanding the roles that this technology plays, and examining the processes involved in the development of capabilities within new ventures (Kouhizadeh et al., 2019; Treiblmaier, 2019).

Table 4. Sample of the blockchain-driven companies examined in the 3rd and 4th articles.

Firm / founding year	Offerings	No. of founders
Article 3		
b-cube.ai 2018	R&D startup in AI and blockchain, cryptocurrency trading bots, educational courses, webinars, and consultancy	2
CoinCash Payments 2017	fintech start-up specialising in cryptocurrency exchange, online transfer services (buy or sell more than 50 cryptocurrencies for local currency), ATM network (16 ATMs) with bi-directional functionality	2
Enerhash Technologies 2019	building and connecting mobile data centres, which provide fixed consumption and extra flexibility, to power plants	2
Internet of People (IOP) Ventures 2018	building the IOP technology stack and related infrastructure, cloud and support services	1
Article 4		
Firm A 2018	producing microgreens, edible flowers, herbs, and leafy greens for chefs and local specialty stores, R&D in service and on demand	2
Firm B 2019	building and connecting mobile data centres, which provide fixed consumption and extra flexibility, to power plants	2
Firm C 2019	web and mobile application development, system integrations, front-end/back-end and blockchain-based services, digital document solution	3
Firm D 2018	innovative parametric microinsurance products: ski and flight delay insurance, 2 products are coming: weather and catastrophe insurance	3
Firm E 2018	healthcare trading platform where tissue banks are linked to healthcare professionals (manufacturers, hospitals, and universities), consultancy services, developing tissue banking related courses and blockchain specialised training programme for the universities	2

In the third article, our sample comprises four companies from various sectors, such as financial services, cryptocurrency trading and crypto asset management, energy, information technology, and identity industries. These firms develop high-value-added and cross-industrial offerings for Hungarian and foreign markets. The primary data source was semi-structured interviews conducted with representatives of the chosen companies. We aimed to maintain consistency in the interview structure and ensure that the results obtained from each interview were comparable.

Additionally, we collected and analysed archival sources, including companies' white papers and official websites, social media posts, press announcements, and other online resources. The initial phase of data analysis involved creating individual case stories focused on addressing the research questions. The objective was to uncover the key external factors that catalysed the establishment of the examined companies and to delve into the microfoundations of the dynamic capabilities linked to each case. Subsequently, we conducted a cross-case analysis in which we compared patterns in each case to those in other cases to establish consistency (Eisenhardt and Graebner, 2007). This process allowed us to define the key external enablers and dynamic capabilities of the new ventures.

In the fourth article, an exploratory, longitudinal, and inductive research design based on case studies of five young blockchain-enabled companies has been adopted. Inductive approaches are suitable when there is a lack of existing theoretical and empirical knowledge regarding a phenomenon. These approaches frequently make use of data that is rich in context to construct and enhance theoretical models, thereby propelling the advancement of a particular field (Eisenhardt and Graebner, 2007; Graebner et al., 2012). We employed the multiple case study approach, which involves the joint analysis of several cases (Yin, 2014). To address our research questions, our approach involved the use of the analytical method known as "theory elaboration" (Eisenhardt, 1989; Lee et al., 1999). This approach includes researchers using preexisting conceptual ideas or a preliminary model to guide the design of the study. Theory elaboration aims to enhance existing theories, making them better at explaining real-world observations. In this process, researchers analyse and evaluate how the data gathered in an empirical context aligns with an established theory and explore ways to modify and improve aspects of the theory to better fit the observed data. Five case studies within the context of Hungarian early-stage blockchain-based ventures were analysed. The ventures from urban farming, energy, insurance, health, information technology and services industries exhibited consistent growth and/or achieved profitability, making them the primary focus of our study. The data regarding the selected case study ventures was collected through a simultaneous and combined approach involving three sources: semi-structured interviews, archival data, and direct observation. Further, we performed thematic analysis on the gathered data (Miles et al., 2014) with the use of a qualitative research software programme, ATLAS.ti. To maintain the robustness of our analysis, we applied predefined codes. In the initial phase, we scrutinised the data for recurring patterns and distinctions in how respondents described the impact of blockchain on startup operations and capability development. Subsequently, we associated related concepts within each case and linked them to emerging themes. Although we had some guiding theoretical concepts, we also allowed for the discovery of other patterns from the raw data. In the final step, we linked these emerging themes and concepts with existing literature, adopting an iterative approach to explore and clarify our findings.

IV. Research results and contributions

Table 5 provides an overview of the primary research findings and the summary of theoretical implications derived from the compiled articles.

Table 5. Summary of findings and implications.

Articles	Findings (F)	Theoretical implications (TI)
ARTICLE 1	F_1 The diffusion of innovation theory, the technology acceptance model, the technology – organisation – environment framework, the unified theory of acceptance and use of technology, and the interorganisational system adoption theory are the widely used theories regarding blockchain use in the supply chain area. F_2 They help to analyse behavioural intention and behavioural expectation in adopting blockchain and understand the perception and intentions of supply chain professionals about adopting technology.	TI_1 The findings show a lack of empirical research investigations and the need for greater theory elaboration to accelerate the adoption process within organisations. TI_2 Organisation studies should be based on predefined research questions and not on paradigm assumptions, as there is no need for such works to be grounded in paradigm debates.
ARTICLE 2	F_1 We found major differences between the samples from Madrid and Catalonia through descriptive statistics: compared to Catalonia, Madrid-headquartered enterprises are bigger and devote a greater portion of their current budgets to paying researcher wages. F_2 Better productivity and innovation performance are strongly correlated with wages. F_3 In terms of analysing the profile of innovative firms in our regional sample, the mixed logit model proved to be more effective and flexible than the multinomial logit approach since it helps disclose more variables with statistically significant explanatory power and interpret their real impact.	TI_1 A comparative analysis of the innovative enterprises situated in different regions within the same country confirms earlier research that reported a significant variance in innovation activity among regions. TI_2 The study's methodological approach, which uses the logit and mixed logit models, provides a powerful analytical tool for evaluating the likelihood of a firm's innovation decisions on innovation novelty. TI_3 The findings add to a growing body of literature on product innovation and the impact of firm size and researcher salary on innovation outcomes.

ARTICLE 3	F_1 Identification of three interconnected external enablers of new venture ideas in the context of blockchain-based firms:
	  - *market volatility associated with the growing popularity of cryptocurrencies and the underlying blockchain technology,*
	  - *the characteristics of blockchain,*
	  - *the ideology behind technology.*
	F_2 Key microfoundations of sensing activities:
	  - *problem and opportunity identification,*
	  - *market analysis and technology monitoring,*
	  - *research and development process.*
	and seizing activities:
	  - *creation of new products, processes, and business models,*
	  - *building a customer base and establishing partnerships,*
	  - *dissemination and legitimising work.*
	F_3 The dynamic managerial capabilities (DMCs) of the entrepreneurs played a decisive role in activating the external enablers.
	A firm's dynamic capabilities reside in founders and/or small entrepreneurial teams at the early stages of firm formation.
		TI_1 The study adds to the theoretical development by integrating external enabler theory, the dynamic capability view, and the concept of dynamic managerial capabilities.
		TI_2 According to our argument, venture creation cannot be well explained by a single external enabler. The study contributes to the limited research on the role of multiple enablers in shaping new venture ideas. External enabler theory is extended through the integration of an actor-dependent view of external enablers and the examination of the microfoundational work conducted by entrepreneurs and entrepreneurial teams within these firms.
		TI_3 We addressed the gap in research on the development of dynamic capabilities in a small business context by identifying core microprocesses that underlie the sensing and seizing capabilities.

	F₄ Development of the model that illustrates the combination of external enablers, DMCs, and sensing and seizing capabilities that led to the formation and development of new ventures.	
ARTICLE 4	**F₁** One of the main drivers of blockchain adoption is its capacity to securely verify, monitor, and share transactions using transparent and encrypted records. Additionally, startups used blockchain infrastructure to increase the reliability and sustainability of their offers as well as to strengthen their market position. **F₂** Blockchain allows larger companies to integrate innovative solutions from startups, sustaining competitiveness and mitigating the risk of obsolescence. **F₃** Eight underlying microfoundations of dynamic capabilities enhanced by blockchain are identified. Blockchain-driven sensing capabilities: *- blockchain-driven recognition of inefficiencies in the incumbents' business processes, - identification of customer needs for sustainable products, - discovery of latent demand and niche solutions.* Blockchain-driven seizing capabilities: *- designing mechanisms to capture value, - the enhancement of customer relationships, - partner development and collaborative capabilities.* Blockchain-driven reconfiguring capabilities: *- renewal of business models and expansion of the customer base, - knowledge-sharing and integrating procedures.* **F₄** Two main propositions and three supporting sub-propositions are formulated. **F₅** Development of the conceptual framework that illustrates how early-stage companies benefit from blockchain-enhanced dynamic capabilities, strengthening their operations and ensuring competitiveness.	**TI₁** Our research makes a theoretical contribution by filling a void in the innovation literature and the literature on blockchain-related entrepreneurship. We bring attention to the less-explored managerial dimensions associated with the impact of blockchain technology on a firm's capabilities. **TI₂** The key contribution of our study is the incorporation of dynamic capabilities as a theoretical framework. Our research makes a valuable addition to the area of study focused on improving our comprehension of how technologies influence the processes that contribute to the development of dynamic capabilities. **TI₃** We enriched the understanding of dynamic capabilities within early-stage businesses by shedding light on the progression of sensing, seizing, and reconfiguring capabilities, all of which are strengthened through the adoption of blockchain technology. **TI₄** Several propositions and a conceptual framework have been developed to direct future research and enhance the use and significance of blockchain in facilitating organisational dynamic capabilities.

In the first article, when addressing the first research question concerning the major technology adoption theories and models used in the context of blockchain technology, it was determined that the diffusion of innovation theory (Kshetri, 2018), the technology acceptance model (Kamble et al., 2019; Queiroz and Wamba, 2019), the unified theory of acceptance and use of technology (Queiroz and Wamba, 2019; Wong et al., 2020b), the technology–organisation–environment framework (Clohessy et al., 2019; Wong et al., 2020a), and interorganisational system adoption theory (Sternberg et al., 2020) were the most frequently utilised theories when studying the field of supply chain in relation to blockchain technology. Regarding the second research question concerning the contributions of these theories to elucidating the adoption process of blockchain, it was revealed that these theories could assist in pinpointing the constructs and variables that influence the choice to embrace blockchain technology. Furthermore, they can facilitate an understanding of the behavioural intentions and expectations of supply chain professionals regarding the adoption of this technology. The examined studies suggest that the implementation of this complex technology

should be a gradual and phased process (Kamble et al., 2019; Wang et al., 2019; Wong et al., 2020a). To ensure the successful integration of technology in supply chain management, several essential factors were highlighted, including the presence of the appropriate infrastructure and resources, employee awareness and knowledge (as emphasised by Wong et al., 2020b), and the crucial support of top management and external network members, as underlined in the studies by Wong et al. (2020a and 2020b).

In the second article, we examined the degree of firm innovation categorised into three groups: firms without innovative products and firms that launch novel products at either firm or market levels. Enterprises headquartered in two Spanish economic hubs—Madrid and Catalonia—and operating in the advanced manufacturing sectors were compared with the application of novel-to-the-topic methodology (i.e., the multinomial logit and mixed logit models) that allows for estimating the probability of a firm's innovation choices on innovation novelty. The profiles of the selected enterprises were analysed considering such characteristics as innovation expenditures dedicated to internal and external R&D activities, the proportion of internal R&D expenditures allocated to researcher salaries, technological development, and firm size. A considerable variation in innovation activity across regions was discovered.

The first question in this study sought to determine the innovation behaviour of the selected high-tech manufacturing companies located at Madrid and Catalonia in relation to firm-specific factors. The effect of these factors was analysed with the application of two discrete choice models. The first method indicated that the evaluated firms shared homogeneous preferences for each of the listed attributes. There is a moderately positive correlation between the wages of researchers and innovation expenditures allocated to internal R&D, as well as between the wages of researchers and technological development in the firm profiles of Madrid and Catalonia. In the second method, we included random effect parameters—in our instance, researcher salaries and firm size—under the premise that the firms have heterogeneous preferences. In Madrid's innovative enterprises, the random effect associated with firm size was significant at all levels of firm innovation, whereas in Catalonian enterprises without innovative products and those with innovative products at the market level, the random effects associated with researcher salaries and firm size were significant. According to the mixed logit model, Catalonia's internal R&D funding has little impact on innovation, while having more resources for internal R&D decreases the probability of radical product innovation in the Madrid sample. Enterprises with headquarters in Madrid prioritise radical over incremental innovation. The impact of external R&D is substantially more significant for enterprises situated in Madrid than for those in Catalonia, yet the situation is the opposite when it comes to spending on technological development. Catalan firms become more innovative as their degree of technological development rises, whereas businesses in Madrid are less likely to introduce incremental product

innovations when they allocate a larger share of their costs to technical development. In both Spanish regions, the amount of the researchers' salaries is an important factor for firm innovation. Firm size demonstrates itself to be a significant random variable in connection to innovation performance in Madrid and Catalonia. Larger businesses in Madrid favour radical innovation over incremental innovation, whereas businesses in Catalonia place equal value on both. Firm size is related to equal preferences for incremental innovation and no product innovation in the Madrid sample, despite the absence of a significant effect in Catalonia. Our findings are consistent with those of Buesa et al. (2006) and Jaumandreu (2009), who found that Catalonia and Madrid operate differently in terms of innovative spending and associated activities.

Returning to the second question posed, we conclude based on a comparison of the findings obtained from the application of two methodological approaches that the mixed logit model, as opposed to the conventional multinomial logit model, allows for a more comprehensive and detailed evaluation of the profile of innovative firms in both regions. The main function of the mixed logit model is to expose the diverse features of the sampled entities, which means that core variables with both fixed and random effects become significant at the same time. As a result of our analysis, we recommend using discrete choice models for similar works in the field of regional statistics. The practical advantage of adapting such a flexible computational approach as the mixed logit specification is its ability to facilitate the simultaneous estimation of fixed- and random-effect parameters in the models and enable the identification of more variables with statistically significant explanatory power.

In the third article, in response to the first research question, the three main external enablers of blockchain-based firms were identified, followed by an explanation of how new ventures use the potential of external enablers. The creation of new ventures was triggered by a combination of actor-independent factors, including the growing popularity of cryptocurrencies associated with the underlying blockchain technology, the characteristics of the technology itself, and ideology. These factors were the driving force for the founders of the mentioned companies to identify potential applications and commence the development of blockchain-based solutions aimed at addressing various customer issues. The mere emergence of the technology alone did not guarantee the company's successful development; instead, this was primarily facilitated by the founders' efforts and capabilities. Our findings align with earlier research (Corner and Wu, 2011; Newbert, 2005; Zahra et al., 2006) that has similarly emphasised the significant role of the entrepreneur in a firm's dynamic capabilities. We noted that the dynamic managerial capabilities of entrepreneurs (human capital, social capital, and managerial cognition) played a crucial role in the activation of these external enablers.

Addressing the second research question, the dynamic capability framework was applied to explore the activities that comprise the shaping of external enablers and new venture ideas. Three microfoundations of sensing activities (i.e., *problem and opportunity identification, market analysis and technology monitoring, research and development process*) and three microfoundations of seizing activities (i.e., *creation of new products, processes, and business models, building a customer base and establishing partnerships, dissemination and legitimising work*) were identified. Those microprocesses are the most prominent in terms of incorporating these enablers into the development of new business concepts and the subsequent establishment of ventures. Despite the relatively young age of these firms, we observed certain characteristics of transformative activities. These took the form of product development, changes in business models, transitioning from a movement to a formal company structure, and an expansion of services and projects. In the end, we developed a model to show the relationship between external enablers, entrepreneurs' dynamic managerial capabilities, entrepreneurs' activities, and new venture ideas.

The fourth article was designed to determine the role of blockchain technology in facilitating early-stage firms' dynamic capabilities, which encompass sensing, seizing, and transforming capacities undergirded by their microfoundations. With respect to the first research question on how early-stage firms leverage blockchain technology to support their activities, our analysis reveals that the primary motivation behind the adoption of blockchain technology in early-stage businesses was to improve reliability, ensure the long-term viability of their products, and bolster their position in a particular market niche. In answering the second research question, which concerns what effect blockchain has on early-stage firms' dynamic capabilities in generating business value, we discovered that blockchain serves as a powerful tool for promoting capability-development in young organisations, namely enhancing the sensing and seizing capabilities of young firms and facilitating their ongoing transformation. Additionally, eight underlying micro-level processes intricately linked to the sensing, seizing, and reconfiguring capabilities were identified. Having synthesised the findings across the cases, we presented a set of propositions to guide future research and introduced the conceptual framework. The model illustrates how dynamic capabilities, enhanced by blockchain technology, bolster the operations of early-stage companies, thereby ensuring their competitive advantage. This study, along with its theoretical and empirical insights, enriches the body of knowledge regarding the development of dynamic capabilities in early-stage enterprises and the ways in which new technologies play a facilitative role in this process.

In summary, these articles collectively enhance our comprehension of how organisations navigate technological advancements, innovation processes, and dynamic capabilities in various contexts. They underscore the significance of harnessing strategic management and organisational

theories, contextual factors, entrepreneurial skills, and emerging technologies to support value creation and organisational growth in an ever-evolving business environment.

The findings presented in this dissertation lead to a number of significant contributions within the domains of technology management, blockchain research, innovation management, entrepreneurship, organisational studies, and strategic management. The initial contribution centres on rectifying a critical gap in innovation research by illuminating the less-explored managerial dynamics and the potential consequences associated with the adoption of blockchain technology. Blockchain technology, being a recent development, opens up numerous unexplored avenues for research, as emphasised by Seebacher et al. (2021). Scholars acknowledge its importance for future applications (Iansiti and Lakhani, 2017; Kher et al., 2020). A key objective was to provide insights into the creation and capture of value through the integration of blockchain and to offer strategies for the development of more secure and efficient products and services empowered by blockchain.

Second, this research enhances scholarly comprehension of the intricate connections between emerging technologies and organisations (Bailey et al., 2019; Steininger, 2018) by showcasing the long-term effects of implementing blockchain technology in early-stage entrepreneurial firms operating across a variety of sectors. The demonstration reveals that incorporating blockchain technologies can enhance capability development in early-stage firms. The implications of blockchain for the firms under examination contribute to the existing body of knowledge in blockchain-related entrepreneurship research (Chalmers et al., 2021; Ilbiz and Durst, 2019; Morkunas et al., 2019; Park et al., 2020; Weking et al., 2020). This contribution involves uncovering the reasons entrepreneurial firms adopt blockchain technology and elucidating its particular roles within firms' value chains.

Third, the analysis of the chosen blockchain-enabled companies contributed to the external enabler theory (Davidsson et al., 2020). This contribution stems from our investigation into the microfoundational activities conducted by entrepreneurs and entrepreneurial teams within these firms. The dynamic managerial capability perspective (Adner and Helfat, 2003) provided an explanation for how and why entrepreneurs were able to incorporate a variety of enablers into their new venture concepts. The examination of founders' managerial capabilities contributed to our understanding of the innovative ways in which entrepreneurs recognised and realised the potential mechanisms of external enablers during the venture-creation process. Hence, an actor-dependent view of external enablers was incorporated into the external enabler theory (Chalmers et al., 2021; Davidsson et al., 2020). Despite the conventional conception of enablers as objective and autonomous actors, our observations demonstrated that the actors actively contributed to shaping the development of the enablers they sought to employ.

Further, we expanded the perspective of dynamic capabilities to encompass new entrepreneurial firms, effectively bridging a research gap regarding the role of dynamic capabilities

in entrepreneurial contexts, particularly during their foundational and developmental phases. This addresses a notable deficiency in the existing literature (Corner and Wu, 2011; Jiao et al., 2013; Newbert, 2005; Razmdoost et al., 2020; Wu, 2007; Zahra et al., 2006). Our study offers a comprehensive understanding of the role of dynamic capabilities in the establishment of new ventures by detailing the nature and function of these capabilities. The sensing and seizing activities undertaken by the selected firms played a crucial role in uncovering external enablers, developing them into novel business concepts, offerings, and products, and subsequently establishing their legitimacy. The establishment of new ventures in this setting, characterised by the technology's novelty, controversial nature, and constantly evolving environment, necessitated a high level of both sensing and seizing capabilities.

Lastly, a contribution was made to the research exploring how technologies influence the processes or foundations that lead to the formation of dynamic capabilities (Cetindamar et al., 2009; Conboy et al., 2019; Franco et al., 2009; Mikalef and Pateli, 2017; Mikalef et al., 2021; Parida et al., 2016) by elaborating on how blockchain enables the enhancement of sensing, seizing, and reconfiguring capabilities. This offers valuable insights into the operational significance of blockchain for early-stage ventures that must navigate resource limitations and adds to the existing knowledge base (e.g., Corner and Wu, 2011; Ma et al., 2015; Zahra et al., 2006) on the dynamic capabilities of emerging businesses.

Thus, the research discussed in this dissertation enriches the conversation surrounding technology management by offering strategic insights tailored to the distinctive opportunities posed by novel technologies. By integrating ideas from the four papers, we offer a comprehensive understanding of how organisations can effectively navigate the opportunities presented by emerging technologies in order to support organisational growth and gain a competitive advantage. This research not only advances scholarly knowledge in these domains but also offers practical implications for decision-makers striving to excel in an increasingly technology-driven world.

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VI. Author's publications related to the topic

Journal articles

1. Semenova, V. (2020). Technology adoption theories in examining the uptake of blockchain technology in the framework of functionalist and interpretive paradigms. *Vezetéstudomány / Budapest Management Review*, *51*(11), 26–38. https://doi.org/10.14267/VEZTUD.2020.11.03

2. Garrido, B. P., Semenova, V., Sebrek, S. S. (2023). Exploring the profile of innovative enterprises in high-tech manufacturing sectors: The case of the regions of Madrid and Catalonia in 2016. *Regional Statistics, 13*(1), 119–148. https://doi.org/10.15196/rs130106

3. Semenova, V., Sebrek, S. S., Garrido, B. P., Katona, A., Michalkó, G. (2023). The interaction of actor-independent and actor-dependent factors in new venture formation: The case of blockchain-enabled entrepreneurial firms. *Acta Oeconomica*, *73*(4), 537–559. https://doi.org/10.1556/032.2023.00001

Conference papers

4. Semenova, V., Qutishat, I., Sebrek, S. S. (2020). New industrial fields, innovativeness and firms' competitive advantage: The birth of the Hungarian blockchain ecosystem. *Proceedings of the 2nd International Conference on Applied Research in Business, Management and Economics*. Diamond Scientific Publishing, pp. 52-65. ISBN: 978-609-485-101-8 https://doi.org/10.33422/2nd.bmeconf.2020.09.230

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