1
Introduction to digital innovation

1.1. The terms "digital" and "digital innovation"

In recent years, the term "digital" has morphed from a simple descriptor into a buzzword that echoes in boardrooms, classrooms, and living rooms around the globe. It is splashed across headlines, woven into company mission statements, and is often hailed as a sign of a forthcoming transformation. But what does "digital" truly mean? And when we talk about "digital innovation," what are we really referring to?

The popularity of the term can sometimes mask its complexity. Different sectors, industries, and individuals interpret "digital" in different ways, often leading to a confluence of meanings and, at times, confusion. As we approach a future that's becoming more and more digitized, it is crucial to clarify these terms, laying a solid foundation for understanding their transformative potential.

A recent exploration on the Web of Science regarding the frequency of the term "digital" as a keyword in scientific publications across diverse fields (see Figure 1) unveils a telling trend: the number of publications featuring the term "digital" in their title has increased dramatically in the past 15 years. When narrowing the search to the term "digital innovation," the difference is even more pronounced. The burgeoning academic focus on terms like "digital" and "digital innovation" reflects a rising dependence of our society on digital technologies. As suggested by the seminal essay "Why Software is Eating the World," software is steadily *invading* sectors once thought immune to digital disruption.

Yet, as academic and professional attention converges on the digital realm, a pressing issue arises: the ambiguity surrounding the term "digital." While its frequent use underscores its contemporary relevance, there exists a conspicuous absence of a unified, clear-cut definition. This is further complicated by the necessity to distinguish "digital innovation" from previous computer-based or internet-based revolutions. Each wave of technological evolution brought with it distinct characteristics, challenges, and opportunities. So, what sets the current digital surge apart? It is an intriguing paradox – as the term is commonly used, its mean-

ing remains nebulous, with varied interpretations spanning across sectors and contexts. This gives rise to the pressing question: What exactly do we mean when we talk about "digital"?

Figure 1. – *Occurrences of the terms "digital" and "digital innovation" in scientific publications*
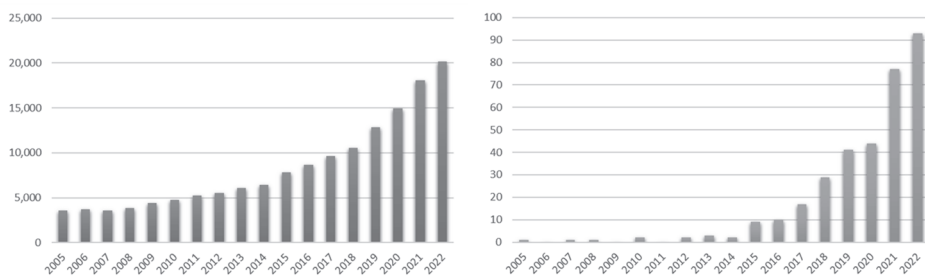
Source: Web of Science.

1.2. Historical Context

In the lexicon of our times, "digital" is often entwined with the idea of an ongoing digital revolution, a transformation so profound that it has earned the moniker of the Fourth Industrial Revolution. This surge of innovation coincides with a shift in the technological paradigm that underpins the functioning of our economy and society as a whole. As these technologies become more intertwined in our daily lives, we find ourselves at the nexus of a profound paradigm shift. Within this transformation, terms like "Industry 4.0" have emerged, often associated with factories equipped with cyber-physical capabilities. Digital technology extends far and wide, encompassing digitally enabled devices, mobile technology, 3D printing, big data analytics, artificial intelligence, the Internet of Things, blockchain, augmented reality, and robotics, among others. In these smart production spaces, devices seamlessly connect and communicate with one another, paving the way for a new era of efficiency and innovation. Yet, as we stand on the threshold of this profound transformation, it becomes increasingly evident that we haven't had the time to fully grasp and savor the benefits of the Fourth Industrial Revolution, colloquially known as "Industry 4.0", before the waves of the Fifth Industrial Revolution (5.0) are beginning to ripple.

Digital 5.0 represents a pivotal phase in the digital revolution, focused on bridging the connection between humans and technologies across various domains. Building upon the achievements of Digital 4.0, which emphasized the integration of transformative technologies like IoT, Big Data, and robotics, Digital

5.0 takes a stride further by placing human involvement and interaction at its core. Technologies so-called 5.0 aims to facilitate seamless collaboration between humans and technology, enabling more intuitive and natural ways for individuals to interact with digital systems. The significance of Digital 5.0 lies in its potential to create a sustainable and human-centric approach. By fostering collaboration between humans and technologies, Digital 5.0 can lead to more fulfilling employment opportunities, improved working conditions, and the development of adaptable and efficient processes capable of responding to evolving market dynamics and supply chain challenges.

It is evident that digital technology has been more than a series of technological advancements. It has been a transformative process, reshaping not just tools and systems, but also mindsets and operational paradigms.

1.3. Realizing and embedding digital innovation into organizations

Digital innovation, as defined by Nambisan *et al.* (2020), is the creation of market offerings, business processes, or models resulting from the use of digital technology. In the contemporary lexicon of business and technology, 'digital innovation' represents a concept that extends beyond mere technological advancement. It encapsulates a shift in approach, mentality, and execution within the field of digital technology. According to Wiesböck and Hess (2019, 75), "the realization and embedding of digital innovations into organizations manifests along three concentric rings: the technology-driven development and the different implementation categories of digital innovations at the core, the enablers of digital innovations in a second ring, and the governance of digital innovations in a third ring" (Figure 2).

Figure 2. – *Realization of digital innovation*
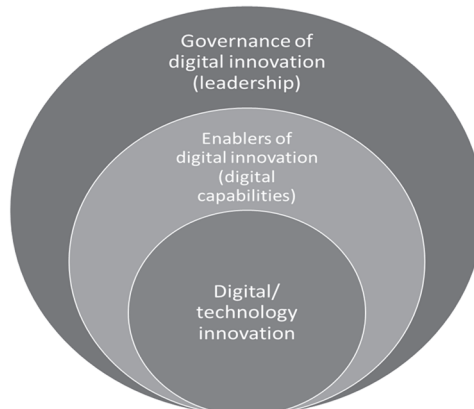
At its core (Figure 2), digital innovation involves leveraging digital technologies to create novel or significantly improved processes, products, or services. It is a multidimensional concept, not confined to one sector or industry but pervasive across various domains, reshaping how we interact, operate, and conceive new ideas. As noted by Soto Setzke *et al.* (2021), digital technologies are fundamentally altering how organizations design services, signaling a shift from traditional, product-centric models to more dynamic, service-oriented digital approaches. Digital innovation manifests in various forms – from the development of new business models and digital platforms to the reinvention of customer experiences and operational processes. It is about harnessing the potential of digital tools to create value in ways that were previously impossible or unimaginable. This innovation is not just about improving efficiency but also about exploring new opportunities and solving complex problems. The immediate impacts of digital innovation are profound and multifaceted. On an operational level, it enhances efficiency, reduces costs, and accelerates decision-making processes. But its effects go deeper, influencing the very essence of organizations. As Anthony (2016) illustrates, companies like Netflix have not only transformed their operational models but have also redefined their core business practices and strategies through digital innovation. We delve into the implementation of a specific digital technology in the first part of the book. In particular, we choose to focus on synergizing human-technology interactions: a digital innovation that is currently in the development phase and that deserves more attention. The relevance of this digital innovation lies in the harmonization of technology with the human dimension. We recognize the essential role of human creativity, which should be seamlessly integrated with digital tools to create innovative solutions. Technology becomes an inherent part of human activities and workflows, enhancing daily work rather than existing as a separate entity. The result is an improved user experience with more customized, automated, and efficient processes.

In the second ring, the enablers of digital innovation encompass various factors that contribute to and facilitate the adoption and successful implementation of digital technologies and innovative practices within organizations. These enablers collectively create an environment that fosters creativity, agility, and a forward-looking mindset. Among these factors is the development of specific digital capabilities, which refer to an organization's ability to effectively leverage digital technologies and resources in order to achieve its strategic objectives and remain competitive in the digital age. These capabilities encompass a wide range of skills, processes, technologies, and organizational practices that enable an organization to harness the power of digital innovation and transformation. Additionally, a critical component of these enablers is the formulation of a digital strategy that aligns digital development with the overall corporate strategy. We discuss the enablers of digital innovation in the second part of the book, specifically focusing on digital capabilities. Digital capabilities, characterized by their modular nature and programmatic interface (Piccoli *et al.*, 2022), enable organizations to adapt, evolve, and stay

ahead of the competition. In a world where digital technology rapidly evolves, the capacity to adapt, integrate, and leverage these technologies becomes a competitive advantage. This aspect underscores the importance of not only acquiring digital tools but also fostering an environment where these tools can be effectively utilized for innovation and transformation.

In the third ring, we find the governance and leadership aspects of digital innovation. These are critical aspects of managing and fostering digital innovation as it requires a structured framework to develop effectively. Leadership and governance ensure proper allocation of resources, including budget, talent, and time, to support innovation efforts, establish clear and measurable objectives, identify, and manage risks associated with innovation, define decision-making processes, and allow for continuous monitoring and evaluation of innovation projects. Effective innovation leaders inspire and guide teams, creating an environment where innovation can flourish. Innovation leaders have a forward-thinking mindset and set a clear vision for innovation. They ensure collaboration and foster a culture where ideas are valued and everyone feels encouraged to participate. We explore the topic of innovation governance in the third part of the book, where we delve into the responsibilities of the leadership that we have situated within the role of Chief Innovation Officer (CInO). We focus on the organizational structure and the necessary leadership characteristics to guide innovation within an organization. The emergence of the CInO role as a key figure that drives the innovation process exemplifies the transition from a decentralized approach to a centralized and strategic oversight of digital innovation initiatives. This leadership is essential for fostering an innovation-driven culture, aligning innovative efforts with business strategy, and ensuring organizational agility and responsiveness.

Together, these concentric rings define the essence of digital innovation and serve as a roadmap in the development of this book, defining the areas to be studied and developed and inspiring our theoretical framework. Digital innovation is a key driver of change in the modern era, fundamentally reshaping the way organizations operate and compete. Its impact is far-reaching, affecting not just the operational aspects of businesses but also changing business models, strategies, and customer engagement approaches. Digital innovation, as we discuss in the next section, has strong transformative potential, presenting numerous opportunities but also significant challenges. Despite its apparent benefits, digital innovation requires organizations to navigate through a context of complexity and uncertainty. The challenge lies in not only implementing digital solutions but also in adapting to the continuous and rapid evolution of technology. Understanding this concept is crucial for any organization seeking to thrive in the current digital age.

1.4. The transformative impact of digital innovation

As mentioned, digital innovation carries a profound transformative potential that can entirely reshape industries and markets. It goes beyond simply adopting new technologies; it is about fundamentally reimagining businesses, from how they operate efficiently to their strategic focus and organizational identity.

Small and medium-sized enterprises (SMEs) are at the forefront of this revolution. As highlighted by Zamani *et al.* (2022), digital analytics are no longer optional but a necessity for SMEs striving to stay competitive. This adoption is not just about technology but about a strategic recalibration to meet evolving market demands and opportunities.

A pivotal aspect of digital innovation lies in its resemblance to architectural innovation (Pisano, 2015), characterized by a combination of technological advancements and business model transformations. This type of innovation involves adopting new technology while reimagining and restructuring the entire business approach. A classic example of this is the transition from traditional to digital photography. For companies like Kodak and Polaroid, historically rooted in the analog photography market, the shift to digital represented a monumental challenge. It was not merely about adopting a new technology; it involved mastering entirely new competencies in solid-state electronics, camera design, software, and display technology. More fundamentally, it required a radical change in their business models – from primarily profiting from disposables like film, paper, and processing chemicals to finding profitability in digital cameras and related services. This underscores the necessity for companies to embrace technological advancements while concurrently developing new services (servitization) alongside product-related innovation.

Troise *et al.* (2022) point out the agility that technological advancements and digitalization bring to organizations. This agility is critical for businesses to swiftly respond to external changes in today's fast-paced environment. Similarly, Sedera *et al.* (2022) emphasize the role of digital business transformation in times of crisis, such as the COVID-19 pandemic, where innovation and entrepreneurship are increasingly digitally-driven. This trend is likely to extend beyond the pandemic, with digitalization becoming the new norm in business transformation.

Denicolai *et al.* (2022) suggest that in challenging times, businesses must seek new forms of competitive advantage and strategy, with digital transformation offering a viable direction for a competitive renaissance. The urgency for action is heightened, necessitating a faster pace of understanding and adaptation by businesses, customers, and the economic and social environment. Furthermore, digital transformation is now seen as a critical path for improving organizational resilience, as observed by Zhang *et al.* (2021). This perspective is echoed both in academic circles and business practice. For example, Grego *et al.* (2024) find that in the short term, companies with a more domestic and less innovative footprint are

more likely to rely on digital transformation because capitalizing on digital transformation represents the most effective strategic approach to fostering resilience. In the long term, a gradual investment in diversification and innovation will make these companies inherently more resilient, reducing their reliance on radical transformation (Grego *et al.*, 2024).

Digital transformation and resulting business model innovation have fundamentally altered consumer expectations and behaviors, exerting pressure on traditional firms and disrupting markets (Verhoef *et al.*, 2021). Similarly, reflecting on the broader economic transformation, Becker *et al.* (2018) discuss how the third industrial revolution, driven by digital computer technology innovations, has increased market complexity and shifted the power to buyers. In the industrial sector, the interplay between servitization and Industry 4.0, as explored by Frank *et al.* (2019), shows different approaches to adding value, whether customer-focused or technology-driven.

Horlacher and Hess (2016) emphasize that integrating digital elements into business models is now the key to success across industries, requiring new managerial thinking. Similarly, Marion and Fixson (2020) highlight the far-reaching changes brought by digitization in innovation processes, affecting everything from output quality to organizational structures and ecosystems.

The transformative impact of digital innovation encompasses a wide array of business aspects, from operational efficiency to strategic reorientation and market redefinition. It is a phenomenon that extends beyond technology implementation, influencing the core strategies, structures, and cultures of organizations. This digital revolution is reshaping the essence of business, leading to a new era of efficiency, agility, and customer-centricity.

1.5. Digital innovation in practice

Digital innovation transcends traditional boundaries, offering new pathways for growth and redefinition. Rolls-Royce, Telepass SPA, and Mercedes-Benz each provide a unique narrative on how companies harness digital innovation. Their stories reveal profound adaptations and leadership in the face of evolving market demands and technological advancements. These case studies illuminate the depth and breadth of digital transformation, showcasing its role in reshaping business models, operational strategies, and industry standards.

Rolls-Royce, a renowned manufacturer of luxury cars and aircraft engines, shifted its business model through digital innovation, embodying the concept of servitization. Traditionally known for manufacturing and selling engines, the company transformed its offering by leveraging digital technologies. Rolls-Royce introduced the "Power-by-the-Hour" program, which represents a fundamental shift

from selling physical products (engines) to providing a service. Instead of selling aircraft engines as a product, Rolls-Royce offers them under a service agreement where customers, typically airlines, pay based on the hours an engine is operational. This approach aligns the interests of the manufacturer and the customer toward maximizing engine uptime and efficiency. Central to this servitization model is the use of digital technologies. Rolls-Royce equips its engines with sensors that collect vast amounts of data during flights. This data is then analyzed to monitor engine health, predict maintenance needs, and optimize performance. The use of advanced analytics and real-time data enhances the service value, offering customers predictive maintenance, reduced downtime, and improved operational efficiency. This transformation has led to stronger customer relationships and a steady revenue stream for Rolls-Royce. It represents a shift from a transactional business model to one focused on long-term service and value creation. The model not only provides financial benefits but also enhances customer satisfaction by ensuring reliability and efficiency. The "Power-by-the-Hour" program by Rolls-Royce is a prime example of how companies can use digital innovation to transition from traditional product offerings to advanced service-oriented models. This approach, underpinned by digital technologies, is also known as servitization, which is the process by which companies transform from offering solely products-based goods to providing a combination of goods and services to meet customer needs.

Telepass SPA, originally known for its electronic toll collection system in Italy, has evolved significantly through digital innovation (Farronato *et al.*, 2021). The company expanded its service offerings far beyond toll collection, embracing a broader mobility concept. Telepass transformed itself into a comprehensive mobility platform by leveraging data-driven technologies. The company expanded its services to include a variety of digital solutions that cater to different aspects of mobility. This includes parking payments, fuel payments, taxi services, and even car sharing. At the heart of Telepass' transformation is its strategic use of data. By analyzing the vast amount of data collected from toll transactions, Telepass gained insights into the travel patterns and needs of its users. This data was then utilized to develop new services that provide added value to customers, such as real-time traffic information, route planning, and personalized travel suggestions. This expansion of services transformed Telepass from a toll service provider into an all-encompassing mobility service platform. It offered customers a more integrated and seamless travel experience, simplifying various aspects of transportation and mobility. For Telepass, this pivot expanded its market reach and opened up new revenue streams, transitioning the company into a more diversified business model focused on digital services. Telepass SPA's transition from a tolling system to a comprehensive digital mobility platform illustrates the power of digital transformation in extending and enhancing service offerings. By adopting a data-driven approach, Telepass was able to innovate and evolve its business model to meet the changing needs of the modern mobility sector.

Mercedes-Benz, a leader in the automotive industry, has taken significant strides in digital innovation as part of its commitment to sustainability and future readiness. A key part of this process is their plan to go fully electric by 2025. A pivotal element in Mercedes-Benz's digital transformation is MO360, a comprehensive digital platform that integrates data across its manufacturing plants. This platform connects plant operations to cloud computing, enabling real-time data analysis and decision-making. During the COVID-19 crisis, MO360 played a crucial role in Mercedes-Benz's ability to quickly identify and address supply chain bottlenecks, a capability that many of its competitors lacked at the time. MO360's implementation proved instrumental not only in navigating the pandemic's immediate challenges but also in aligning the company with long-term sustainability goals. The platform's efficiency and predictive capabilities are key in supporting Mercedes-Benz's transition to electric vehicle production, a move critical for reducing $CO2$ emissions and adhering to environmental standards. The deployment of MO360 signifies Mercedes-Benz's proactive approach to digital innovation, ensuring that the company is not just coping with current challenges but is also well-prepared for future ones. This strategic move highlights the role of digital technologies in enhancing operational efficiency, improving environmental sustainability, and ensuring long-term business resilience. Mercedes-Benz's adoption of MO360 technology exemplifies how digital platforms can revolutionize traditional manufacturing processes, enabling companies to meet contemporary challenges while preparing for a sustainable future. It demonstrates the transformative power of digital innovation in aligning business practices with evolving global standards and consumer expectations.

These three cases – Rolls-Royce, Telepass SPA, and Mercedes-Benz – show three different transformation models, starting from the servitization model, the data-driven model, and the sustainability-driven model. They highlight the varied applications and profound impacts of digital innovation. Each model reflects how companies adapt to challenges and leverage digital technologies for strategic growth and sustainability in unique ways.

1.6. Strategic implementation: the role of leadership

As observed by Chen *et al.* (2021), there is a surprising gap in understanding how digital innovation is practically implemented within organizations. Bridging this gap is crucial, and it often begins with strategic leadership and the appointment of dedicated roles for steering digital innovation efforts. Effective digital transformation is rarely a bottom-up process; it requires commitment and direction from the top. Leadership in the context of digital innovation goes beyond general oversight; it involves making critical strategic decisions, fostering a cul-

ture of innovation, and allocating resources effectively. Leaders must not only en-vision the digital future of their organization but also actively drive the transition toward it.

As emphasized by He *et al.* (2022), effective transformation and innovation management result in organizational resilience. Leadership capabilities provide an organization with a transformative vision, effective governance, a culture that nurtures employee talents and innovativeness, and built-in leadership that fosters such an environment. This conducive atmosphere is essential for enhancing resili-ence, which, in turn, has a positive impact on both organizational performance and employee optimism.

The role of a single individual with C-level responsibilities to drive the com-pany's business model transformation is emphasized by Klos *et al.* (2022) and Firk *et al.* (2021b). This leader should be responsible not just for the integration of digital technologies but also for restructuring the corporate vision and driving comprehensive transformation plans. This central role is crucial for addressing the urgency of digital transformation and coordinating efforts across various organi-zational dimensions.

Leaders in the digital age, as per Schiuma *et al.* (2021), must champion digital transformation entrepreneurship. This involves creating or evolving businesses with digital transformation at their heart, emphasizing the continuous development and application of digital knowledge for value creation. The emergence of digital transforming capabilities, comprising digital-savvy skills, digital intensity, and con-ducive contexts for action and interaction, further supports this, as identified by Sousa-Zomer *et al.* (2020). These capabilities are linked to enhanced firm perfor-mance, underscoring the importance of skilled human capital in shaping data-driven business models.

The comprehensive role of an innovation leader extends to strategic planning and communication regarding digital transformation. As noted by Artemenko (2019) and Becker *et al.* (2018), digitalization involves not just the alteration of processes but the fundamental transformation of entire business areas. The digital innovation leader plays a critical role in this transformation, driving digital chan-ges and providing the expertise needed for digital challenges.

Embedding digital innovation leaders effectively within the organizational structure is crucial for the company's success. This involves both vertical integra-tion into the company's hierarchy, depending on the firm's digital transformation strategy and the leaders' task focus, and horizontal coordination across different units and hierarchical levels. The involvement of such C-level executives is es-sential for successful digital strategic implementation, as asserted by Soto Setzke *et al.* (2021).

Moreover, digital innovation leaders often deal with the complexities of insti-tutionalizing digital innovation. Tumbas *et al.* (2018) describe how these leaders, as institutional entrepreneurs, articulate and develop the emerging digital logic of action and strategize to bridge gaps between traditional and digital approaches.