Data-centric Business Model Innovation

Evidence from Eastern European and Baltic Region Enterprises

Nima Yahyapour

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Data-centric Business Model Innovation

Evidence from Eastern European and Baltic Region Enterprises

Nima Yahyapour

Södertörns högskola

Subject: Business Studies
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Abstract

This dissertation examines how data can move from being an operational resource to becoming a strategic and ecosystem-level enabler of business model innovation, creating opportunities for firm growth. Drawing on four interrelated studies and a cumulative multi-method research design, the dissertation develops an integrative data-centric framework that links digital readiness achieved through digital transformation, data strategy, and intra- and interorganizational business model innovation. The framework is dynamic, incorporating feedback loops that enable continuous interaction between business model innovation, digital readiness, and data strategy.

The findings show that data-centric business model innovation depends not only on technological adoption but also on organizational readiness, leadership capabilities, cultural change, and skill shifts as enabling mechanisms of data strategy. The dissertation argues that data strategy acts as a central bridge between digital readiness and business model innovation by defining how data is collected, integrated, modeled, governed, shared, and used for value creation and value capture.

With evidence from Article 5 and additional publicly available datasets, the dissertation further contextualizes some of these dynamics through a descriptive comparative analysis of digital readiness conditions in selected Eastern European and Baltic region economies. The results suggest that while larger economies tend to have greater ICT scale, digital sophistication, particularly cloud and AI adoption, should be understood as a qualitative capability dimension rather than simply a function of economic size. The regional analysis therefore provides contextual support for the framework, while not claiming causal evidence between country-level digital readiness factors and firm-level growth outcomes.

Overall, the dissertation contributes to business model innovation and ecosystem research by positioning data as a strategic resource, a mechanism for coordination, and an enabler of value creation at both the firm and ecosystem levels.

It also offers practical implications for managers, emphasizing the need to align digital transformation with clear data strategies while strengthening elements such as organizational digital capabilities, ecosystem alignment, digital infrastructure, human capital, and responsible data sharing practices.

For policymakers and decision-makers, it also highlights the importance of supporting digital infrastructure, human capital development, regulatory clarity, and facilitating data-sharing conditions.

The dissertation acknowledges that the proposed framework is a conceptual synthesis rather than a universal prescription and calls for future research across longer time horizons, broader geographical contexts, and more diverse industrial settings. Additionally, the country-level comparative analysis is constrained by limited temporal scope and available data coverage, which restricts the depth of insights.

Keywords: Data, data strategy, data-centric framework, business model innovation, data ecosystem, firm growth, digital transformation, digital readiness, data-sharing, Eastern Europe, Baltic region

Abstract (svenska)
Datacentrerad affärsmodellsinnovation: Empiriska belägg från företag i Östeuropa och Östersjöregionen

Med utgångspunkt i fyra sammanlänkade studier utvecklar avhandlingen ett integrerat datacentrerat ramverk som kopplar samman digital beredskap, uppnådd genom digital transformation, med datastrategi samt intra- och interorganisatorisk affärsmodellinnovation. Ramverket är dynamiskt och inkluderar återkopplingsloopar som möjliggör kontinuerlig interaktion mellan affärsmodellinnovation, digital beredskap och datastrategi.

Avhandlingen argumenterar för att datastrategi fungerar som en central länk mellan digital beredskap och affärsmodellinnovation genom att definiera hur data samlas in, integreras, modelleras, styrs, delas och används för värdeskapande och värdefångst.

Med stöd i evidens från artikel 5 och ytterligare datamaterial kontextualiserar avhandlingen vidare vissa av dessa dynamiker genom en deskriptiv jämförande analys av förutsättningarna för digital beredskap i ett urval av ekonomier i Östeuropa och Östersjöregionen.

Sammantaget bidrar avhandlingen till forskningen om affärsmodellinnovation och ekosystem genom att positionera data som en strategisk resurs, en mekanism för koordinering och en möjliggörare av värdeskapande på såväl företags- som ekosystemnivå.

Avhandlingen ger även praktiska implikationer för chefer och beslutsfattare genom att betona behovet av att samordna digital transformation med tydliga datastrategier, samtidigt som faktorer såsom organisatorisk digital förmåga, ekosystemmässig samordning, digital infrastruktur, humankapital och ansvarsfulla metoder för datadelning stärks. För beslutsfattare på policyområdet understryker avhandlingen även vikten av att stödja digital infrastruktur, utveckling av humankapital, tydliga regelverk samt förutsättningar som underlättar datadelning.

Nyckelord: Data, datastrategi, datacentrerat ramverk, affärsmodellinnovation, dataekosystem, företagstillväxt, digital transformation, digital beredskap, datadelning, Östeuropa, Östersjöregionen

“Data is the new oil!”
(Clive Humby, 2006)

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Abbreviations

AI	(Artificial intelligence)
AIoT	(Artificial intelligence of things)
API	(Application programming interface)
ARTO	(Awareness, readiness, technology, operations)
BSS	(Business support system)
DCF	(Data-centric framework)
GDS	(Global distribution system)
GVA	(Gross value added)
IT	(Information technology)
ICT	(Information and communication technology)
MaaS	(Mobility as a service)
MLR	(Multivocal literature review)
OSS	(Operating support system)
SLR	(Systematic literature review)

1. Introduction

1.1. Background

Digital transformation is widely recognized as a driver of firms' competitiveness, efficiency, innovation capacity, business models, and long-term growth (Schallmo & Williams, 2018; Verhoef et al., 2021). Across industries, organizations invest in digital technologies, analytics, and data infrastructures with the expectation that such investments will support new ways of creating, delivering, and capturing value (Nambisan et al., 2017; Vial, 2019). Yet digital transformation does not automatically lead to business model innovation or the creation of growth opportunities (Verhoef et al., 2021; Vial, 2019). Many organizations remain constrained by legacy systems, fragmented processes, siloed data repositories, and difficulties in coordinating data across functions and ecosystem partners (Bharadwaj et al., 2013; Irani et al., 2013). As a result, digital transformation initiatives often remain limited to operational improvement or cost reduction rather than enabling broader strategic renewal (Vial, 2019). This tension points to a central problem in both research and practice: although data is widely recognized as important for digital transformation, how data becomes a strategic and organizing resource for business model innovation is not yet sufficiently understood.

Existing research has generated valuable insights into the potential of data, the use of data-driven algorithms, the application of data in digital technologies, organizational capabilities, and transformation processes (Bharadwaj et al., 2013; Vial, 2019). However, much of this literature remains predominantly firm-centric and technology-oriented. Data is often treated as a secondary resource that supports decision-making or operational improvement (Sjödin et al., 2022), rather than as a central element around which business models, interorganizational relationships, and ecosystem coordination can be designed.

This distinction is important. In this dissertation, data-driven refers to the use of data to improve decisions, processes, and operations, whereas data-centric means that data becomes central to the architecture of the business model itself. In a data-centric business model, data is not only an input to analysis but also a core resource for value creation, value delivery, value capture, and coordination across organizational boundaries. This shift requires attention not only to internal digital readiness but also to an organization's data strategy, ecosystem participation, and the collaborative arrangements through which data is shared, combined, and transformed into value.

Prior research has examined factors influencing data-driven business model innovation (Sorescu, 2017; Wang et al., 2025), big data characteristics and their

relationships (Cappa et al., 2021; Johnson et al., 2017), as well as business model components such as value creation, delivery, and capture (Zott & Amit, 2010). Other studies have explored business model innovation opportunities and barriers (Chesbrough, 2010), collaborative business model innovation, and the relationship between business strategy and business model design (Teece, 2010). While these streams provide important foundations, they commonly focus on specific elements and do not fully explain how data and data strategies can be systematically integrated into business model architecture, nor how firms transition from digital transformation readiness to business model innovation, either within the firm or at the ecosystem level.

A further limitation is that digital transformation is often conceptualized as a technology adoption problem (Kraus et al., 2021; Tabrizi et al., 2019), a firm-internal change process (Rego et al., 2022), or an operational efficiency initiative (Wujarso, 2023). Such perspectives underplay the strategic role of data and overlook the increasing importance of interorganizational collaboration. In many contemporary industries, value creation depends not only on what a single firm can do internally but also on its ability to mobilize, share, govern, and combine data with other actors in an ecosystem (Zeng & Glaister, 2018). Consequently, there is a need for a clearer explanation of how data moves across analytical levels: from internal digital readiness to strategic data capabilities, to ecosystem coordination, and finally to business model innovation. This makes data-centric business model innovation particularly important because data increasingly becomes embedded in digital infrastructures, platforms, and services that extend beyond firm boundaries.

This dissertation addresses this gap by developing an integrative framework with data at its core and seeks to show how data can be transformed into value. The framework explains how digital transformation, with a strong focus on data, creates organizational readiness; how data strategy converts this readiness into a strategic capability; and how business model innovation and ecosystem participation translate that capability into growth opportunities.

In this dissertation, growth or growth opportunities refer not only to classical understanding of firm growth (Penrose, 2009), or increases in firm size and sales, but also to the process of expansion driven by the development and deployment of productive resources, particularly through identifying new ways of leveraging data to create value and pursue new opportunities.

The main synthesized outcome of this dissertation is a proposed framework for understanding data-centric intraorganizational and ecosystem-oriented business model innovation. The research questions are designed to derive this framework transparently by identifying its components, relationships, ecosystem implications, and contextual conditions.

1.2. Eastern Europe and Baltic (EEB) region

The "Eastern Europe and Baltic"[1] (EEB) region provides a relevant context for examining these dynamics because it combines diverse levels of digital readiness, industrial transformation, regional integration, and ecosystem development. The region includes economies with established industrial bases, digitally advanced central European, Nordic, and Baltic countries, emerging technology-driven firms, and nearshoring service providers connected to broader European value chains. This diversity makes the region analytically useful for studying how data-centric business model innovation may scale across different institutional, technological, and market conditions.

The regional focus also matters because data-driven transformation is not only a firm -level issue. It depends on wider conditions such as digital infrastructure, regulatory proximity, data governance maturity, cross-border collaboration, skills availability, and ecosystem participation. By situating the dissertation's findings in selected Eastern European and Baltic region economies, the dissertation can examine how regional digital-readiness conditions shape the scalability and contextual relevance of data-centric business model innovation. At the same time, the dissertation recognizes that the included articles differ in empirical scope. The firm-level framework is primarily developed through the synthesis of Articles 1 to 4, while the regional and country-level analysis in Article 5, with the support of additional datasets, provides a contextual extension that examines how selected regional conditions may support or constrain the broader applicability, relevance, and scalability of the framework.

1.3. Research questions

The overarching research problem addressed in this dissertation is how data-centric business model innovation is formed and how it fits within firms and business ecosystems, with the aim of creating growth opportunities. The previous discussion suggests that this problem cannot be answered by focusing only on technology adoption, internal transformation, or isolated business model components. Instead, it requires an integrated understanding of how digital transformation, data strategy, ecosystem collaboration, and business model innovation are connected.

Accordingly, the dissertation addresses the following research questions:

- RQ1: What components and relationships explain how firms progress toward data-centric business model innovation?

—

[1] In this study, the East Europe and Baltic (EEB) region refers to post-communist Central, Southern, and Eastern Europe, together with the countries bordering the Baltic Sea, including but not limited to the following 30 countries: Albania, Armenia, Azerbaijan, Belarus, Bosnia and Herzegovina, Bulgaria, Croatia, Denmark, Estonia, Finland, Georgia, Germany, Hungary, Kazakhstan, Kosovo, Latvia, Lithuania, Moldova, Montenegro, North Macedonia, Poland, Romania, Russia, Serbia, Slovakia, Slovenia, Sweden, Czech Republic, Turkey and Ukraine; as referenced in the following page: https://ostersjostiftelsen.se/en/for-researchers/research-relevance-for-baltic-sea-region-and-eastern-europe

- RQ2: What new ecosystem collaborative arrangements emerge when data becomes a central value driver for business model innovation?
- RQ3: How do regional digital-readiness conditions in selected Eastern European and Baltic region economies shape the scalability and contextual relevance of data-centric business model innovation?

Together, these questions build toward the dissertation's integrative framework. RQ1 identifies the internal and strategic logic through which digital transformation and data strategy become connected to business model innovation. RQ2 extends the analysis beyond the firm by examining how data-centric business model innovation fits within and depends on ecosystem collaboration, coordination, and role reconfiguration. RQ3 situates the framework in a regional context by examining how country-level conditions influence its scalability and relevance.

1.4. Overall orientation of the thesis

In doing so, rather than viewing digital transformation as a discrete organizational initiative or a linear process of technology adoption (Tavoletti et al., 2022), this dissertation conceptualizes digital transformation (Kraus et al., 2021) as an ongoing process in which data plays a central strategic and coordinating role (Mann et al., 2022). The overall purpose of the dissertation is to synthesize and integrate the included articles and to demonstrate how, taken together, they contribute to a deeper understanding of how a data-centric digital transformation approach enables business model innovation within and beyond organizational boundaries.

The dissertation advances a multilevel perspective. At the firm level, digital transformation creates the readiness required for organizations to generate, process, and use data more effectively. At the strategic level, data strategy connects digital readiness to decisions about governance, platforms, standards, capabilities, partnerships, and value creation priorities. At the business model level, these capabilities and relationships support new mechanisms of value creation, delivery, and capture. At the ecosystem level, data enables new forms of collaboration, coordination, and role distribution among multiple actors.

1.5. Structure of the dissertation

The remainder of this dissertation is structured as follows. The next chapter presents the theoretical framework and research context, which position the dissertation within relevant research streams and define the core theoretical concepts used across the dissertation. The subsequent chapters provide an integrated overview of the materials and methods and a cross-article methodological reflection, followed by a presentation of the key results. The final chapter is dedicated to the theoretical and empirical contributions of the dissertation, reflect on its limitations, and outline directions for future research and a conclusion section.

2. Theoretical Framework

2.1. Data

Data is a foundational asset in the modern business landscape, transforming decision-making processes and driving competitive advantage (Magalhaes & Roseira, 2020; Oghazi, 2009; Wamba et al., 2015). Traditional decision-making often relies on intuition and experience; however, the exponential growth of data has enabled companies to employ statistical analyses and predictive modeling to inform their strategies. Firms are redefining decision-making processes by shifting from unsystematic insights to quantifiable, reproducible insights, thereby reducing uncertainty and aligning business actions with observed realities (Oghazi et al., 2024; Provost & Fawcett, 2013). The rapid growth of digital technologies has led to the generation, collection, and storage of vast amounts of data within firm and government repositories (Harrison et al., 2012; Magalhaes & Roseira, 2020). Existing research indicates that open data could generate over three trillion dollars in additional global value across various industries in the coming years (Kazantsev et al., 2023).

This paradigmatic shift has fundamentally transformed how organizations conceptualize and leverage their data assets, enabling enterprises to recognize data not merely as an operational tool but as a strategic asset with high commercial value that can be monetized and shared across organizational and industry boundaries (Kühne & Böhmann, 2019; Sjödin et al., 2020). The evolution toward data products has facilitated cross-organizational collaboration and cross-industry partnerships, where diverse data sources are combined to generate novel insights and innovative solutions, ultimately catalyzing substantial business model innovation through platform-mediated ecosystems (Ojala et al., 2021; Sjödin et al., 2020; Trabucchi & Buganza, 2022). This approach has enabled the development of collaborative data-sharing arrangements that transcend traditional industry silos, creating new mechanisms for value creation and capture while fostering innovation ecosystems that leverage shared data resources for competitive advantage (Haki et al., 2024).

In an era where data is a strategic asset, data exchange enables firms to leverage collective insights that could not be achieved independently. This collaborative approach drives efficiency and competitive advantage and encourages the creation of novel products, services, and revenue streams (Chen et al., 2014; Oghazi et al., 2012).

2.2. Data as a central strategic resource

Unlike conventional resources such as physical assets, human capital, or financial resources, data exhibits unique characteristics that make it particularly valuable for sustaining competitive advantage in the digital economy (Mayer-Schönberger & Cukier, 2013; Veldkamp, 2023).

The strategic importance of data stems from several properties that differentiate it from traditional resources. First, data demonstrates network effects, where its value increases exponentially with the volume and variety of information collected (Brynjolfsson et al., 2019). This can create powerful positive feedback loops where organizations with larger datasets can generate superior insights, leading to better products and services, which in turn attract more users and generate additional data (Zhu & Iansiti, 2012). Second, data exhibits what economists call "non-rivalrous consumption." Data can be used simultaneously across multiple applications without being exhausted, unlike physical resources that are consumed in the production process (Jones & Tonetti, 2020).

Data's value is enhanced through aggregation and analysis rather than direct consumption. Raw data alone provides limited strategic benefit; it is the organization's capability to collect, process, analyze, and derive actionable insights from data that creates competitive advantage (Davenport, 2014; McAfee & Brynjolfsson, 2012). This is notable in organizational strategies, which place greater emphasis on data and increasingly adopt multistage data management methodologies, such as the "Medallion architecture," which suggests organizing data into three distinct progressive layers: bronze (raw data), silver (cleansed and validated data), and gold (enriched data). Medallion architecture is a layered data architecture that segments data into progressively refined stages, enabling incremental improvements in data quality, governance, and usability as data moves from raw ingestion to analytics-ready datasets.

A simple example can be described through an e-commerce business that collects data from multiple sources, such as customer transactions, website interactions, mobile applications, and external platforms. At the bronze layer, data is stored in its raw format, such as files or data strings, and may be ingested in real time or near-real time. This layer primarily supports data engineering activities, including data ingestion and storage. At the silver layer, the raw data are cleaned, standardized, and transformed into conformed tables. These datasets are processed on an hourly or daily basis and provide a structured foundation for data scientists and analysts to conduct analysis and develop data-driven applications. At the gold layer, the processed data are further aggregated and organized into star schemas or data marts, which are typically refreshed according to predefined schedules or event-based triggers. This layer serves a broader range of business and analytical applications, including business intelligence dashboards, machine learning and AI models, executive decision-making, and personalized customer communications. It also feeds

into data-sharing mechanisms through which selected datasets or insights are made available to external partners.

This transformation of data into strategic insights requires sophisticated technological infrastructure and organizational and analytical capabilities that are difficult, resource-intensive, and time-intensive for competitors to replicate quickly (Davenport & Harris, 2017; Runkler, 2020).

This dissertation positions data as a fundamental strategic resource, transcending its traditional conceptualization as a mere operational by-product of digital systems. Drawing on the resource-based view (RBV) of the firm (Barney, 1991), the knowledge-based view of the firm (Curado & Bontis, 2006), and dynamic capabilities (Teece, 2007, 2018), data is conceptualized as a valuable, rare, and difficult-to-imitate resource that can provide sustained competitive advantage. However, unlike traditional physical or financial assets, data exhibits unique characteristics, including non-rivalry, network effects, and value co-creation or combinatorial value creation (Autio & Thomas, 2020; Parker et al., 2016).

Contemporary scholarship has also increasingly recognized data as a strategic asset whose value emerges through governance, mobilization, and recombination across organizational boundaries (Constantiou & Kallinikos, 2015; Kretschmer et al., 2022).

In addition, researchers have emphasized the need for companies and organizations to develop strategies and frameworks, commonly referred to as "data strategies," that promote data quality, diversity, and privacy, thereby addressing the challenges associated with data use across various applications (Aldoseri et al., 2023).

This perspective aligns with an extended resource-based view, in which the strategic value of data lies not in its mere possession but in the organizational capabilities and services it enables when combined with analytical competencies, governance mechanisms, and interorganizational knowledge (Mikalef et al., 2020; Wamba et al., 2017).

This suggests a relational and ecosystem-oriented view of data value creation potentials. Data generates strategic value through circulation, sharing, and coordination among multiple ecosystem actors rather than through isolated firm-level exploitation (Adner, 2017; Jacobides et al., 2018). This conceptualization positions data as both a coordination mechanism and a shared resource whose strategic relevance is fundamentally tied to interorganizational arrangements and ecosystem participation (Wareham et al., 2014; Yahyapour & Oghazi, 2025).

2.3. Digital transformation as an enabling process

Existing digital innovation theory shows that digital technologies differ from earlier technologies because they are generative, modular, scalable, and embedded in platforms and infrastructures. Nambisan (2017) argues that digital technologies reshape entrepreneurial and innovation processes by changing the nature of artifacts, agency, boundaries, and outcomes.

Digital transformation has become a central concern for firms across industries as digital technologies, data, and analytics increasingly shape competitive dynamics and value creation (Vial, 2019). Organizations invest heavily in digital infrastructures (Wang et al., 2025; Webber et al., 2022) and initiatives with the expectation that such efforts will increase their competitiveness (Santoso et al., 2024), enable business model innovation (BMI), and support growth opportunities (Gigova et al., 2019; Kane et al., 2015). Despite these investments, however, empirical evidence consistently points to uneven and frequently disappointing transformation outcomes (Kempeneer & Heylen, 2023; Westerman et al., 2014), with many firms struggling to translate digital initiatives into lasting strategic benefits (Irani et al., 2023; Vial, 2019; Warner & Wäger, 2019). This persistent gap between ambition and outcome has motivated a rapidly expanding body of research seeking to explain how digital transformation unfolds and why its effects vary so substantially across organizations and contexts.

Digital transformation is conceptualized in this dissertation as a comprehensive, multidimensional organizational phenomenon that transcends technological adoption to encompass fundamental changes in organizational structures, processes, capabilities, and strategic orientation (Verhoef et al., 2021; Vial, 2019). Rather than viewing digital transformation as a singular technological intervention, this dissertation takes a holistic perspective that recognizes digital transformation as an integrative process involving organizational culture, leadership paradigms, governance strategies, and capability development (Chirumalla et al., 2025; Fitzgerald et al., 2014; Kane et al., 2015; Matt et al., 2015).

The strategic significance of digital transformation lies in its capacity to create the organizational conditions, readiness, and capabilities necessary for the effective mobilization of data as a strategic resource (Bharadwaj et al., 2013). Digital transformation enables organizations to develop sophisticated data governance frameworks, build advanced analytical capabilities, and facilitate cross-functional and cross-boundary data integration that would be difficult or costly to achieve, and in some cases impossible, within traditional organizational structures (Mikalef et al., 2020).

However, digital transformation alone does not automatically generate competitive advantage or organizational value creation (Sebastian et al., 2017; Westerman et al., 2014). The strategic impact of digital transformation materializes only when it is systematically aligned with initiatives such as business model innovation and strategic ecosystem participation, creating synergistic effects that amplify the value potential of digital investments (Hanelt et al., 2021; Parviainen et al., 2017).

2.4. Ecosystem concept

The concept of ecosystems (Moore, 1993) has evolved significantly over recent decades, building on ecosystem articulation across various research domains. Moore (1996) describes business ecosystems as economic communities responsible for

creating valuable products and services for customers, thriving on interaction among various organizations and individuals constituting vital components of the business world. These economic communities encompass suppliers, primary producers, competitors, and various stakeholders who collectively develop capabilities and adapt roles, often aligning with directions established by central companies.

In business and management studies, the ecosystem approach emerged in response to strategic shifts in which companies increasingly adopted ecosystem strategies. Globalization and digital technologies, particularly the sharing economy, opened new collaborative opportunities across industries, creating networks of organizations, businesses, technologies, and resources that collectively enhance value generation for ecosystem actors (Parente et al., 2018; Richter et al., 2015; Szaro et al., 1998; Tsujimoto et al., 2018).

The ecosystem approach replaced previous debates about strategic alliances and business networks, offering a more comprehensive framework for understanding how businesses co-evolve, cooperate, collaborate, and compete in innovation development within an increasingly competitive landscape (Moore, 1993; Szaro, 1998).

Several overlapping concepts highlight ecosystems within management and business studies, including business ecosystems, platform ecosystems (Autio, 2022), knowledge ecosystems (Attman & Cohen, 2022), entrepreneurial ecosystems (Alvedalen & Boschma, 2017), industry ecosystems (Burström et al., 2024), innovation ecosystems (Autio, 2022; Granstrand & Holgersson, 2020), and emerging denominations such as data ecosystems (Oliveira & Lóscio, 2018; Sepúlveda, 2023). While these concepts differ, they share common theoretical foundations such as collaboration, orchestration, interdependence, mutual benefit generation, innovation creation, value capture, and value proposition through strategic collaboration strategies.

Innovation ecosystems are opportunity-driven and emphasize the generation of innovation that enhances value creation and capture among ecosystem members (Autio & Thomas, 2020; Burström et al., 2024; Stonig & Muller-Stewens, 2019). Innovation ecosystems, sometimes used interchangeably with business ecosystems (Autio & Thomas, 2014; Dedehayir et al., 2018; Jacobides et al., 2018), are defined by Adner (2017, p. 42) as *"…the alignment structure of the multilateral set of partners that need to interact for a focal value proposition to materialize."* These networks of interconnected actors collaboratively propose and create value, translating new ideas into practical applications.

Throughout this dissertation, the term "ecosystem" specifically refers to innovation ecosystems that fundamentally utilize data as both a driving force and an operational mechanism for innovation, and which may also be designated as "data ecosystem." Therefore, when ecosystem terminology appears in this research, it should be understood within this data-centric context rather than broader ecological or business ecosystem frameworks.

Data ecosystems represent specialized innovation networks where data serves dual purposes: acting as a catalyst that initiates and accelerates innovative activities while

simultaneously functioning as the primary mechanism through which innovation is created, executed, and delivered (Oliveira & Lóscio, 2018; Runeson et al., 2021). This distinction is crucial for understanding the scope and analytical boundaries of this research, as it focuses exclusively on ecosystems where data is not only a supporting element but rather the central organizing principle around which innovation activities revolve.

2.5. Business model innovation in data-centric contexts

Business model innovation constitutes the primary theoretical mechanism through which organizational strategies and technological investments are translated into tangible economic value (Teece, 2010; Zott et al., 2011). To understand business model innovation, it is first necessary to define the business model itself. Building on the activity system perspective, a business model is conceptualized as a complex configuration of interdependent organizational activities that collectively define how a firm creates, delivers, and captures value (Amit & Zott, 2001; Zott & Amit, 2010). This perspective moves beyond traditional product-market positioning and emphasizes the firm's cross-boundary architecture of transactions (Massa et al., 2017).

Within this lens, business model innovation is defined not just as the introduction of a new product or service, but also the deliberate systemic reconfiguration of underlying activity system components (Foss & Saebi, 2017). It involves altering what activities are performed, how they are linked, who performs them, and the underlying governance mechanisms that manage these relationships (Amit & Zott, 2012). In data-driven settings, business model innovation undergoes a fundamental qualitative shift. Data-driven business model innovation involves rearchitecting the firm's value creation logic to incorporate continuous data flows, advanced predictive analytics, and data-based interactions (Gawer, 2014; Loebbecke & Picot, 2015).

This transformation significantly affects all three dimensions of the business model. Value creation is enhanced through data-enabled personalization, real-time insights, predictive capabilities, and new digital services (Bresciani et al., 2021; Toorajipour et al., 2024). Value delivery is optimized through algorithmic decision-making, automated processes, and digital channels that allow for real-time customer engagement (Verhoef et al., 2021). Finally, value capture mechanisms are reimagined, moving away from traditional one-off product sales toward subscription models, data monetization, and performance-based contracting (Teece, 2018; Trabucchi & Buganza, 2019).

Several recent scholarly works have studied business model innovation within data contexts and data ecosystems, focusing on factors such as the capability to create value through data exchange and revenue-sharing models (D'Hauwers et al., 2022). Others have identified dimensions such as control and customization in shaping business model archetypes within AIoT-based data ecosystems (Toorajipour et al., 2024), while studies on digitalization-driven retail business model innovation, have

explored value creation, delivery, and capture mechanisms (Mostaghel et al., 2022). Recent studies have also begun to connect data strategy to business strategy (Baecker et al., 2025), customer value (Grassi et al., 2022), and business models (Berentzen & Schaefer, 2023), yet they fall short of addressing how data strategy specifically contributes to business model innovation, an area that remains largely underexplored. In addition, attempts have also been made to define frameworks for digital sustainable business models, emphasizing elements such as platform development (Palmié et al., 2025). Although these studies acknowledge data as a key factor, most do not explore the data dimensions and the strategies surrounding its management and utilization.

For example, they mention real-time insights and digital add-ons (Toorajipour et al., 2024), data-driven insights and enhanced omnichannel customer interactions (Mostaghel et al., 2022), or data sharing through platforms for data exchange (D'Hauwers et al., 2022). However, they mostly assume access to clean, aggregated, pipelined, and enriched real-time data on various data management systems and platforms. Achieving such outcomes demands a data strategy that is strong in both conceptual design and operational execution. Such a strategy must be holistically integrated with the dimensions identified in prior research, ensuring that data initiatives are not treated in isolation but are instead embedded as a core element of the firm's overall strategy, allowing for seamless integration of data assets into the firm's processes of value capture, creation, and delivery.

2.6. The growth of the firm: classical, neoclassical, and modern perspectives

Understanding how firms create growth opportunities through data-driven strategies requires integrating classical economic theory, neoclassical perspectives, and modern strategic management approaches. The theoretical foundation builds upon Penrose's (2009) work, which conceptualized the firm as an administrative organization whose growth is driven not by resources themselves but by the productive services these resources can render when effectively coordinated by managerial capabilities (Kor & Mahoney, 2004; Penrose, 2009). Growth emerges from management's ability to identify new productive opportunities and recombine existing resources in novel ways, creating "unused productive services" (Rugman & Verbeke, 2002).

If Penrose's logic is to be applied to data-driven contexts, "data strategy" can be conceptualized as a novel form of managerial service. Firms grow through their capacity to develop analytical capabilities, implement data governance frameworks, and orchestrate ecosystem relationships that enable productive participation in data-sharing networks (Mikalef et al., 2020). Penrose's (2009) concept of "unused productive services" translates into data assets, where growth occurs when management transforms these assets into dynamic value-creation mechanisms (Davenport & Ronanki, 2018).

Classical growth models and frameworks emphasize equilibrium, diminishing returns, and factor accumulation as growth drivers. However, these approaches are inadequate for explaining digital growth dynamics, failing to account, for example, for the reusable nature of data assets (Brynjolfsson et al., 2019). Data itself does not create growth simply because it exists within the firm. Growth opportunities arise when managers identify unused productive potential in data, organize the capabilities needed to mobilize it, and recombine it with ecosystem resources and business model design. In this sense, data strategy functions as a novel form of managerial service: it transforms latent data resources into realized growth opportunities through deliberate sensing, coordination, and reconfiguration. This extension of Penrose moves beyond metaphor by treating data not as an automatically valuable asset, but as a resource whose productivity depends fundamentally on managerial imagination and organizational action.

Neoclassical and modern strategic management theory offers a contemporary lens for explaining this phenomenon. The resource-based view (RBV) explains competitive advantage through valuable, rare, inimitable, and non-substitutable resources (Barney, 1991), where proprietary datasets and analytical capabilities constitute strategic assets (Brynjolfsson & McAfee, 2014). However, the dynamic capabilities framework offers a more suitable lens for explaining firm adaptation and transformation in digital environments (Teece et al., 1997). Dynamic capabilities represent a firm's ability to "*… integrate, build, and reconfigure internal and external competences to address rapidly changing environments*" (Teece et al., 1997, p. 516). Teece's (2007) framework identifies three foundational capabilities: "sensing" opportunities, "seizing" them through strategic investments, and reconfiguring or transforming resources and functional competences to match and align with successful digital transformations observed across industries. Ultimately, these capability-driven processes can materialize through business model innovation, which serves as the strategic mechanism that helps translate latent data capabilities into sustained competitive advantage (Amit & Zott, 2012; Teece, 2010).

2.7. Theoretical position of the dissertation

This dissertation is positioned at the intersection of two principal theoretical perspectives: business model innovation and ecosystem theory. Data is treated as the central strategic and organizing concept that connects the two perspectives (Figure 1). Rather than adopting a firm-centric or technology-deterministic stance, the dissertation approaches data as a sociotechnical concept that simultaneously affects organizational practices and interorganizational relations. Data is central to this concept, but not as a purely technical input. Data is understood as a strategic resource whose value depends on how it is collected, governed, integrated into strategy, and embedded in business model configurations. This distinguishes a data-centric view from a data-driven view. While a data-driven view emphasizes using data for analysis

and decision-making, a data-centric view places data at the core of strategic, organizational, and ecosystem transformation.

Within the business model innovation literature, the dissertation aligns with perspectives that view business models as evolving activity systems (Zott & Amit, 2010), while foregrounding data as a central structuring logic influencing value creation, delivery, and capture over time by influencing all design elements and themes of the business model. This position builds on the view of business models as evolving activity systems for value creation and capture (Zott & Amit, 2010).

The dissertation distinguishes between intraorganizational and interorganizational dimensions of business model innovation. The intraorganizational dimension concerns changes to activities, processes, capabilities, offerings, and revenue mechanisms within the firm. The interorganizational dimension concerns business model changes that depend on data exchanges, partnerships and complementary activities extending beyond the firm.

These dimensions are analytically distinct but closely connected. Firms often need internal capabilities and governance arrangements before they can participate effectively in wider data ecosystems. Conversely, ecosystem participation can expose firms to new resources, partners, and value-creation opportunities that stimulate further internal business model change.

From an ecosystem perspective, this dissertation adopts a relational view of data ecosystems where data serves as the primary innovation catalyst. Ecosystem theory complements the business model perspective by directing attention to interdependence among actors. In data-intensive settings, value is rarely created by a single firm acting independently. It emerges through relationships among firms, customers, technology providers, public organizations, and other stakeholders.

Data ecosystems are conceptualized as dynamic sociotechnical configurations comprising four interdependent subsystems: stakeholders, infrastructure, governance mechanisms, and data assets. Strategic value emerges not from individual components but from how these elements are connected and coordinated (Autio & Thomas, 2020).

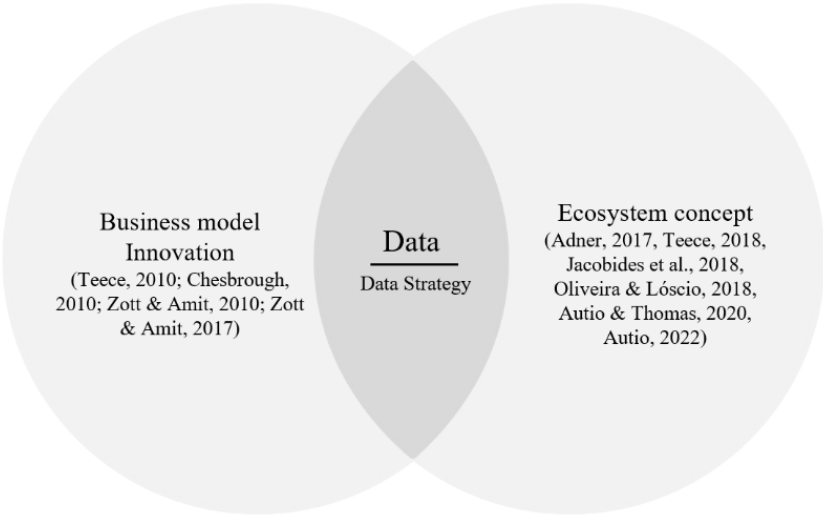

Figure 1. Theoretical position of the dissertation

Business model innovation and ecosystem theories consequently serve complementary explanatory roles and, together, provide the principal theoretical architecture of the dissertation. Digital transformation, digital readiness, the resource-based view, dynamic capabilities, and firm-growth theory remain relevant but have supporting roles. Digital transformation and readiness describe conditions that may enable firms to work strategically with data. The resource-based view explains why data, digital infrastructure, and digital capabilities may become strategically valuable. Dynamic capabilities theory adds how firms sense digital opportunities, seize them through strategic action, and reconfigure organizational and ecosystem arrangements over time. Penrose's theory of firm growth further supports the explanation that data resources can contribute to creating growth opportunities only when managerial services identify productive opportunities and transform latent resources into scalable business activities. The contribution of this dissertation is to connect these perspectives into a coherent pathway.

3. Methodology, material and methods

3.1. Overall research design

The overall methodological approach of this dissertation is designed to address the overarching research question articulated in the introduction: how data-centric business model innovation is formed, and how it fits within firms and business ecosystems, with the aim of creating growth opportunities.

Because this phenomenon is multidimensional, emergent, and situated across organizational and ecosystem levels, the dissertation adopts a cumulative, multi-method research design. Such designs are appropriate when the aim is not hypothesis testing but conceptual clarification, theory development, and analytical integration across multiple sources of evidence (Eisenhardt, 1989; Eisenhardt & Graebner, 2007; Yin, 2018). The purpose of this design is not to test a single predefined hypothesis but to develop conceptual clarity, synthesize insights across articles, and build an integrative framework that explains how digital transformation, data strategy, business model innovation, and ecosystem participation are connected.

The dissertation is structured around two related but analytically distinct tracks. The first track focuses on intra- and interorganizational business model innovation. It draws mainly on Articles 1 to 4 and explains how firms develop digital readiness, transform data into a strategic capability, and engage in ecosystem collaboration to enable business model innovation. This track's output is an integrative framework and forms the core basis of the dissertation.

The second track provides a regional and country-level contextual extension. It draws on Article 5 plus some additional publicly available datasets and examines how selected Eastern European and Baltic region economies differ in digital-readiness conditions that may support or constrain the scalability and contextual relevance of data-centric business model innovation. The second track does not replace the firm-level analysis. Instead, it situates the firm-level framework within broader regional conditions such as infrastructure, technology, skills, and economic growth indicators.

This distinction is important because the dissertation combines articles with different units of analysis. Articles 1 to 4 primarily inform the development of a firm- and ecosystem-level framework, while the second track examines country-level conditions that shape the broader environment in which such innovation may take place. The methodological design therefore treats Article 5 as a contextual extension rather than as a direct continuation of the same empirical unit of analysis.

3.2. Research logic and methodological positioning

The dissertation follows an abductive research logic. Abduction is understood here as an iterative movement between existing theory, empirical findings, and conceptual development. Rather than beginning with fixed hypotheses or relying only on inductive discovery, the research process developed through repeated comparison between theoretical concepts, article-level findings, and the emerging framework (Andrade, 2023). This approach is particularly useful when existing theory provides partial guidance but does not yet fully explain the phenomenon under study (Dubois & Gadde, 2002; Timmermans & Tavory, 2012). In this dissertation, abduction supports the progressive refinement of the framework by moving between prior literature, article-level findings, and the synthesis developed in the kappa (Walton, 2014).

Existing literature provides important starting points on digital transformation, business model innovation, data-driven value creation, ecosystems, and organizational capabilities. However, these streams do not yet fully explain how data becomes a central strategic and organizing resource for business model innovation across firm and ecosystem boundaries. The dissertation therefore uses abductive reasoning to connect existing theoretical insights with the findings of the appended articles and to refine its proposed framework progressively.

This dissertation is based on an interpretive orientation. This means that the study treats digital transformation, data strategy, business model innovation, and ecosystem collaboration as socially and organizationally embedded phenomena. These phenomena are shaped by managerial interpretations, organizational practices, technological infrastructures, governance arrangements, and interorganizational relationships. The purpose is therefore to understand meanings, mechanisms, relationships, and processes in complex organizational settings rather than to isolate variables in a purely causal or predictive model (Klein & Myers, 1999; Walsham, 1995).

3.3. Unit of analysis

The dissertation uses different units of analysis across its two tracks, and these are explicitly separated to avoid methodological ambiguity.

The primary unit of analysis in the first track (Articles 1 to 4) is the firm in relation to its ecosystem. Article 1 focuses on organizational digital transformation readiness, particularly in manufacturing firms. Articles 2 and 3 extend the analysis beyond the individual firm by examining ecosystem orchestration and data ecosystems. Article 4 returns to the firm as a strategic actor but emphasizes how data strategy and business model innovation are connected. Together, these articles explain how firms move from internal digital transformation toward ecosystem-enabled business model innovation.

The second track uses a different unit of analysis: the country or regional context. Its purpose is not to explain firm-level transformation directly but to examine the broader regional readiness conditions that may influence whether data-centric

business model innovation can scale across selected Eastern European and Baltic region economies, with support from Article 5 and some additional datasets. This includes indicators related to digital infrastructure, connectivity, analytical capacity, and broader economic conditions. Article 5 therefore functions as a contextual extension that complements the firm-level framework by asking how regional conditions may enable or constrain its applicability.

By separating these two analytical levels, the dissertation avoids conflating firm-level mechanisms with country-level conditions. The firm-level articles explain how data-centric business model innovation may unfold within and across organizations. The regional analysis examines whether the surrounding environment provides conditions that make such innovation scalable.

3.4. Methodological contribution of the articles

Each article contributes a distinct methodological and conceptual role to the dissertation.

Article 1 uses a systematic literature review and practitioner-oriented empirical input to identify key factors influencing digital transformation outcomes. Its methodological role is to establish digital transformation readiness as a foundational condition for later data-centric business model innovation. The article contributes to the dissertation by identifying digital readiness-related dimensions such as awareness, readiness, technology relevance, and operations.

Article 2 uses qualitative ecosystem investigation to examine mobility-as-a-service innovation. Its methodological role is to show how data sharing can reshape coordination, value creation, and actor roles within an ecosystem. The article contributes to the dissertation by demonstrating that data is not only an internal organizational resource but also a mechanism for ecosystem-level coordination and orchestration.

Article 3 develops a conceptual understanding of data ecosystems as sociotechnical configurations. Its methodological role is to clarify the components of data ecosystems, including stakeholders, infrastructure, data, and governance. This article contributes to the dissertation by providing the ecosystem-level foundation needed to understand how elements such as coordinated data sharing supports intra- and interorganizational value creation.

Article 4 uses qualitative multiple source-based analysis to connect data strategy with business model innovation. Its methodological role is to explain how data strategy connects digital readiness to business model innovation and the creation of growth opportunities. This article contributes to the dissertation by showing that data strategy involves more than technology choices. It includes architecture, governance, standards, data management platforms, skills, leadership, investment priorities, and partnership decisions.

Article 5 uses publicly available country-level documents and statistics to study regional digital readiness conditions in selected Eastern European and Baltic region

economies. Its methodological role is to contextualize the firm-level framework by identifying broader conditions that may affect the scalability and relevance of data-centric business model innovation. Because this article operates at a different level of analysis, its findings are interpreted as a regional extension rather than as direct evidence of firm -level business model innovation.

3.5. Integration across the articles

As mentioned in the previous section, the dissertation kappa synthesizes the articles through an abductive and cumulative logic. The proposed framework is not derived from a single article, nor is it presented as an isolated conceptual artifact. Instead, it is built by identifying how the articles contribute different components to the overall explanation of data-centric business model innovation.

The synthesis follows four steps. First, the main constructs from each article are identified. Second, overlapping and complementary constructs are compared across articles. Third, relationships among constructs are inferred from the article findings and relevant theoretical literature. Fourth, the framework, as the core basis and main output of the dissertation's first track, is presented as an integrative explanation of the pathway from digital readiness to data-centric business model innovation, while recognizing that alternative entry points and iterative loops exist. This stepwise synthesis is intended to make the framework transparent and defensible. It also responds to the need for a clearer evidence chain from articles to constructs, from constructs to framework components, and from framework components to the relationships represented in the framework. Together, these articles support a framework that explains how firms may progress from digital transformation readiness to strategic data capability, ecosystem participation and business model innovation, with the aim to create growth opportunities.

Table 1 summarizes how the five articles collectively address the dissertation's three research questions. The table shows that Articles 1, 3, and 4 primarily develop the firm- and strategy-level explanation of data-centric business model innovation. Articles 2 and 3 provide the main ecosystem-level contribution, and Article 5, with support from additional datasets, extends the dissertation by explaining how regional digital readiness conditions shape scalability and contextual relevance. Later, in Section 3.7, a more detailed overview of the specific methodological approaches and research methods employed across the appended articles is provided.

Article	Article focus	**RQ1:** What components, and relationships explain how firms progress toward data-centric business model innovation?	**RQ2:** What new ecosystem collaborative arrangements emerge when data becomes a central value driver for business model innovation?	**RQ3:** How do regional digital-readiness conditions in selected Eastern European and Baltic region economies shape the scalability and contextual relevance of data-centric business model innovation?
Article 1	Digital transformation readiness in manufacturing industry	**Primary** – develops the readiness logic and explains how organizational digital transformation capabilities form the basis for later data-centric innovation.	**Limited** – mainly firm-level but provides the internal readiness foundation needed for ecosystem participation.	**Limited** – contextual relevance is implied through sectoral transformation conditions rather than directly analysed.
Article 2	Mobility-as-a-service ecosystem orchestration	**Secondary** – shows how internal digital readiness extends into inter-organizational coordination through data-enabled services.	**Primary** – explains collaborative ecosystem arrangements and temporary orchestration roles enabled by data sharing.	**Secondary** – indicates that ecosystem maturity and contextual conditions affect scalability.
Article 3	Data ecosystems as socio-technical systems	**Primary** – conceptualizes the structural components linking data, infrastructure, stakeholders and governance subsystems.	**Primary** – directly theorizes data ecosystems as collaborative arrangements for value creation.	**Secondary** – provides concepts for understanding how data attributes, infrastructure and governance differences may affect shape regional scalability.
Article 4	Data strategy and business model innovation	**Primary** – explains how data strategy translates digital transformation into business model innovation.	**Primary** – shows how business model innovation increasingly depends on ecosystem relationships, and partner alignments.	**Secondary** – suggests that contextual and regional readiness affects data-driven business model scalability.
Article 5 + Additional datasets	Regional digital readiness in Eastern Europe and the Baltic region	**Secondary** – situates firm-level transformation within broader readiness conditions.	**Secondary** – shows how regional infrastructure, can facilitate ecosystem development and collaboration.	**Primary** – Analyses how regional digital-readiness conditions can influence scalability and contextual relevance of data-centric business model innovation.

Table 1. Article's contribution to the research questions

3.6. Role of theory

Theory is used in this dissertation as a foundation for interpretation and synthesis rather than as a rigid coding scheme applied uniformly across all articles. The dissertation draws on literature on digital transformation, business model innovation, ecosystems, data-driven innovation, and organizational capabilities to establish what is already known and to position the contribution of the dissertation.

The use of theories such as the resource-based view, dynamic capabilities, and the theory of the growth of the firm is treated carefully. The dissertation does not claim to conduct a full resource-based or dynamic capabilities analysis. Where such theories are used, they serve as sensitizing theoretical lenses that help interpret how data becomes a strategic capability and why firms reconfigure data resources and relationships to enable data-centric business model innovation.

This positioning avoids overclaiming theoretical application. It also clarifies that the dissertation's main theoretical contribution lies in integrating data-centricity into business model innovation and ecosystem collaboration.

3.7. Article-specific methodological approaches

This section provides a comprehensive overview of the specific methodological approaches and research methods employed across the appended articles. Each article adopts distinct research designs tailored to address its specific research questions and theoretical objectives, collectively contributing to a multi-method, triangulated understanding of the dissertation's themes.

The methodological diversity across the articles reflects the complexity of the research phenomenon and the need to capture both micro-level organizational processes and macro-level ecosystem dynamics. By combining qualitative case studies, systematic literature reviews, conceptual modeling, empirical field research, and quantitative analysis, the dissertation ensures methodological rigor while maintaining contextual depth and theoretical richness (Eisenhardt & Graebner, 2007; Yin, 2018).

3.7.1. Article 1: *Critical factors affecting digital transformation in manufacturing companies*

- **Research design:** Systematic Literature Review (SLR) combined with expert survey.

  Article 1 employs a two-phase methodological approach to investigate digital transformation in manufacturing firms. The study begins with a systematic literature review (SLR) that follows a structured and transparent protocol to identify, screen, and synthesize prior research, explicitly addressing fragmentation and inconsistency in the digital transformation literature (Denyer & Tranfield, 2009; Tranfield et al., 2003). This rigorous approach ensures compre-

hensiveness and provides a theoretical foundation for identifying critical digital transformation factors.

- **Data collection:** The SLR phase systematically searched major academic databases (Web of Science and Scopus) using predefined search strings related to digital transformation. Articles were screened through multiple stages (title, abstract, and full-text review) based on explicit inclusion and exclusion criteria, yielding a final corpus of 22 peer-reviewed articles published between 2005 and 2021.

  The subsequent expert survey phase complemented the literature review by incorporating practitioner perspectives from 27 senior executives, industry experts, and digital transformation leaders in manufacturing firms. Experts were selected through purposive sampling based on their experience with digital transformation initiatives, ensuring diversity across firm sizes and industries. Survey instruments included structured questions derived from the SLR findings, enabling validation and contextualization of the identified factors and proposed ARTO model.

- **Data analysis:** The SLR data were analyzed using content analysis techniques, pattern matching, and thematic synthesis to extract, code, and categorize digital transformation factors identified across the literature. Coding reliability was ensured through independent review by multiple researchers and iterative refinement of coding schemes. The expert survey data were analyzed using descriptive statistics and thematic coding to identify convergence and divergence between academic literature and practitioner insights.

  The integration of both data sources enabled the construction of the ARTO model (Awareness, Readiness, Technology selection and relevance, Operations), which represents an analytically informed synthesis rather than a statistically generalizable model. The ARTO framework systematically organizes critical factors influencing digital transformation outcomes across four interrelated dimensions.

  Methodologically, Article 1 serves two critical purposes within the broader dissertation framework:

- **Establishing contextual foundations:** It positions digital transformation as an enabling context and necessary organizational foundation rather than the primary explanatory variable for business model innovation. This clarifies that digital transformation creates organizational readiness but does not, by itself, generate competitive advantage or sustained growth (Verhoef et al., 2021; Vial, 2019).
- **Identifying theoretical gaps:** The analysis reveals the limited conceptualization of data as a strategic resource in existing digital transformation research, where

data typically appears as one factor among many rather than a central strategic driver. This finding directly motivates the subsequent studies' explicit focus on data strategy, data ecosystems, and data-centric business model innovation as the primary mechanisms through which digital investments could be translated into growth opportunities for firms.

3.7.2. Article 2: *Orchestrating an ecosystem touring approach: United data and mobility as a service*

- **Research design:** Qualitative multiple-case study analysis, complemented by a multivocal literature review (MLR) of secondary data.
  Article 2 employs a multiple-case study approach focusing on five MaaS use cases that fulfill three criteria: innovation, driven ecosystems, utilizing data platforms, and following innovative smart city initiatives. This approach enables in-depth exploration of orchestration dynamics while considering contextual factors across different settings, achieving a multidimensional understanding of ecosystem coordination mechanisms (Eisenhardt & Graebner, 2007; Yin, 2018).

  The case selection involved screening 21 MaaS schemes worldwide, including pilots, conceptual models, and operational cases, identified through a focused literature review. Cases were then categorized into five distinct types based on orchestration mechanisms. One representative case from each category was selected for in-depth analysis, ensuring comparative breadth while maintaining analytical depth and excluding cases with similar orchestration mechanisms.
- **Data collection:** The study employs a multivocal literature review (MLR) encompassing peer-reviewed articles and grey literature (white papers, websites, and press releases), recognizing that MaaS represents a novel innovation where internet-based secondary data offers extensive value (Benzies et al., 2006). A literature search was conducted across Google Scholar, Scopus, and Web of Science databases, using a two-round strategy to minimize the risk of overlooking relevant results. Sources from 2013 onward were included, excluding duplications, non-open-access, and non-English results. Titles and abstracts were reviewed to exclude purely technical studies, focusing on sources addressing MaaS ecosystems or architecture from business and organizational perspectives.
- **Data analysis:** Analysis proceeded through systematic within-case and cross-case comparison (Eisenhardt, 1989). Each case was analyzed individually to understand orchestration logic, data-sharing mechanisms, actor roles, and governance structures. Cross-case analysis identified recurring patterns, divergent mechanisms, and contextual contingencies.

Through comparative analysis, the study develops the concept of "touring orchestration," demonstrating how the pivotal ecosystem leadership role can be decentralized, temporary, and enabled through data governance and accessibility, rather than hierarchical authority. The Analysis reveals that data can function as a critical coordination mechanism, enabling alignment among heterogeneous participants without centralized control, while demonstrating how different forms of data sharing, such as data-as-a-service models, can enhance value propositions.

Methodologically, article 2 contributes to the current dissertation by: (1) providing an empirical basis for ecosystem-level analysis through rich contextual evidence of interorganizational dynamics; and (2) demonstrating data as an active coordination element rather than only an input or output.

3.73. Article 3: *Understanding Data Ecosystems: Conceptual Foundations of the Phenomenon*

- **Research design:** Mixed-method approach combining systematic literature review and exploratory multiple-case study.

  Article 3 employs a multi-method research design that integrates two complementary approaches: a systematic literature review and an in-depth exploratory multiple-case study (Hunter & Brewer, 2015; Sarker et al., 2025). This methodological strategy addresses two key research questions: (1) identifying the components of data ecosystems through literature synthesis and (2) exploring the interrelations between these subsystems through empirical investigation.
- **Data collection:** Data collection consisted of two complementary components. First, a systematic literature review was conducted across Scopus, Web of Science, IEEE Xplore and AIS eLibrary. Second, the empirical component involved an in-depth multiple-case study focusing on data ecosystems enabled by IoT, 5G, and AI technologies. Primary data were collected through semi-structured interviews with 25 industry experts selected from diverse stakeholder groups within technology-intensive data ecosystems, including technology platform providers, data infrastructure managers, IoT and AI technology specialists, and business strategy leaders in data ecosystem domains. The interviews lasted between 30 to 125 minutes and explored themes related to data ecosystem subsystem interactions.
- **Data analysis:** The study employed an inductive thematic analysis following Braun and Clarke (2012), systematically coding both literature review and interview data to identify conceptual patterns and empirical insights. For the literature review, researchers coded text segments line-by-line, focusing on explicit statements about ecosystem components and moving beyond word

counting to capture implicit conceptual elements. Case study interview data were analyzed by employing pattern matching and thematic coding to validate the literature-derived framework and explore subsystem interactions. The analysis moved iteratively between theoretical propositions and empirical observations, identifying four foundational subsystems (infrastructure, stakeholders, data, and governance) and their dynamic interrelationships across different technological and organizational contexts. This multi-method approach enabled a comprehensive understanding of data ecosystems that bridged conceptual abstraction with practical empirical evidence, revealing the complex, contextual nature of ecosystem formation and functioning.

Article 3 bridges conceptual abstraction with empirical evidence, offering an understanding of data ecosystems that goes beyond single-method limitations. By combining a systematic literature review with expert interviews, the study develops a robust, multilayered framework for analyzing data ecosystem structures and interactions. The four-subsystem model (infrastructure, stakeholders, data, and governance) emerged as a key theoretical contribution, demonstrating how these elements dynamically interrelate in contemporary digital innovation contexts.

Article 3 contributes to the dissertation by refining ecosystem theory, demonstrating data's role as a strategic coordination mechanism, and providing a methodologically rigorous approach to analyzing how technological, organizational, and governance elements interrelate in contemporary innovation contexts. This conceptual development supports the dissertation's broader argument about data as a transformative strategic resource that enables new forms of value creation across organizational boundaries.

3.7.4. Article 4: *Driving growth through data strategy: Ecosystem pathways to business model innovation*

- **Research design:** Exploratory multiple-case study with longitudinal perspective.

  Article 4 utilizes an exploratory, multi-source research design to examine how ecosystem actors align data strategies to enable business model innovation across the automotive industry. The study employs comparative case analysis and process tracing to capture the dynamic evolution of data-driven strategic transformation.
- **Data collection:** The empirical foundation of Article 4 comprises a comprehensive, multi-source data collection strategy designed to capture the complexity of data-driven business model innovation in the automotive ecosystem. Semi-structured interviews were conducted with 23 key informants selected across different hierarchical levels and organizational roles, ensuring diverse perspectives from various ecosystem actors. These interviews were collected at

multiple time points throughout the research period, enabling the capture of evolving strategic narratives and organizational responses.

Complementing the interview data, researchers gathered 1,076 pages of industry association reports and documents tracked longitudinally. These documents were sourced from three leading industry associations with diverse business memberships, providing a macro-level perspective on sectoral trends and strategic transformations. The longitudinal document collection allowed for systematic tracking of industry-wide shifts in data strategy and business model approaches.

To further enrich the empirical foundation, the research incorporated ethnographic field observations from six international industry conferences, exhibitions, and seminars. These observations, conducted over a sustained period of engagement, provided real-time insights into emerging strategic discussions, technological developments, and ecosystem interactions that might not be captured through retrospective interview or documentary methods.

- **Data analysis:** The data analysis approach employed a multistage thematic analysis strategy that enabled deep exploration of the research phenomenon. Initially, Braun and Clarke's (2012) systematic thematic analysis procedure was utilized, involving repeated readings of the interview transcripts to develop comprehensive familiarity with the data. This was followed by a coding process that generated initial codes capturing meaningful text units, moving beyond surface-level descriptions to identify underlying patterns.

  The analysis proceeded using the Gioia method (Gioia et al., 2013), which facilitated the transformation of initial descriptive codes into higher-order analytical categories. This approach enabled the researchers to develop a structured yet flexible framework for understanding how data strategies can enable business model innovation. The documentary analysis employed a reflexive thematic analysis with a keyword-in-context approach, focusing specifically on segments related to data strategy, growth, and business model innovation.

  The field observation data also underwent a distinct yet complementary analytical process. Analytic memos from the six international events were systematically reviewed to identify emergent themes, temporal dynamics, and contextual details not captured in retrospective interview or documentary accounts. These observational insights were coded, focusing on capturing real-time market trends, interaction patterns, and strategic discourse around data.

  The abductive reasoning strategy allowed continuous, iterative movement among all three data sources and theoretical constructs. This approach supported the development of a three-layer strategic framework linking contextual conditions, internal capabilities, and business model activity system design (Zott & Amit, 2010).

Article 4 serves as the central contribution of the dissertation, providing a comprehensive synthesis that demonstrates how data strategy functions as a strategic mechanism for enabling business model innovation and driving firm growth. By developing a three-layer strategic framework linking contextual conditions, internal capabilities, and business model activity system design, the article offers a well-defined theoretical translation of how organizations can strategically leverage data across different contexts.

The article's primary contribution lies in establishing the critical link between data strategy and growth opportunities, by identifying the mechanisms through which data enables business model innovation. By synthesizing insights from previous articles into a pragmatic, actionable model, Article 4 provides empirical substantiation for the dissertation's overarching theoretical claim about data as a strategic resource. The three-layer framework emerges as a significant theoretical contribution, offering organizational leaders and researchers a structured approach to understanding strategic transformation in data-intensive environments, while simultaneously serving as the foundational bridge for the integrative theoretical claims advanced in the thesis.

3.7.5. Article 5: *Digital readiness in Eastern Europe and the Baltic rim: A comparative study*

- **Research design:** Comparative country-level analysis using methodological and theoretical triangulation.

  Article 5 utilizes a comparative research design to examine national-level digital readiness across five Eastern European and Baltic region countries. The study employs configurational analysis and temporal trajectory mapping to capture cross-country differences in digital readiness and catch-up dynamics.
- **Data collection:** The empirical foundation comprises a corpus of 55 documents from national authorities and international bodies such as the EU and OECD, statistical analysis based on EUROSTAT data, and eight interviews with managers in relevant industries in the countries studied.
- **Data analysis:** The analytical approach employs comparative and systematic document analysis rather than causal modeling, identifying patterns and divergences across national contexts without claiming deterministic relationships (Krippendorff, 2004; Stone, 2020). Collected data were analyzed using python programming language scripts, leading to the identification of categories that were subsequently validated and organized into five overarching categories (Birkenmaier et al., 2024), namely digital infrastructure and digital government; human capital and digital capability of the population; regulatory frameworks; and degree of digital convergence.

Temporal trajectory analysis tracks the evolution of digital readiness indicators, digital capacity, degree of digital innovations, and the articulation of digital and data-driven ecosystems in selected Eastern European and Baltic countries. This involves explaining contextual differences and conditional digital readiness while problematizing why nations, industries, and businesses have different preconditions in their digitalization journeys and why some are better positioned than others to leverage data ecosystems as drivers of innovation and economic development.

Article 5 provides a macro-level extension to the dissertation's analytical scope by embedding the dynamic insights from Articles 1 to 4 within a comparative national context. While earlier articles explain how data-centric business model innovation works at the firm and ecosystem levels, Article 5 addresses where and under what structural conditions such innovation becomes viable and scalable.

3.8. Additional datasets

To enrich and expand the empirical foundation established by Article 5, additional statistical datasets were systematically incorporated from a broader set of Eastern European and Baltic region countries beyond the original sample, bringing the total number of selected countries to nine: Estonia, Finland, France, Germany, Latvia, Lithuania, Poland, Romania, and Sweden, listed in alphabetical order.

These supplementary data were also sourced from publicly available EUROSTAT databases,[2] covering a ten-year longitudinal period that aligns with the temporal scope of the dissertation's analytical approach. By extending the geographical coverage beyond Article 5 to include additional countries from the same regional cluster, the analysis gains greater comparative depth and supports more robust identification of regional patterns and divergences.

For the analysis, a subset of variables from the datasets was carefully selected and aligned with the corresponding factors defined in the framework proposed in the dissertation's first track. Then, to investigate the relationship between economic performance and information and communication technology (ICT) development, a series of correlation analyses were applied to the panel of selected data over the selected period from 2016 to 2025. To achieve this, two complementary measurement approaches were employed.

In the level (euros) analysis, total gross value added (GVA) and ICT GVA were also correlated with other variables: ICT investment, ICT employment, internet traffic, AI adoption, cloud adoption, and change in number of ICT job ads. For each pair of variables, the Pearson correlation coefficient (r), which measures the strength and direction of the linear association between the variables, was computed. On the

[2] The additional datasets were downloaded during the winter of 2026 from publicly available datasets in the Database section of the EUROSTAT website, accessible via the following link: https://ec.europa.eu/eurostat/en/data/database

basis of these "r" values and the sample size (n = 80), t-statistics were then calculated, as well as the corresponding two-tailed p-values to test the null hypothesis of zero correlation (Benesty et al., 2009). This approach captures scale effects: how much larger ICT becomes as economies get larger in absolute monetary terms.

In the share (relative) analysis, ICT GVA and ICT investment, as a share of total GVA, were constructed and correlated with the same ICT and digitalization indicators. The same procedure was followed: Pearson correlation coefficients (r) were computed for each pair, and their statistical significance was assessed using t-tests and p-values based on n = 80.

This captures structural or quality effects: how important ICT is within the economy and how this relates to AI, cloud, and other digital indicators, independent of pure size. It is worth noting that, while Pearson correlation coefficients and p-values are reported to indicate the strength of associations, these significance levels should be interpreted descriptively. Because the datasets consist of repeated country-year observations, the results indicate strong patterns within the sample rather than providing causal evidence.

The analysis also acknowledges some data limitations that may affect the interpretability and generalizability of findings. Specifically, incomplete data availability for certain variables across particular years and countries represents a methodological limitation. It is also worth mentioning that the period covered by the selected datasets include the COVID-19 pandemic period, which may include an important contextual shock. The pandemic may have influenced indicators such as internet traffic, digital adoption, and data-related activity. Therefore, any trends observed during this period should be interpreted cautiously.

Additionally, due to practical constraints and the need for a more focused analytical scope, a purposive sampling strategy was employed, resulting in the selective inclusion of specific countries and datasets while excluding others that lacked sufficient coverage or variable consistency, ultimately resulting in the selection of five core variables tracked across eight countries within Eastern Europe and the Baltic region. These sampling decisions, while methodologically justified, impose boundary conditions on the transferability of findings beyond the studied regional context.

3.9. Methodological strengths and limitations

The methodological rigor of the dissertation is supported through cumulative article development, transparent synthesis, and explicit separation of analytical levels. Each article applies methods appropriate to its own research purpose, while the kappa explains how the articles collectively contribute to the overarching research problem.

The main strength of this design is that it allows the dissertation to address a complex and emerging phenomenon from multiple angles. The combination of literature review, qualitative research, and conceptual development provides a broad basis for framework development, as well as the later regional contextual analysis.

At the same time, this design also creates challenges. The articles differ in methods, empirical contexts, and units of analysis. To address this, the kappa distinguishes between the primary firm- and ecosystem-level framework and the country-level regional extension.

Another limitation is that the integrative framework is developed as a synthesized theoretical contribution rather than as a universally validated model. It should therefore be understood as a structured explanation of relationships derived from the included articles and supporting literature. The framework is intended to guide analysis, reflection, and future research rather than prescribe a single pathway to be followed.

Table 2 presents a summary of all five articles incorporated into the dissertation, including the author's specific contributions to each study and the methodological approaches employed in each article.

3.10. Ethical considerations, data management, and research integrity

Ethical considerations are fundamental to the research process, serving to protect the rights and well-being of participants, uphold the integrity of research, and maintain public trust (Beauchamp & Childress, 2001). Incorporating ethical principles into research ensures that studies are conducted with respect for individuals, fairness, and accountability. This not only helps prevent harm to participants but also fosters an environment of transparency and integrity crucial for reproducible and trustworthy outcomes.

One key reason to consider ethics in research is to safeguard human dignity. Research often involves vulnerable populations, and ethical guidelines help ensure participation is voluntary, informed, and free from coercion. As the Swedish Ethical Review Authority (Etikprövningsmyndigheten) outlines, researchers must provide clear information about the study's aims, methods, and potential risks, allowing participants to make well-informed decisions about their involvement. This commitment to informed consent is central to respecting participants' autonomy and protecting their rights.

Furthermore, ethical research practices contribute to the reliability and credibility of findings. By adhering to established ethical standards, researchers minimize bias and misconduct. This, in turn, enhances data quality and fosters a scientific culture built on trust and accountability.

Therefore, to ensure compliance with ethical standards, the author, together with the principal supervisor, submitted an application to the Swedish Ethical Review Authority (Etikprövningsmyndigheten) and received clearance to proceed with the study (application no. 025-01506-01-750955).

Article No.	Title	Methods	Status	Position of authorship	Author's contribution
Article 1	Critical factors affecting digital transformation in manufacturing companies	Systematic literature review (SLR) combined with expert's survey	Published Jan. 2025 "International Entrepreneurship and Management Journal"	5th of 5 authors	Contributed to data collection, participated in the research design and methodological choices, and supported parts of the systematic literature review.
Article 2	Orchestrating an ecosystem touring approach: United data and mobility as a service	Qualitative multiple case study analysis, complemented by a multi-vocal literature review of secondary data	Published Mar. 2025 "Management decision Journal"	1st of 2 authors	The leading author and responsible for writing the majority of content as well as collaborating with the second author on the research design and methodological choice
Article 3	Understanding Data Ecosystems: Conceptual Foundations of the Phenomenon	Systematic literature review and exploratory multiple case study	Accepted for publication Oct. 2026 "Electronic Markets Journal"	2nd of 4 authors	Contribution to the conceptual framing, methodological and analytical strategy, data collection and interpretation of the results. Also critically revising the manuscript and helping in strengthening its theoretical contribution.
Article 4	Driving growth through data strategy: ecosystem pathways to business model innovation	Multi staged mixed methods and exploratory multiple case study with longitudinal perspective	Manuscript Under-review	Sole author	Responsible for the entire article.
Article 5	Digital readiness in Eastern Europe and the Baltic rim: A comparative study	Document analysis complemented by interviews and comparative country-level analysis	Manuscript Under-review	1st of 4 authors	Assisting with research design, data collection and interpretation of results, as well as critically revising the manuscript.

Table 2. Summary of the appended articles

The research data were managed in accordance with the university's guidelines for research data management, handling of personal data, and applicable ethical requirements. Particular attention was given to secure storage, confidentiality, retention policies, and responsible handling of research material. Although the study involved interviews, no names or direct personal identifiers were included in the reported findings, and potentially identifiable information was anonymized or excluded where necessary. Commercially sensitive and organization-specific information was treated confidentially and was not disclosed where it could identify individuals or organizations.

The trustworthiness of the findings was supported through systematic documentation and analysis and comparison across multiple data sources where appropriate. These practices supported the protection of participants and organizations as well as the transparency, credibility, and integrity of the research.

4. Results

4.1. Data-centric framework as business model innovation enabler

The main output of this dissertation is the development of a framework that explains how organizations progress from digital readiness shaped by digital transformation toward data-centric business model innovation, with the aim of creating growth opportunities. The proposed data-centric framework (DCF) conceptualizes this development as a staged but recursive process in which digital readiness, data strategy, intraorganizational business model innovation and interorganizational business model innovation, are analytically distinct but mutually connected. Rather than treating digital transformation as a direct route to business model innovation and the creation of growth opportunities, the framework emphasizes the mediating role of data strategy and the importance of both internal and ecosystem-level forms of business model innovation.

The starting point of the framework is digital readiness. Digital readiness refers to the organizational capacity to recognize, absorb, and operationalize digital transformation initiatives and technologies in ways that make data strategically useful. This includes digital technologies, managerial awareness, people competence, organizational culture and overall strategy, as well as the ability to align digital investments with business priorities. In this sense, digital readiness represents the enabling condition that allows firms to move from isolated digital initiatives toward more systematic and strategic use of data, usually through broader digital transformation initiatives and programs. Organizations with higher levels of digital readiness are better positioned to identify where data can improve decision-making and enable new forms of value creation.

However, digital readiness alone does not generate business model innovation. The framework therefore positions data strategy as the central bridging mechanism. Supported by enabling conditions such as forward-thinking leadership, an adaptive organizational culture, and a skilled workforce, data strategy translates digital readiness into actionable innovation capacity by defining how data is collected, stored, enriched, governed, integrated, shared, analyzed, and monetized. It includes decisions about data pipeline design architecture (e.g., medallion architecture), data quality, data management platforms, analytics and artificial intelligence capabilities, business and operations support systems, as well as the organizational roles and elements needed to transform data into business value. Data strategy also clarifies the

strategic logic of data, whether data is used to improve efficiency, personalize services, support new offerings, marketing activities, or coordinate partners. In this way, data strategy connects technological potential with business model change.

At the intraorganizational level, data strategy enables business model innovation by reshaping the content, structure, and governance of the firm's activity system. Firms can leverage data in reconfiguring their business model design elements, to enhance efficiency, enable novel offerings, strengthen complementarities among products and services, and support lock-in mechanisms. This internal dimension is important because organizations often need to develop internal capabilities before they can innovate effectively across organizational boundaries. Intraorganizational business model innovation therefore concerns how data changes the firm's own resources, routines, processes, offerings, and revenue logic.

The framework then extends to the interorganizational level, where data-centric business model innovation takes place across partners, external platforms, and ecosystems. As firms become more capable of governing and mobilizing data internally, they can use data to collaborate externally through APIs, shared platforms, ecosystem partnerships, and data-sharing arrangements and mechanisms. At this level, innovation is not limited to what a single firm can do with its own resources. Instead, value creation becomes distributed across multiple actors, requiring coordination, trust, interoperability and role reconfiguration. Interorganizational business model innovation may include data-as-a-product or data-as-a-service offerings, shared platforms, open banking arrangements, digital travel ecosystems, analytics partnerships, or other forms of collaborative value creation.

Finally, the framework conceptualizes generation of growth opportunities as a multidimensional outcome of data-centric business model innovation. Creation of growth opportunities is not limited to revenue or profitability increase, although these remain important. It also includes pursuing new opportunities for market expansion, stronger customer engagement, operational scalability, better ecosystem positioning, and increased innovation capacity.

Business model innovation also creates feedback effects: as firms scale data-driven and data-centric initiatives, they encounter new demands for realigning strategies. These feedback effects reshape digital readiness and data strategy, making the framework dynamic rather than linear.

Overall, the framework (Figure 2) explains data-centric business model innovation as a progression from digital readiness to data strategy, from data strategy to internal and external business model innovation, and from business model innovation to growth opportunities generation. Its theoretical contribution lies in clarifying the role of data strategy as the mechanism that links digital transformation and readiness with business model innovation. It also distinguishes between intraorganizational and interorganizational levels of business model innovation, showing that data-driven business model change unfolds both within the firm and across ecosystems. This distinction is central to understanding how organizations move from

using data for internal improvement toward using data as a basis for collaborative and ecosystem-oriented business model innovation.

The approach discussed above becomes evident when reviewing successful data-centric transformations, such as Netflix's evolution from a DVD rental service to a global streaming leader, which exemplifies how foundational digital infrastructure (content delivery networks and recommendation algorithms) enabled strategic data capabilities (personalization and content production insights) that ultimately reconfigured the entire entertainment ecosystem through platform-based business model innovation (Gomez-Uribe & Hunt, 2016; Teece, 2010).

Most elements of Netflix's business model were reasonably easy for competitors to imitate. Netflix had identified a viable approach and made the investments required to establish and develop the online streaming market. Subsequently, competitors largely adopted defensive responses to Netflix's approach, seeking to leverage their established brand equity and extensive networks of physical stores to capture value by adapting and modifying the business model pioneered by Netflix.

Netflix, however, continued to evolve its business model by leveraging customer data, its online infrastructure, and the declining reliance on physical DVD rentals, enabling the company to redesign its business model and maintain its competitive position.

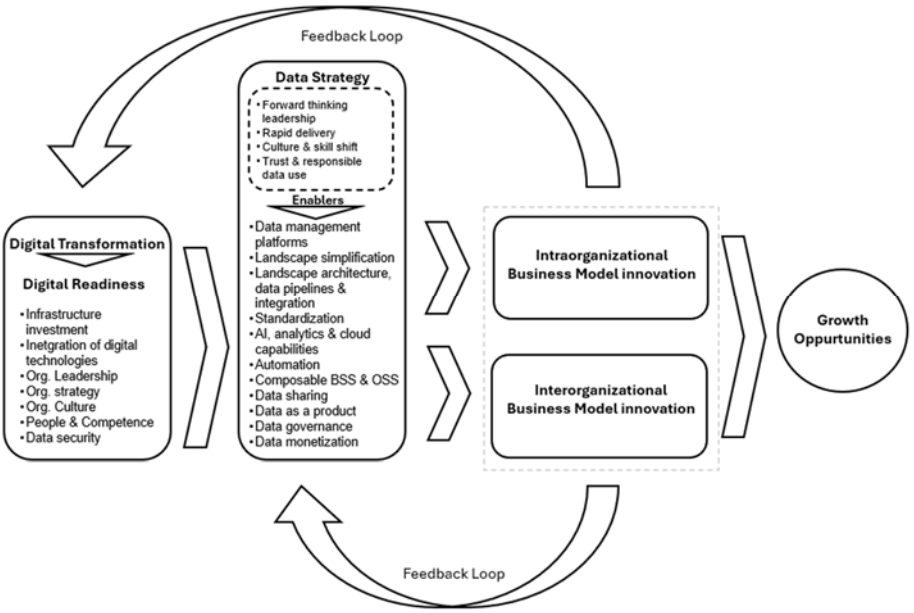

Figure 2. The proposed data-centric framework

A more recent example is Amadeus, a global technology company that provides software and infrastructure powering the travel and tourism industry. Amadeus began as a global distribution system (GDS), and its business model was primarily

based on transaction fees generated through airline reservations and ticket sales. Over time, however, the company transformed from a booking intermediary into a travel technology platform serving a broad ecosystem of airlines, airports, hotels, rail operators, travel agencies, payment providers, and other travel actors. This transformation was not merely technological; it involved a reconfiguration of how value was created, delivered, and captured (Amadeus, 2026; Databricks, 2026).

As a first digital transformation step, Amadeus digitized and standardized core industry processes by developing cloud-based operational platforms for airlines. Through its Altéa passenger service system, the company moved beyond booking transactions and began providing reservation systems, inventory management, ticketing, departure control, and revenue management capabilities as shared services. Airlines increasingly consumed these capabilities through cloud-based services rather than operating their own infrastructure.

These digital transformation initiatives created the readiness and foundation for a more comprehensive data strategy. Rather than treating data as a by-product of transactions, Amadeus organized its technology architecture around shared platforms that enabled information flows across multiple participants in the travel ecosystem. The strategic role of data can be seen in the company's use of integrated platforms, common cloud infrastructure, and open digital architectures connecting airlines, airports, hotels, travel sellers, and payment providers. Data therefore became an organizational resource that supported coordination, interoperability, platform governance, and ecosystem integration rather than merely operational reporting.

Amadeus made a strategic partnership with Databricks, a leading cloud-based data intelligence platform provider that popularized the medallion data architecture in 2019. This partnership contributed to the execution of a data strategy that enabled multiple forms of business model innovation for Amadeus.

First, Amadeus shifted from a predominantly transaction-based revenue model toward recurring software and service revenues through software-as-a-Service offerings. Second, the company expanded from airline distribution into broader travel ecosystem services, including hotels, airports, rail, and payments. Third, data generated across the platform enabled new forms of travel retailing, such as dynamic pricing, personalized offers, complementary services, and offer-and-order management. Finally, the company's open platform strategy created opportunities for partners and developers to build complementary services on top of its infrastructure. Together, these innovations transformed Amadeus from a booking intermediary into a platform orchestrator generating value from transactions, software services, payments, data-enabled services, and ecosystem participation.

Viewed through the lens of the dissertation's proposed framework, the Amadeus example demonstrates that business model innovation did not emerge directly from digital technologies alone. Rather, digital transformation created the technological and organizational readiness and conditions for a strategic data capability, and this data capability subsequently enabled platform expansion, ecosystem participation,

new revenue logics, and novel forms of value creation. This illustrates the framework's central proposition that data strategy acts as the critical bridge between digital transformation and business model innovation.

Another example from a different industry is Santander, the Spanish multinational banking group founded in 1857, which demonstrates how data-driven operational transformation can support the development of new business models. Similarly, SEB, one of Sweden's largest banks, provides an example of how open banking ecosystems and platform-based innovation can enable new forms of value creation and business model innovation.

Santander provides an example where digital transformation primarily supports the modernization and integration of a large multinational enterprise. The bank's transformation strategy focused on establishing a common global data architecture, creating a unified customer view, implementing artificial intelligence-driven personalization, developing API services, and building banking-as-a-Service capabilities. These initiatives were supported by shared technology platforms and common data structures across national operations.

Within the proposed framework (Figure 2), these initiatives represent a transition from digital transformation to data strategy. Data became a strategic asset that enabled efficiency, scalability, personalization, and organizational integration rather than only serving operational purposes. The strategic importance lies not only in technology but also in decisions regarding platform standardization, architectural governance, investment priorities, and capability development across the organization.

The resulting business model innovation was primarily evolutionary rather than disruptive. Santander remained fundamentally a bank but transformed how it delivered financial services. The organization moved from product-centric to customer-centric operations, from country-specific IT infrastructures to a shared global platform, and from branch-focused delivery toward omnichannel banking. In this case, data strategy enabled business model innovation through operational transformation and scalability rather than through ecosystem orchestration.

SEB bank represents a different pathway in which data strategy leads to ecosystem-oriented business model innovation. Through its open banking strategy, SEB established standardized APIs that enable third parties to access banking services and customer-authorized data while simultaneously integrating external data into its own services. The bank explicitly positions "open banking" as a mechanism for creating new ecosystems in which organizations collaborate around customer needs.

From a framework perspective, digital transformation provided the technical foundation, but the critical step was the development of a data strategy centered on API management, consent management, integration, governance, and controlled information exchange. The architecture mediates data flows among customers, fintech firms, merchants, insurers, and payment service providers. This illustrates why data strategy should be understood as a strategic capability involving partnering logic and ecosystem coordination rather than as a purely technical activity.

This data strategy enabled a more substantial business model innovation than that observed in Santander. Rather than simply using data internally to improve existing banking processes, SEB increasingly acts as a platform that enables partners to build new services on top of banking capabilities. Value is therefore created not only through traditional financial products but also through orchestrating secure information flows and ecosystem interactions. As a result, SEB represents a closer example of data-centric business model innovation, where the organization captures value by facilitating exchange among multiple independent actors.

Taken together, Santander and SEB demonstrate why the framework positions data-centricity as its core and data strategy between digital transformation and business model innovation. Both organizations invested in digital platforms, APIs, and modern technology infrastructures. However, the strategic choices concerning governance, data sharing, ecosystem participation, and platform design influenced the type of business model innovation that emerged. Santander illustrates a pathway toward enterprise-wide operational transformation, whereas SEB illustrates a pathway toward ecosystem orchestration and platform-based value creation.

The suggested framework (figure 2) represents the result of the dissertation's first track and provides a unifying lens through which the individual articles can be interpreted as interdependent contributions to a broader concept of data-centric business model innovation. The framework is intended as a guiding suggestion and is proposed to be followed in the suggested sequence; however, depending on the context, it may also be applied differently and through alternative pathways.

4.2. Contextualizing the data-centric framework: Illustrative macro-level analysis in selected Eastern European and Baltic region economies

Although the proposed framework in this dissertation mainly addresses firm-level mechanisms for data-centric business model innovation rather than country-level elements, a compelling analytical case exists for examining these relationships at the macroeconomic scale. For example, if systematic correlations can be identified between national economic growth trajectories and the upsurge of technologies that constitute core elements of the proposed data-centric framework, such as those enabling advanced data processing, storage, and analytics, then it becomes theoretically reasonable to suggest that these technological elements contribute to broader economic value creation at the national level.

This macro-level inference assumes that widespread adoption of data-driven and data-centric technologies across multiple firms and various sectors within a national economy generates aggregate effects manifested in measurable economic growth indicators. For instance, when numerous organizations simultaneously develop capabilities in cloud computing, AI, advanced analytics, and digital infrastructure, the cumulative impact creates positive externalities that can amplify economic

growth beyond isolated firm transformations. Factors such as national investments in digital infrastructure, ICT education, and the adoption of AI and analytics can further strengthen the effectiveness of firm-level data-centric framework initiatives. Therefore, while the proposed framework operates primarily at the organizational level, empirical testing at the country level provides valuable insights into the scalability and systemic impact of data-centric innovation strategies, offering evidence of how micro-level business model innovations aggregate into macro-level economic development outcomes and may support or constrain the scalability and contextual relevance of such innovation.

Based on the empirical findings from Article 5 and supplementary longitudinal datasets sourced from EUROSTAT, specific structural and innovation-related indicators were systematically selected and comparatively analyzed across the selected countries studied in Article 5.

The selected cases were primarily chosen because they are located within Eastern Europe and the Baltic region, representing diverse maturity profiles, and importantly, because the data collected for Articles 4 and 5 originated from several of these countries. They also offered stronger EUROSTAT data coverage. To enhance the robustness and geographical scope of the comparative analysis, additional countries from the broader Eastern European and Baltic region (e.g., France and Germany) were incorporated into the dataset compared to the cases studied in Article 5.

Although the expanded sample may introduce influential outliers, it also provides richer contextual variation across different levels of digital maturity, and enables comparisons of data and innovation configurations, allowing for a more detailed identification of potential regional patterns.

For comparative longitudinal tracking among the selected countries, a set of variables was carefully selected for further analysis, including human capital development, digital infrastructure investment, the adoption of cloud computing and AI within firms, and gross value added (GVA). Table 3 illustrates a conceptual mapping between the selected variables from the longitudinal dataset and their potential corresponding indicators within the data-centric framework proposed in the dissertation's first track.

It is important to acknowledge several potential limitations of the analysis, including the relatively small country sample, heterogeneous observation years, missing observations, breaks in the time series, and the potential influence of COVID-19-related effects on the data.

Results from applying correlation analysis to the selected factors for 2016 to 2025 show that total gross value added (GVA) and the information and communication technology (ICT) sector demonstrate a strong positive association, indicating that larger economies tend to exhibit larger ICT sectors in terms of monetary value, ICT expenditure, workforce size, and overall investment levels. Internet traffic also increases alongside GVA, although the relationship is slightly weaker. In contrast, when variables are measured in levels, the adoption of AI and cloud computing does

not appear to be directly associated with economic size, as reflected in near-zero correlations. Additionally, changes in ICT-related job advertisements tend to be more negative in larger economies, suggesting that mature markets may be undergoing adjustment and optimization rather than rapid expansion. Overall, these interpretations indicate that ICT scale and GVA tend to grow in parallel. This could be primarily because larger economies generally operate at greater scale across multiple dimensions, rather than implying a direct causal relationship between the two. Figures 3 and 4 illustrate total GVA and ICT GVA for the selected countries, excluding France. Although France and Germany were included in certain datasets to provide an additional comparative perspective, France was omitted from these two figures because its substantially higher values distorted the visualization range and reduced overall readability.

No.	Data centric framework indicator	Variables from additional datasets
1	People and competence Culture and skill shift	Number of employees in ICT Number of job Ads in ICT
2	AI, analytics & Cloud capabilities Data management platforms	Usage of paid cloud computing Usage of AI
3	Infrastructure investment Landscape architecture Integration of digital technologies	Government investment (Expenditure) in ICT
4	Integration of digital technologies Data sharing	Internet traffic
5	Economic performance and growth	GVA total GVA ICT industry Country expenditures

Table 3. Mapping between the five selected variables from the longitudinal dataset and their corresponding factors in the data-centric framework

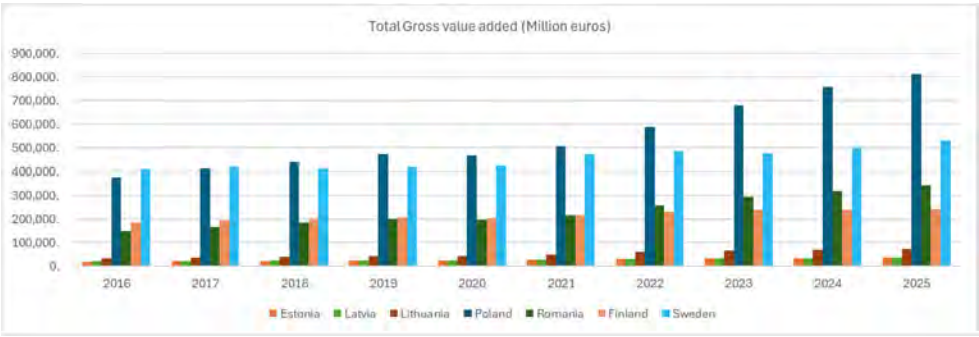

Figure 3. Total Gross value added in Million euros

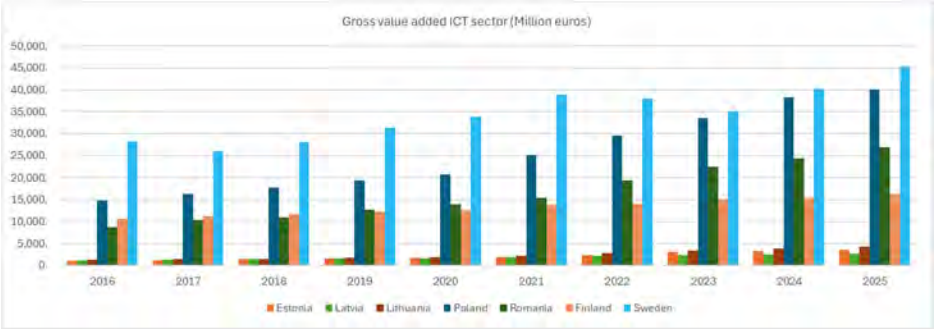

Figure 4. Total Gross value added of the ICT sector in Million euros

Countries and years characterized by higher ICT GVA also tend to exhibit overall larger economies, greater ICT expenditure, higher numbers of ICT employees, and higher internet traffic, indicating strong scale-related relationships across these variables. In contrast, when examining absolute euro values, cloud computing and AI adoption show only weak associations with ICT GVA. This suggests that cloud and AI adoption may be more closely associated with the relative importance of the ICT sector within the economy than with its absolute economic size. In particular, cloud adoption shows a positive association with ICT GVA as a share of total GVA, while the association with AI adoption is weaker. These patterns are exploratory and do not establish a causal relationship.

4.2.1. Large, diversified economies: France, Poland, Sweden

France demonstrates exceptionally high levels of both total GVA and ICT GVA in monetary terms, alongside very large ICT expenditure, ICT employment, and related investment indicators. As a result, France consistently appears in the upper-right range of the scatter plots comparing total GVA with ICT-related variables, substantially contributing to the strong positive correlations observed between economic size and ICT scale indicators.

Poland represents a relatively large and rapidly modernizing economy characterized by substantial growth trajectories in ICT spending and digital workforce development over the observed longitudinal period. The country contributes significantly to the positive association between total GVA and ICT variables, particularly occupying the mid-range of the economic size distribution. Poland's positioning suggests an economy actively transitioning toward greater digital intensity, providing valuable suggestions of how emerging economies can systematically build ICT capabilities while expanding the overall economy.

"…as we also deliver nearshore services to various European countries, we always operate under strict data governance frameworks, ensuring compliance with regulations such as GDPR." (Business development manager, Poland)

Sweden, while smaller than France in absolute economic size, displays a particularly high level of ICT intensity, characterized by strong ICT GVA, substantial ICT expenditure and employment, and very high internet traffic levels. Consequently, Sweden also ranks highly across ICT-related indicators relative to its economic size, further strengthening the overall correlations.

4.2.2. Smaller but high-ICT countries: Finland and Estonia

Finland represents a medium-sized economy in terms of total GVA, yet demonstrates relatively high ICT GVA and ICT expenditure compared to its overall economic size. This positioning contributes to strengthening the correlation between GVA and ICT expenditure or internet traffic, as Finland performs above the average level of ICT intensity for its GVA category. When viewed in share terms, Finland's relatively high ICT share in the economy and strong cloud and AI uptake further underline its status as a digitally advanced economy rather than simply a mid-sized one.

Estonia, by contrast, remains a comparatively small economy in absolute GVA terms but has experienced strong growth in ICT GVA, internet traffic (Figure 5), and the adoption of cloud computing (Figure 6) and AI technologies (Figure 7) over time. Although Estonia appears within the lower range of the scatter plots when measured in absolute monetary terms, it exhibits a comparatively high ICT share relative to its economic size. Consequently, Estonia becomes more prominent when the analysis is conducted using percentage-based indicators rather than absolute euro values, which is consistent with the positive correlations observed between ICT share in the economy and cloud/AI adoption.

"The Estonian government is promoting the development of a digital economy through various initiatives, such as the development of e-government services and the promotion of IT education." (Cloud integration & application lead, Estonia)

4.2.3. Mid-sized catching-up economies: Latvia, Lithuania, Romania

Latvia and Lithuania exhibit lower total GVA and ICT sector GVA in absolute monetary terms compared to larger economies such as France, Poland, and Sweden. However, both Baltic states demonstrate consistent upward trajectories in ICT expenditure, digital infrastructure investment, and internet traffic over the studied period. These countries occupy the lower-middle segment of the GVA ICT scatterplot distributions, reinforcing the overall positive correlation between economic scale and digital capability development, although with smaller absolute investment volumes.

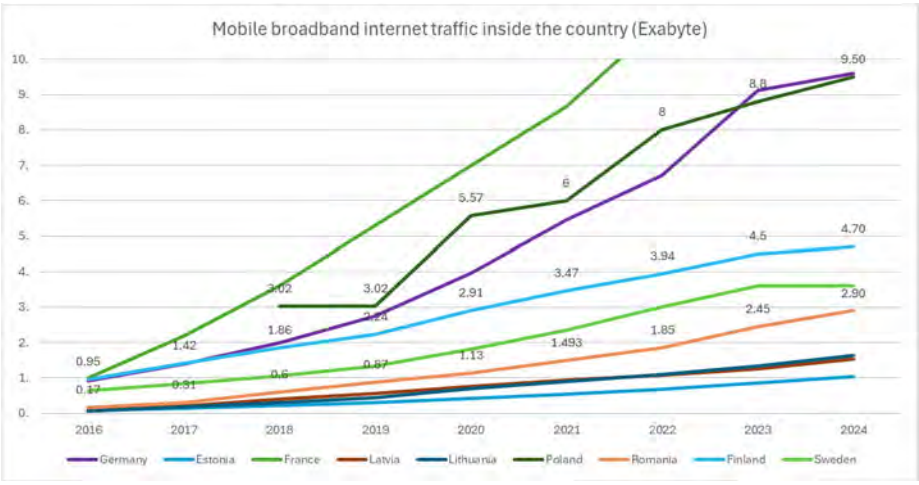

Figure 5. Mobile broadband internet traffic inside the country (Exabytes)

Figure 6. Percentage of enterprises with more than 10 employees using paid cloud computing services

Their sustained growth patterns illustrate how smaller economies systematically build digital capacity through incremental yet persistent investment strategies, contributing empirical evidence of regional convergence dynamics within the Eastern European and Baltic digital landscape. In share terms, they gradually increase their ICT share in the economy but generally remain below the most digitally advanced countries, reflecting an ongoing but incomplete "catch-up" process (Saghafi et al., 2021).

Romania represents a mid-sized transitional economy characterized by rapidly accelerating ICT sector GVA and digital infrastructure spending throughout the observation period. In longitudinal total GVA versus ICT variables plots, Romania's data points demonstrate upward movement over time, reflecting simultaneous expansion in overall economic scale and digital intensity. This trajectory contributes significantly to the positive correlations observed across the sample while simul-

taneously suggesting classic "catch-up dynamics," where emerging economies leverage strategic ICT investments to narrow developmental gaps with more advanced digital leaders. Romania's case offers valuable empirical insights into how targeted, growing ICT sector maturity can contribute to broader economic value creation in transitional economies, even though AI and cloud adoption levels, as well as ICT shares, remain below those of the Nordic and most advanced Baltic countries.

"We take AI seriously in Romania. Last year, our government approved the national Artificial Intelligence strategy, outlining the country's approach to adopting AI technologies across various sectors, with the ambition to become a global leader in AI." (Head of AI solutions, Romania)

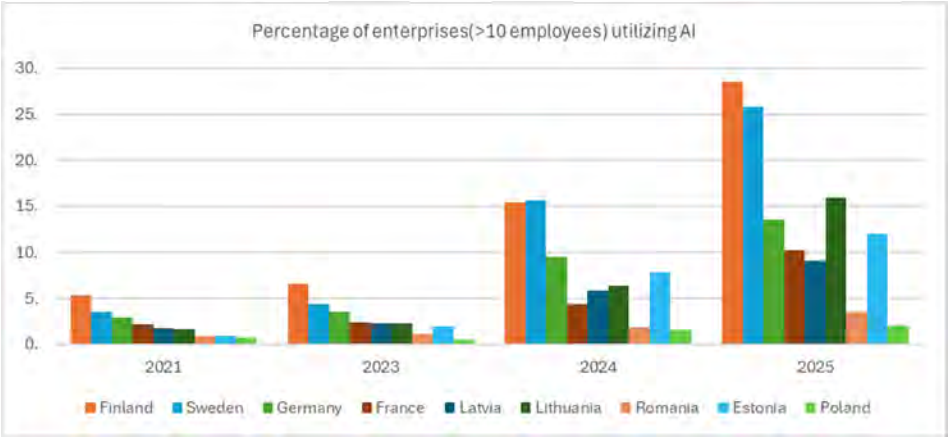

Figure 7. Percentage of enterprises with more than 10 employees using AI-related solutions

4.3. Summary of the findings

The quantitative analysis revealed distinct patterns across economic scale and digital sophistication dimensions. A strong scale effect emerges when measuring variables in absolute monetary terms: correlation analysis demonstrates extremely strong positive relationships ($r > 0.9$) between total GVA, ICT GVA, ICT expenditure, employment, internet traffic, and total ICT spending. This reflects the natural tendency for larger economies such as France, Poland, and Sweden to host proportionally larger ICT sectors and make greater absolute investments in digital infrastructure.

Country positioning reveals rich patterns beyond simple economic size. France and Poland dominate the high-GVA, high-ICT segments, while Sweden and Finland, despite smaller total GVA, demonstrate exceptional ICT intensity relative to their economic scale. Estonia, Latvia, Lithuania, and Romania occupy lower to middle ranges in absolute terms but exhibit clear upward trajectories in ICT spending and traffic, indicating systematic digital catch-up dynamics.

When variables are measured in euros, AI and cloud adoption function as quality rather than scale dimensions, showing virtually no correlation with total or ICT GVA

in absolute terms. When measured in shares, however, ICT share in the economy is strongly and significantly correlated with cloud adoption and moderately with AI adoption, while ICT's share in the economy is negatively correlated with both, suggesting that advanced digital capabilities reflect strategic choices and sectoral structure rather than expenditure intensity alone. Smaller but digitally sophisticated countries (Estonia, Finland, and Sweden) achieve high cloud and AI adoption and relatively high ICT share in GVA without ranking among the largest economies in absolute GVA terms.

The job market analysis reveals that larger, more mature ICT markets tend toward stabilization or cyclical corrections in job postings, while smaller or catching-up economies experience temporary demand surges, suggesting different phases of digital maturity development. Figures 8 and 9 present a summary of the correlation analysis conducted across the selected variables, illustrating the strength and direction of relationships between economic scale indicators, ICT shares, and ICT-related variables within the analyzed samples.

It is important to reemphasize that the country-level analysis presented in this section serves a contextual and descriptive purpose rather than providing validation or evidence of direct causal relationships with financial performance outcomes.

	GVA total	GVA ICT Industry	Country Expenditure total	Number of employees in ICT	Internet traffic	Usage of AI	Usage of paid cloud computing	New job Ads in ICT	Investment in ICT
GVA total	1.000								
GVA ICT industry	0.994 ***	1.000							
Country Expenditure total	0.998 ***	0.993	1.000						
Number of employees in ICT	0.963 ***	0.955	0.948	1.000					
Internet traffic	0.740 ***	0.736	0.723	0.823	1.000				
Usage of AI	-0.080	-0.035	-0.077	-0.099	-0.052	1.000			
Usage of paid cloud computing	0.012	0.123	0.045	-0.008	0.206		1.000		
Number of job Ads in ICT	-0.290 **	-0.296	-0.216	-0.254	-0.131	0.139		1.000	
Investment in ICT	0.889 ***	0.895	0.874	0.837	0.800	-0.126	-0.066	-0.448	1.000

Figure 8. Summary of the level correlation analysis: significance levels: * ($P < 0.05$), ** ($P < 0.01$), *** ($P < 0.001$)

	ICT share of GVA	ICT invest-ment share of GVA	Country Expenditure total	Number of employees in ICT	Internet traffic	Usage of AI	Usage of paid cloud computing	New job Ads in ICT
ICT share of GVA	1.000							
ICT investment share of GVA	0.084	1.000						
Country Expenditure total	-0.146	-0.053	1.000					
Number of employees in ICT	-0.215 *	-0.090	0.948	1.000				
Internet traffic	-0.155	-0.095	0.723	0.823	1.000			
Usage of AI	0.278 **	-0.531	-0.077	-0.099	-0.052	1.000		
Usage of paid cloud computing	0.552 ***	-0.317	0.045	-0.008	0.206		1.000	
Number of job Ads in ICT	-0.098	-0.289	-0.216	-0.254	-0.131	0.139		1.000

Figure 9. Summary of relative correlation analysis: significance levels: * (P < 0.05), ** (P <0.01), *** (P < 0.001)

5. Conclusions

5.1. Concluding synthesis and key insights

The focus of this dissertation has been to explain, through the proposed framework, how leveraging data as a strategic resource and implementing data strategy practices enable data-centric business model innovation within firms and across firm boundaries in ecosystem settings.

The dissertation also situates some elements of this framework within the broader context of selected Eastern European and Baltic region economies and their selected growth-path indicators, examining whether a correlation between them can be identified.

The cumulative evidence presented in this dissertation demonstrates that data-centric business model innovation is not an isolated managerial act or a purely technological outcome, but rather a systemic, multilevel process that unfolds through the interaction of organizational readiness, data strategy, ecosystem partnership, and business model reconfiguration. By integrating insights from digital transformation research, business model innovation and ecosystem theories, the dissertation advances a coherent explanatory framework that clarifies how data operates simultaneously as a strategic resource, coordination mechanism, and innovation catalyst.

The first argument of the dissertation is that digital transformation does not automatically lead to business model innovation. This is consistent with some previous research findings (Celestin & Vanitha, 2015; Sebastian et al., 2017; Verhoef et al., 2021; Vial, 2019). Investment in infrastructure, digital technologies, and data management platforms can create important preconditions, but they do not by themselves produce value.

Digital readiness occurs as the result of well-planned digital transformation and refers to the organizational ability to recognize, absorb, and use digital technologies and data in meaningful ways. However, readiness alone is not enough. It needs to be translated into strategic action.

This translation takes place through data strategy. Data strategy connects digital readiness to business model innovation by defining how data is collected, integrated, stored, modeled, shared, governed, analyzed, and used for business purposes. It further emphasizes that these data-related elements are interdependent and should therefore not be examined in isolation but understood as interconnected components of a broader system. It also clarifies how firms make decisions about data management platforms, landscape architecture, standards, data quality, and value creation priorities. In this way, data strategy is not only a technical activity. It is a strategic capability that shapes how firms use data to create and capture value and is enabled

by forward-thinking leaders, the right competencies, rapid delivery, trust, and the responsible use of data.

The framework then distinguishes between two related forms of business model innovation. The first is intraorganizational business model innovation. This concerns how data changes the firm's internal activities, resources, processes, product and service offerings, and revenue logic. These internal changes are important because firms often need to build internal capabilities before they can participate effectively in wider data ecosystems.

The second form is interorganizational business model innovation. This concerns how data enables value creation across partners and ecosystems. In such settings, value is not created only by one firm. It is created through data sharing and coordinated collaboration among multiple actors. Data can therefore become both a strategic resource and a coordination mechanism. It can support new ecosystem roles, new partnership models, new forms of orchestration, and new ways of creating and capturing value.

A key conclusion of the dissertation is that firm growth in data-intensive environments depends on the connection between these elements. Creating growth opportunities is not simply the result of investing in digital technologies. It emerges when firms develop digital readiness, translate this readiness into data strategy, use data strategy to redesign internal and external business model activities, and then mobilize these changes toward new growth opportunities. Growth of a firm can then appear in the form of revenue growth, market expansion, stronger ecosystem positioning, new products and services, new revenue models, or increased innovation capacity.

5.2. Addressing the research questions

The first research question asked: *What components and relationships explain how firms progress toward data-centric business model innovation?* The dissertation answers this question by developing an integrative data-centric framework. The framework explains a pathway from digital transformation and digital readiness, through data strategy, toward intraorganizational and interorganizational business model innovation. The framework does not suggest that all firms follow the same linear path. Instead, it presents a structured explanation of the main relationships among the components, with data strategy acting as the bridge. The framework highlights that, when business model design is shaped by data strategy, data does not only support existing activities. Rather, it influences which data-related elements are incorporated, which activities are performed, and how these activities are configured and connected. It also emphasizes the feedback loop effects that reshape digital readiness and data strategy, making the framework dynamic rather than linear. Business model innovation becomes the mechanism through which data is translated into new value creation and value capture.

The second research question examined: *What new ecosystem collaborative arrangements emerge when data becomes a central value driver for business model innovation?* The dissertation shows that when data becomes central to business model innovation, collaboration often moves beyond firm boundaries and traditional firm-to-firm relationships. Data enables new ecosystem arrangements in which firms, platform providers, customers, public actors, and other stakeholders coordinate around shared data flows. The findings show that data can support temporary and distributed forms of orchestration, including arrangements where leadership and coordination roles shift depending on the activity, resource, or value proposition. The concept of "touring orchestration" illustrates this point. It shows that ecosystem leadership does not always need to be fixed or centralized.

Data as a strategic reusable asset can reshape power dynamics and competitive relationships within ecosystem configurations. Firms that control valuable data, or that have strong capabilities to govern and use data, may gain stronger bargaining power and a more central role in ecosystem collaboration. They may become orchestrators, intermediaries, or complementors. This means that data is not only an input to innovation. It can also influence how roles, dependencies, and value capture opportunities are distributed across the ecosystem.

The third research question investigated: How do regional digital-readiness conditions in selected Eastern European and Baltic region economies shape the scalability and contextual relevance of data-centric business model innovation?

The dissertation answers this question through a regional and country-level contextual extension and quantitative analysis. This part of the dissertation does not claim to prove that firm-level data-centric business model innovation directly causes national economic growth. Instead, it examines broader readiness conditions that may support or constrain the scalability of the framework.

The country-level analysis shows that economic size accounts for substantial variation in absolute information and communication technology investment, employment, and infrastructure. Larger economies generally tend to have larger ICT sectors and higher absolute levels of investment.

The analysis also shows that digital sophistication is not only a matter of economic size. Indicators such as cloud computing and AI adoption appear more closely related to the quality and structure of digital capability than to scale alone. Countries such as Estonia and Finland show relatively high levels of digital sophistication compared with their economic size, while larger economies do not automatically achieve stronger digital capability in every dimension. This supports the dissertation's broader argument that growth potential depends not only on the amount of digital investment but also on how digital and data capabilities are organized, governed, and used.

These findings qualify the idea that data ecosystems are boundaryless. Data may be easily shared cross-national borders, but the capacity to use, exchange, and monetize it remains affected by factors such as regional infrastructure, skills, gover-

nance, and technology adoption. Regional conditions therefore shape the possibilities for ecosystem participation and the scaling of data-centric business models.

The regional analysis therefore helps contextualize the firm-level framework. It suggests that data-centric business model innovation is more likely to scale in environments where digital infrastructure, skills, governance, technology adoption, and ecosystem maturity are sufficiently developed. At the same time, the analysis remains descriptive and should be interpreted carefully. It provides contextual support for the framework rather than demonstrating causal effects.

5.3. Theoretical implications

From a theoretical standpoint, this dissertation makes two main theoretical contributions. First, it contributes to business model innovation research (Chesbrough, 2010; Teece, 2010; Zott & Amit, 2010, 2017) by showing how data and the organizational strategies surrounding it can serve as a central design logic for business models. Existing business model research explains how firms create, deliver, and capture value through activity systems. This dissertation extends that view by arguing that in digital and data-intensive contexts, data strategy increasingly shapes the content, structure, and governance of those activity system design elements. This can strengthen the business model design themes by enabling novel offerings, improving efficiency, enhancing complementarities among products and services, and consolidating lock-in mechanisms.

Data strategy does not only support activities, but it influences which data elements to be included. Data affects what activities are performed, how they are linked, who performs them, and how value is captured. This means that data-centric business model innovation is not only about adding digital tools to existing models. It is about redesigning the business model around the strategic use of data.

Second, the dissertation contributes to ecosystem research (Adner, 2017; Autio & Thomas, 2014, 2020; Jacobides et al., 2018; Moore, 1993, 1996; Teece, 2018) by explaining how data functions as both a shared resource and a coordination mechanism. Prior ecosystem research has shown that value creation increasingly depends on interdependence among multiple actors (Jacobides et al., 2018; Kapoor, 2018). This dissertation extends that view by showing that data can organize these interdependencies. Elements such as data sharing, governance, power dynamics, and coordination mechanisms can help actors coordinate without relying only on hierarchy or focal firms. This perspective challenges traditional views of firms as relatively bounded entities operating within clearly defined activity links and network boundaries (Håkansson & Ford et al., 2022). The findings suggest that data, as a reusable and shareable resource, can increasingly move across organizational boundaries and connect firms with a wider range of ecosystem actors.

At the same time, data ecosystems are not entirely boundaryless. Data may move relatively easily across organizational and national borders, but the capacity to access,

process, exchange, and monetize it remains shaped by regional infrastructure, regulation, skills, and digital readiness. The dissertation therefore treats national and regional conditions as contextual factors that enable or constrain ecosystem participation rather than as a separate theoretical track. The dissertation therefore highlights data ecosystems as sociotechnical arrangements in which infrastructure, stakeholders, governance, and data assets interact to support collaborative value creation.

5.4. Supporting analytical lenses

As analytical lenses rather than direct theoretical contributions, several additional perspectives assist in interpreting the dissertation's contributions without constituting separate theoretical foundations.

Building on Penrose's (2009) foundational insight that firm growth emerges from the productive deployment of resources through managerial services, this research demonstrates that data strategy constitutes a novel form of managerial service that, when articulated and championed by forward-thinking leaders, enables organizations to systematically recombine and extend their capabilities in data-intensive environments. The dissertation connects data strategy to the productive use of resources and argues that data does not generate growth or create growth conditions simply because it exists. Data becomes productive when managers identify its potential, organize the capabilities needed to use it, and connect it to new business opportunities. From this perspective, data strategy can therefore be understood as a form of managerial capability or managerial service. It helps transform latent data resources into business model innovation and growth opportunities.

Schumpeter's view of innovation (Breschi et al., 2000; Schumpeter, 1947) also provides a useful point of view for understanding the role of data and data strategy in business model innovation within an ecosystem setting. While Schumpeter Mark I emphasizes entrepreneurial innovation and the role of new firms, and Mark II highlights innovation within established firms through accumulated knowledge and capabilities, the findings of this study suggest that data strategy can enable data-centric business model innovation under both conditions, although through different resources and organizational mechanisms. Thus, data-centric business model innovation can extend beyond this distinction, encompassing both entrepreneurial innovation and the renewal of established business models.

The dissertation also uses the resource-based view (Barney, 1991) and dynamic capabilities perspective (Teece, 2007, 2008; Teece et al., 1997) as supporting theoretical lenses. The resource-based view (Barney, 1991; Wernerfelt, 1984) provides an additional theoretical lens by explaining how proprietary data assets and analytical capabilities can constitute valuable, rare, and difficult-to-imitate resources that sustain competitive advantage. Unlike many physical resources, data can be used simultaneously and repeatedly without being depleted. The dissertation reveals that the strategic value of data goes beyond traditional resource-based logic, as data's non-

rivalrous nature create opportunities for shared value creation often across organizational boundaries.

This means that its value cannot be explained only by ownership or exclusivity. It must also be understood through recombination, sharing, and ecosystem use. This perspective also challenges traditional views of the firm as embedded in networks where resources are exchanged and coordinated through directional relationships, rather than primarily around shared value propositions.

More critically, the dynamic capabilities perspective (Teece, 2007; Teece et al., 1997) offers an explanatory theoretical lens for understanding how organizations systematically develop the capacity to sense data-enabled opportunities, seize them through data strategy and strategic investments in business model innovation, and transform their organizational structures to maintain ecosystem alignment. The empirical findings across appended articles demonstrate that gaining competitive advantage in data-intensive environments requires organizations to continuously reconfigure their sensing, seizing, and transforming mechanisms in response to evolving technological possibilities and ecosystem dynamics, moving beyond static resource accumulation toward dynamic capability development that enables ongoing strategic adaptation and value creation.

Overall, the theoretical contribution of the dissertation lies in integrating these perspectives into a clearer pathway. Digital transformation creates readiness. Data strategy turns readiness into strategic capabilities. Business model innovation translates those capabilities into new forms of value creation and capture. Ecosystem collaboration expands the scope of business model innovation beyond firm boundaries. Growth opportunities become the outcome of this connected process.

Taken together, these supporting perspectives clarify enabling conditions, adaptation processes, and possible consequences. The central theoretical contribution remains the integration of business model innovation and ecosystem theory to explain how data and data strategies reshape value creation and capture within and across organizational boundaries.

5.5. Methodological reflections

The dissertation follows a cumulative research design that combines different methods, article types, and levels of analysis. This approach and design allowed the dissertation to study a complex phenomenon from several angles. The systematic literature reviews support conceptual clarity. The qualitative case-based studies provide insight into organizational and ecosystem processes. The conceptual and empirical work on data ecosystems helps explain the role of governance, infrastructure, stakeholders, and data assets. The country-level analysis adds contextual understanding of broader digital readiness conditions.

This combination strengthens the dissertation by allowing theoretical development across several forms of evidence. It also creates limitations. The included studies

differ in methods, empirical contexts, and units of analysis. Firm- and ecosystem-level findings cannot be treated as equivalent to country-level associations.

The dissertation therefore separates two analytical tracks. The first, supported principally by Articles 1 to 4, develops the framework for data-centric business model innovation within and across organizations. The second, associated with Article 5 and supplementary indicators, examines regional conditions that may support or constrain the framework's scalability.

The dissertation should therefore be read as a theoretical and conceptual contribution rather than as a generalizable test of a causal model. It identifies relationships and mechanisms that can guide further research, but it does not imply that every firm will follow the same sequence or achieve the same outcomes.

5.6. Practical implications

Beyond its theoretical contributions, the dissertation offers practical implications for managers, organizational leaders, and policymakers. For managers, one implication is that digital transformation should not be treated as a purely technological project. Investments in digital infrastructure, cloud services, and analytical capabilities are important, but they need to be connected to a clear data strategy. Without such a strategy, digital transformation may remain limited to efficiency improvements or isolated technical initiatives. Managers need to ask themselves how data will be integrated, governed, shared, analyzed, monetized, and connected to business models.

The dissertation also suggests that firms should distinguish between internal and ecosystem-level innovation. The research emphasizes the necessity of developing integrated data strategies that simultaneously address internal capabilities and external coordination mechanisms. Internally, firms need to build the capabilities, routines, and structures to use data effectively. Externally, they need to understand how data can support partnerships, data-sharing, and ecosystem coordination. Firms that succeed on both dimensions are better positioned to use data not only for operational improvement but also to develop new value propositions, new revenue models, and stronger ecosystem positions.

For policymakers, the dissertation highlights the importance of digital-readiness conditions. Although data is increasingly regarded as a borderless and shareable resource, business model innovation is not developed or scaled independently of its surrounding context. Data-centric business model innovation is shaped not only by firm-level actions, but also by wider contextual factors, including digital infrastructure, skills, regulation, digital adoption, and ecosystem maturity. Policies that support digital infrastructure, data-sharing, cloud adoption, human capital development and cross-border collaboration can improve the conditions under which firms can develop and scale data-centric innovations.

In the Eastern European and Baltic region context, the findings suggest that catch-up is not only about increasing investment volume. It is also about building the

quality of digital capabilities. Smaller economies can become digitally advanced when they develop strong digital infrastructure, skills, and technology adoption. Larger economies may have greater scale, but scale alone does not guarantee digital sophistication. This distinction is important for both regional innovation policy and firm-level strategy. These insights may have implications for regional innovation policy and digital development strategies; however, it is important to note that this analysis is descriptive in nature and is based on limited country-level data.

5.7. Limitations and suggested directions for future research

While the dissertation offers theoretical and practical implications, and advances understanding of data-centric business model innovation, it has several limitations that should be acknowledged. First, as acknowledged earlier, the proposed framework is conceptual and synthesized across different article designs. It should not be interpreted as a framework or model that guarantees successful business model innovation and subsequent firm's growth. Instead, it provides a theoretically based explanation of how digital readiness, data strategy, business model innovation, ecosystem collaboration, and growth opportunities may be connected.

Second, the dissertation does not directly measure firm-level financial performance. When business model objectives are discussed, these concepts are used in a broad sense, encompassing, but not limited to, market expansion, scalability, innovation capacity, ecosystem positioning, and value creation potential. Future research could examine these relationships using longitudinal firm-level data and performance measures. An additional avenue for further research could also be to investigate tensions created by data-centric business models. Relevant issues include unequal access to data, dependence on infrastructure providers, conflicting value-capture interests, privacy, governance, and shifts in ecosystem power.

Finally, the country-level analysis is descriptive and based on selected indicators, countries, and available data. It helps contextualize the framework but does not provide causal evidence that regional digital readiness directly leads to firm-level data-centric business model innovation or creates growth opportunities, or vice versa. Future studies could expand the dataset, include more countries, and apply more advanced longitudinal methods.

5.8. Concluding remarks

In conclusion, this dissertation demonstrates that data-centric business model innovation is a distinct and important phenomenon. It cannot be fully explained by technology adoption alone, by firm-internal transformation alone, or by traditional business model theory alone. Instead, it is a complex and multifaceted phenomenon that requires an integrated perspective and should be viewed and analyzed from multiple angles.

This study shows that data becomes valuable not simply when it is collected, stored, or analyzed, but when it is strategically governed, mobilized, shared, and embedded in business model design. Data strategy is therefore central because it connects technological potential with organizational capabilities and ecosystem partnerships.

The dissertation ultimately argues that the familiar phrase *"data is the new oil"* is incomplete. Data does not create value by itself. Its value depends on how firms and ecosystems organize around it. When digital readiness is translated into data strategy, and when data strategy enables business model innovation within and across organizations, data can become a foundation for creating growth opportunities in the digital economy.

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Appendix

The table below presents the citation frequency of the top 15 most frequently cited references in the dissertation body.

Rank	Reference	Approx. in text mentions
1	Vial (2019)	9
2	Verhoef et al. (2021)	5
3	Zott & Amit (2010)	5
4	Barney (1991)	4
5	Jacobides et al. (2018)	4
6	Teece (2010)	4
7	Autio & Thomas (2020)	4
8	Bharadwaj et al. (2013)	3
9	Adner (2017)	3
10	Eisenhardt & Graebner (2007)	3
11	Yin (2018)	3
12	Mikalef et al. / Mikalef-related work	3
13	Penrose (2009)	3
14	Toorajipour et al. (2024)	3
15	Teece (2007)	3

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Drawing on interrelated studies, an integrative data-centric framework connecting digital readiness, data strategy, intra- and interorganizational business model innovation is proposed. It is demonstrated that data strategy is a central bridge between digital readiness and business model innovation, defining how data is collected, integrated, modelled, governed, shared and used for value creation and value capture.

The findings add to current research by positioning data as a strategic resource, a mechanism for coordination, and an enabler of value creation at both company and ecosystem levels. There are practical suggestions for executives and policy makers, emphasizing the need to align digital transformation with clear data strategies while strengthening elements such as organizational digital capabilities, ecosystem alignment, digital infrastructure, human capital, responsible data sharing practices, and regulatory clarity.

Nima Yahyapour conducts research on business ecosystems and business model innovation.

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