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The Next Frontiers of Digital Innovation Research

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1. Introduction

At the dawn of the millennium, digital innovation emerged as a transformative promise. The unforeseen power and ubiquitous presence of digital technology engendered a compelling vision of individuals across society as potential creators who would not only enjoy their own digital experiences in everyday life (Yoo 2010), but also generate novel products. Yoo et al. (2010) associated this promise with the emergence of a new technical architecture, the Layered Modular Architecture (LMA), that established the conditions whereby the focus of value creation shifted from the control of corporates behind opaque walls into the hands of ordinary, yet savvy, individuals and entrepreneurs. Furthermore, they envisioned that this new technical architecture would bring a new organizing logic that was bound to challenge the traditional one that governed the industrial economy. Digital technology was no longer hidden in beige boxes in the back offices of large corporations. Rather, it was in the hands of people in their everyday contexts (Weiser 1991, Yoo 2010). The ubiquity of digital infrastructures (Tilson et al. 2010, Henfridsson and Bygstad 2013) and the availability of smartphones as a delivery mechanism (Lyytinen and Yoo 2002) radically lowered the entry barriers for entrepreneurs to pursue unprecedented market opportunities through digital innovation.

The research commentary by Yoo et al. (2010) arguably served as a catalyst for the interest in digital innovation among IS scholars.[1] Defining digital innovation as "the carrying out of new combinations of digital and physical components to produce novel products" (Yoo et al. 2010, p. 725), it offered two key ideas that enabled scholars to frame and study the unique nature and consequences of digital innovation. First, it described the specification of a technology architecture through which innovation is enabled and markets are transformed. In particular, the LMA advances the notion of four distinct layers—hardware, software, content, and network—as separate value spaces of innovation (cf. Henfridsson et al. 2018). Second, it put forward the incessant recombination as the driving force of digital innovation. Combined with the accessibility of digital technologies as the primary means of digital innovation and the historically low cost of capital, these two forces—the separation of four layers and recombination—allowed researchers to explore new forms of value creation far beyond the traditional vertical industrial and product boundaries.

Some 15 years later, digital innovation has come of age. Consider how digital innovation has transformed industries, reshaped economies, and altered our lives and work. We navigate with Google Maps, share memories on Instagram, work remotely via Zoom, shop endlessly on Amazon, and stay connected through Facebook. From LinkedIn for professional networking to X (formerly Twitter) for real-time updates, from Dropbox for file storage to Venmo for seamless transactions, and from Fitbit for fitness to Headspace for mindfulness, digital tools permeate every aspect of our lives, reshaping the way we connect, learn, and grow. Apple, Google, Amazon, Microsoft, and Meta are among the world's most valuable companies, boasting trillions of dollars of market capitalization. The advent of the gig economy, fueled by companies like Uber, Airbnb, and Etsy, has disrupted traditional employment models and created new opportunities for millions of people worldwide. Most recently, hardware companies like Nvidia have enabled other companies to accelerate digital innovation further by supplying technologies that enable parallel computation. For the most part, the IS community has been at the forefront of researching this digital innovation revolution.

Yet, it is clear that our current society does not readily map to the positive image envisioned by Yoo et al. (2010). Even though the past 15 years have indeed unleashed a wave of generative innovations, the lion's share of the value created has been captured by a handful of big tech platforms that have mastered and exploited the inner workings of digital infrastructure. Although we, people in our everyday contexts, enjoy free, convenient, and almost abundant digital services, we pay for these "free" services with the data we create through our attention and actions. The early promise of democratizing innovation through the unbounded generativity of digital technology has been tamed by the iron grip of the few companies, often referred to as the Magnificent Seven. The most recent court ruling on Google's monopoly case is just the tip of the iceberg (*United States of America et al. v. Google LLC* 2024). Moreover, as these technologies have expanded, concerns have emerged, in turn, about their unintended negative consequences for society, from the unsustainable level of electricity demands to power data centers and generative artificial intelligence (AI) (Watson et al. 2010) to the amplification of fake news (Muchnik et al. 2013, Kitchens et al. 2020) and declines in youth mental health associated with the use of social media platforms like Instagram and TikTok (Krasnova et al. 2015).

Addressing the apparent chasm between the early vision of unbridled value creation of digital innovation and the reality 15 years later of the negative consequences of digital innovation is the grand challenge that the global information systems research community must confront. The power of digital innovation is too ubiquitous, its reach too pervasive, and its impact too consequential for our community to stand on the sidelines and passively document what happens. The urgency of this challenge serves as the impetus for this editorial.

In this editorial essay, we take a step back to critically examine the current state of digital innovation to trace the root of both the positive and the negative consequences of digital innovation from multiple perspectives. In doing so, we revisit some of the early assumptions about the nature of digital innovation as they manifest in the literature, both explicitly and implicitly. We also reflect and draw upon more recent theoretical developments (Yoo et al. 2010, Kallinikos et al. 2013, Henfridsson et al. 2018, Faulkner and Runde 2019, Baskerville et al. 2020, Recker et al. 2021, Alaimo and Kallinikos 2022, Baiyere et al. 2023) and empirical studies (Huang et al. 2017, Svahn et al. 2017, Tumbas et al. 2018, Recker et al. 2021, Huang et al. 2022, Lehmann et al. 2022, Fürstenau et al. 2023, Ganguly et al. 2024, Lorenz et al. 2024). With a focus on architecture, externalities, or data, we now see an increasingly mature set of diverse, yet complementary, theoretical perspectives that help us offer a more balanced view of digital innovation and address the developments that keep changing the technical and institutional landscape in which it unfolds.

The goal of this editorial essay, therefore, is to critically review the contours of the evolution of digital innovation research over the years and offer a set of entry points for IS scholars with diverse backgrounds to engage with this important intellectual challenge that our field should address. We attempt to clarify some key constructs underpinning our collective discourse on digital innovation and how they evolved. We also try to shed light on the inherent connections and tension between the two sides of value—creation and capture—which has not received much attention in the IS community. We do so in the spirit of advancing our collective understanding of this complex and dynamic phenomenon among the broader IS community, rather than closing down the discourse.

2. Digital Innovation: Background, Current Status, and Limitations

2.1. Background

In the aftermath of the dot.com bubble, the world saw decisive and irreversible changes driven by digital technology. As observed by Friedman (2017), the launch and breakthrough of the iPhone, Hadoop, GitHub, Facebook, Twitter, YouTube, Android, Kindle, Airbnb, and IBM Watson, among many other significant innovations, roughly happened when internet users hit 1 billion in late 2006. Given these breathtaking innovations, the promises of the early visions of computing seemed to have finally arrived. Computers were no longer just tools for work in the office, but became integral parts of our daily lives (Weiser 1991, Dourish 2001, Yoo 2010).

Until then, information technology (IT) was a tool to support business. IT had to align with the business to support its strategic goal (Henderson and Venkatraman 1999). To wit, IT was not the business; it was merely a tool to support it. However, all of that changed this century. Now, IT has become the business. It started with early digital native companies like Google, Amazon, and Facebook, selling digital goods. These digital goods were not subject to the economic rules of the physical goods of traditional firms (Shapiro and Varian 1999). Over time, however, the barrier between digital and physical goods blurred with the introduction of smartphones, the Internet of Things, and mobile communications.

Given this historical context, scholars were confronted with the need to make sense of the new role of IT, which had become more pervasive and ubiquitous than ever before. Although the emergence of IT as the driving force of economic and societal transformations was a welcome development for IS scholars, it also presented significant challenges to those who historically focused on the role of IT within organizations. Although it was possible to offer partial explanations of the evolving landscape through the existing "IT" lens, the field needed new perspectives that would allow us to see the world in a fundamentally different way. The early digital innovation research was born out of this historical context.

2.2. Current Status

The term "digital" started to emerge in our discourse as a meaningful signifier some 15 years ago. Early works by Yoo et al. (2010), Yoo (2013), Faulkner and Runde (2013, 2019), Kallinikos et al. (2010, 2013), and Leonardi (2010) offer contributions that speak to digital innovation. This early body of work emphasizes reprogrammable, recombinable, ephemeral, and ambivalent characteristics of digital objects that enable the procrastinated and temporary binding of digital resources for new market offerings (Lehmann et al. 2022), generativity (Yoo et al. 2012, Fürstenau et al. 2023), rapid scaling (Huang et al. 2017), and, eventually, the establishment of digital platform ecosystems (Parker et al. 2016, Jacobides et al. 2018).

A series of conceptual breakthroughs came when scholars began articulating digital objects' properties. Two contributions stand out. First, Faulkner and Runde (2013, 2019) conceptualize digital objects, such as software applications and data files, as essentially nonmaterial, bitstring-based objects that contrast with the spatial attributes associated with physical objects. Nonmaterial objects of this sort nonetheless have an enduring structure and are variously entangled with material bearers (e.g., hard-disks, CD-ROMs), through which they are stored, shared, and acted upon. Second, Kallinikos et al. (2010, 2013) elaborate on digital objects as editable, interactive, open, and distributed. These properties, Kallinikos and his coauthors claim, challenge the conventional notions of stability, boundedness, and closure that have characterized most artifacts in the past. Moreover, they suggest that digital objects are not only different from physical objects, but also from other types of symbolic or informational objects, such as texts, images, or sounds. Digital objects are not merely representations or carriers of information, but active agents that can manipulate, transform, and generate information through various computational processes.

In parallel to these works seeking to define digital objects and their unique features, Yoo et al. (2010) expound on how embedding digital components into previously physical products changes the nature of products, value creation, and the organizing logic. Building on two foundational theories in computer science—von Neumann's theory of the stored-program computer (later known as von Neumann Architecture) (von Neumann 1945) and Claude Shannon's digital signal theory (Shannon 1948)—they highlight two critical separations in product architecture as a consequence of digital innovation. These separations give rise to two fundamental properties of digital technology. First, building on von Neumann's computing architecture, they propose that the separation of hardware and software leads to reprogrammability. This means that the functionality of a digital device can be changed by modifying its software without altering the physical hardware. Second, building on Shannon's digital signal theory, they propose that the separation between network and content leads all types of content—texts, images, and sound—to be homogenized into bits. The separation between data and content is a fundamental prerequisite of the ongoing data revolution, as it allows different types of data to be transmitted, stored, and processed and combined using the same digital infrastructure (Gleick 2011, Alaimo and Kallinikos 2024). Furthermore, Yoo et al. (2010) note the self-referential nature of digital technology; digital innovation requires digital technology. They argue that the self-referential nature of digital innovation creates a virtuous cycle through the positive externalities of the diffusion of digital technology.

Observing the consequences of the infusion of layered modular architecture into previously nondigital products, Yoo et al. (2010) unravel the broader consequences of digital innovations. LMA's most crucial insight is that pervasive digitalization upends the long-held assumption of product design. With the proliferation of product-agnostic digital components and easily recombinable digital data objects, the very idea of a product as a fixed category is challenged. With the integration of software-enabled digital capabilities, things do not just become smarter and connected, but the boundaries between different products become blurred (Verganti 2009, Yoo et al. 2012, Wang 2021). Smartphones are not just smarter phones; the phone is one of many apps on a smartphone. A vehicle is now a "moving computing platform." Smartwatches and smart rings are wearable health devices that monitor our sleep, steps, heartbeats, breathing, and blood oxygen levels. No longer can firms apply existing mental models about product categories and industries to define what a product is and its value propositions (Kaplan and Tripsas 2008). Using generative, reprogrammable, and recombinable digital components, firms began looking for ways to discover hidden unmet needs to create new sources of customer value (Verganti 2009). This focus on value creation with digital innovations is a fundamental shift away from the traditional focus on value capture in the management literature.

Ever since the seminal work of Teece (1986) on "profiting from technological innovations," an implicit assumption in the management literature has been that the value creation potential for a given product category is more or less known and fixed once a dominant design of the product is established (Murmann and Frenken 2006). Therefore, extant literature suggests that firms must focus on value capture by adding new features, improving the efficiencies of their operations, and increasing their market share (Anderson and Tushman 1990). Casual observations of digital innovations, however, challenge such an assumption. Digital innovations do not simply marginally improve a firm's ability to capture value. Instead, they disrupt the existing market by offering different value propositions. LMA provides a theoretical foundation for firms to explore these unforeseen value-creation opportunities (Henfridsson et al. 2018, Jacobides et al. 2018, Gregory et al. 2021, Wessel et al. 2021). Furthermore, such explorations of new value-creation opportunities radically increase knowledge heterogeneity, demanding different innovation practices (Lyytinen et al. 2016).

Taken together, the term "digital" in early and subsequent work on digital innovation seems to have evolved to signify two separate, yet interrelated, departures from the previous ways of thinking about computer and communication technology. In the beginning, "digital" is used in contrast to "physical," marking a departure from industrial-age thinking, where physical assets were considered the primary sources of value creation (Penrose 1963, Porter 1985, Chandler 1990, Barney 1991). In this context, scholars suggest that digital assets have emerged as equally, if not more important, value-creating strategic assets for firms (Giustiziero et al. 2023). This perspective was driven by observing new market offerings providing seemingly boundless innovation opportunities (Yoo et al. 2012, Yoo 2013).

Over time, however, scholars have started using "digital" in contrast to "IT" to signal the emergence of new technology in organizations. This encompasses concepts like the consumerization of IT (Gregory et al. 2018) and experiential computing (Yoo 2010). Here, digital technology signifies a broad shift in the role of technology within organizations, moving beyond the traditional IT function (Tumbas et al. 2018). This departure of digital from IT coincided with the rise of various initiatives often led by parties outside traditional IT organizations, such as digital ventures and customer experience teams. These initiatives include pilot projects with smart and connected products, apps linked to conventional offerings, and new business models such as subscriptions and ad-supported revenue.

Through this evolution of the term "digital," we see an emerging consensus, whereby the term signifies the advent of digital resources and assets as unique sources of value creation via product innovation. As we stand now, we believe it is important to continue to build on the idea of "digital" as a meaningful signifier that implicates using various digital resources to create value, differentiating it simultaneously from physical and IT. It is equally important to note that the term digital does not necessarily signify different material capabilities per se, as others have suggested (Piccoli et al. 2022). Rather, it refers to the change in the role and the ownership of digital assets (even with the same material characteristics) and the shift in the locus of value creation processes.

2.3. Limitations of Digital Innovation to Date

Given the early excitement about the potential of distributed and generative digital innovation, mainly stressing the shift of the locus of value creation as a positive force for industrial organizing logic (Yoo et al. 2010), it is important to re-examine these early assumptions and projections to understand ways by which current economy and society do not necessarily map onto the reality envisioned.

We see at least three distinct, yet related, aspects of digital innovation that can serve as entry points to understanding the limitations of digital innovation research (see Table 1). First, *recombination* in layered modular architecture turns out to be subject to far more centralized control than originally imagined. Consider that, in modular systems, control is codified in the interfaces between components (Baldwin and Clark 2000, Lee and Berente 2012), and whoever has control over significant boundary resources (Ghazawneh and Henfridsson 2013) will also dominate the value spaces related to layers of digital innovation (Woodard 2008, Um et al. 2023, Benzell et al. 2024). The centralized control of key digital resources involved in the distributed value creation process can lead to uneven value distribution among participating actors.

Second, initially, the architectural view of digital innovation, represented by LMA, ran in parallel with the economic view of digital platform ecosystems, which view them as multisided markets (Rochet and Tirole 2003, Parker and Van Alstyne 2005). Over time, however, there is a growing convergence between the two perspectives as scholars increasingly draw on architectural and economic views on digital innovation (Van Alstyne et al. 2024). Early studies on digital innovation focused on the power of *network externalities* in the context of the supply side of platform ecosystems (Parker et al. 2016). This focus is often due to the visible and measurable impacts of supply-side growth, such as increased innovation, new product offerings, and enhanced platform capabilities. The supply side is frequently seen as the driver of network growth and value creation in digital ecosystems (Huang et al. 2017).

Table 1. Re-examination of Early Assumptions and Visions of Digital Innovation

Key ideas	We thought then	Yes, but
Distributed, generative, and recombinant innovation through LMA	Four distinct layers creating separate value spaces with system-agnostic digital components, which enables distributed and generative innovation through recombinations Industry and product boundaries blurred Shift of value creation from corporations to individuals and entrepreneurs	Disproportionate value capture by few big tech platforms Centralized control over key digital resources
Positive network externalities	Positive externalities driving innovation Enhanced platform capabilities	New form of externalities, data network effect Negative demand-side externalities (e.g., overcrowding, privacy concerns, entry barriers, and gatekeeping) Need for careful examination of centralized LMA used by dominant platforms
Data as the center stage of digital innovation	Homogenization of all data as a part of LMA's content layer Data as new economic resources through learning effect Data as the medium or vehicle by which innovation occurs	Centrality of data in value creation; data as an independent value source rather than enabler Privacy concerns and data exploitation Data perform epistemic, semantic, and communicative functions with far-reaching work, industry, and structural implications

However, the demand-side externalities, which have been less explored, can have profound implications, such as negative consequences associated with undesirable outcomes like overcrowding, gatekeeping, diminished user experience, and privacy concerns. Indeed, there is a growing concern among scholars and policymakers alike that the centralized nature of the current LMA needs to be carefully examined to address these negative externalities of digital innovations (Cennamo 2021, Van Alstyne et al. 2021, Cennamo et al. 2023, Jacobides et al. 2024).

Third, *data* have become a critical frontier in digital innovation. Although the LMA provides a framework for understanding content and its intersections with other layers of digital innovation, there is a growing recognition that value creation does not necessarily happen via the recombination of system-agnostic components alone. Rather, data homogenization and the aggregation and recombination of different types of data enable these platforms to create and capture value along diverse value paths (Baskerville et al. 2020, Gregory et al. 2021, Alaimo and Kallinikos 2022). It is, therefore, not surprising that new perspectives centered around data and digital objects have emerged (Alaimo and Kallinikos 2024) alongside work on data network effects (Gregory et al. 2022).

What connects these three aspects is the growing recognition of seemingly irreconcilable tension between digital innovation's incredible value creation possibilities and decisively distorted value distribution among participating actors. We believe these three aspects of digital innovation—recombinant innovation, network externalities, and data—offer potential entry points for IS scholars to address the grand challenge that our community faces.

3. Digital Innovation: Moving Forward

A central tension emerging from our reflection on the past 15 years is the irreconcilable chasm between the massive value created from distributed, generative, and recombinant innovations and the disproportionately uneven distribution of value created among actors. Thus, a compelling intellectual challenge that our field must confront is vigorous intellectual inquiries on how to resolve this tension efficiently, fairly, and sustainably. Our analysis highlights three aspects of digital innovation serving as complementary entry points to address this challenge: (a) the centralization of control over digital architectures, (b) the impact of negative externalities leading to market concentration, and (c) the emergence of data as a critical driver of value and organizational change (see Table 2). These three dimensions represent complex tensions between the architectural, economic, and epistemic dimensions of digital innovation. In what follows, we outline a set of research areas that we believe can serve as the frontiers of digital innovation research to resolve this tension in the years to come.

3.1. Decentering Architectural Control in Modularity and Recombinant Innovation

Recombination is essential to the innovation (Schumpeter 1983, Arthur 2009). Innovation is about combining

Table 2. Emerging Research Themes and Example Research Questions

Research areas	Themes	Example research questions
Architectures	New organizational and institutional rearrangement of firms	• What are the different forms of organizing, performing, and learning with deferred and temporary binding of digital resources? • How do digital innovation reorder organizational, technological, and institutional arrangements at a macro level? • How do organizations learn with massively parallelized and decentered organizational arrangements?
	Key interfaces and architectures are increasingly centralized	• What are the governance mechanisms that favor (nearly) symmetric value capture in digital innovation? • How can the benefits of modular recombination be leveraged within, and between, layers of digital architecture? • What is the role of emerging technologies, such as blockchain technology, in governance models that combine value creation with decentralized control?
	Design choices and consequences in digital innovations	• How do new structural conditions of layered modular architecture interact with human design agency in reshaping digital innovation practices? • What are the unintended consequences of digital innovation practices on individuals and society, including individual users' and workers' well-being and environments?
Externalities	Impact of regulations	• How effective are different regulatory approaches in addressing negative externalities?
	Socio-technical governance mechanisms	• How can decentralized technologies and governance structures mitigate market concentration and power issues? • What novel mechanisms can address societal consequences like misinformation? • How and why can platforms be designed to harness the positive aspects of network effects while mitigating market concentration?
Data	The emergence of data as drivers of value and organizational change	• How does the diffusion of data reshape organizational structure, practices, and decision-making processes? • How are data linked to platforms, concentration, and market control?
	The broader impact of digitalization and its innovation practices on social structures	• What is the impact of data as a source of digital innovation on the individual, firm, and industry levels? • How can one design technology architecture that ensures data ownership, while preserving data network effects?
	Data's role in reshaping expertise and knowledge generation (AI)	• What are the impacts of AI-driven cognition on social practices and modes of expertise? • How and why will expertise in data governance shape industries?

ideas, tools, and practices, established and new, into a product or service that creates value in a novel way. Bitcoin combines existing functions, such as the transaction timestamp, hashing, and distributed ledgers. It excels over many other attempts to establish digital cash among computer scientists and cryptographers by combining established functions in a novel and powerful way (Baucherel 2020).

Since Simon (1962, p. 468) observed that a complex adaptive system is "one made up of a large number of parts that interact in a non-simple way," decomposition and recombination of modules have been key to innovation strategies (Parnas 1972, Baldwin and Clark 2000). Such decomposition and modularization rely on interfaces to resolve potential conflicts among the complex system's interacting parts (Ulrich 1995, Sanchez and Mahoney 1996). Interfaces enable information hiding (Parnas 1972) that reduces a specific change's implications for the overall system and allows concurrent subsystem design, thus increasing the pace and scope of innovation (Baldwin and Clark 2000, Brusoni 2001). Therefore, recombinant innovation from modularity is critically dependent upon well-established interfaces offered by a dominant design (Anderson and Tushman 1990, Murmann and Frenken 2006).

Firms traditionally maintain tight control over design rules, including subsystems and components and interfaces that connect them, to serve specific products and services that they offer for specific market needs (Baldwin and Clark 2000). Once a dominant design of such systems emerges, firms use standardized design rules to coordinate through loosely coupled systems to maintain flexibility, adaptability, and efficiency (Sanchez and Mahoney 1996).

Digital innovations upended this model. Unlike the traditional modular architecture of physical products that follow the inherent hierarchical structure of system components (Clark 1985), Yoo et al. (2010) argue that digital components in LMA are fundamentally system-agnostic, even though, in practice, there may be limits on how far such components can be used across systems. With well-established interfaces of service-oriented architecture and cloud-based computing infrastructure, digital platforms defied the core assumption of traditional logic (Fishman and McLarty 2024). Instead of focusing on a single design hierarchy tightly controlled by a focal firm, companies like SalesForce, Google, and Amazon built their businesses by providing system-agnostic, programmable, and recombinatorial digital components to third-party developers. Amazon Web Services (AWS) and the entire software-as-a-service (SaaS) industry are built on this premise. Jeff Bezos, in his famous Bezos's mandate, wrote:

> All teams will henceforth expose their data and functionality through service interfaces. Teams must communicate with each other through these interfaces. There will be no other form of interprocess communication allowed: no direct linking, no direct reads of another team's data store, no shared-memory model, no back-doors whatsoever. The only communication allowed is via service interface calls over the network … All service interfaces, without exception, must be designed from the ground up to be externalizable. That is to say, the team must plan and design to be able to expose the interface to developers in the outside world. No exceptions. (quoted in Iansiti and Lakhani 2020, p. 79)

From this, Amazon transformed digital infrastructure designed to sell books into highly elastic and dynamic computing, communication, and storage tools that can be plugged into *any solution*. Other companies like Google and Microsoft followed suit with their web services, and a generation of digital entrepreneurs built a sprawling ecosystem of heterogeneous digital innovation ecosystems with application programming interfaces (APIs) and software development kits (SDKs) that enabled others to develop their products (Yoo 2012, Um et al. 2023).

The theoretical implication of this technical change is profound. A bedrock of modern management theory is how to create capabilities to design complex products for product-market fits under uncertainty through organizational design (Galbraith 1973, Tushman and Nadler 1978), coordination (Thompson 1967), control (Lawrence and Lorsh 1967), and learning (Nelson and Winter 1982). Common across all these classic management theories is that components of a product are system-specific and that organizations must set the design rules that govern how these components are designed, integrated, and tested (Baldwin and Clark 2000). With LMA, organizing for value creation is no longer trapped in a single design hierarchy within a firm. Instead, searching for the product and market fit is massively accelerated by parallel search pursued via millions of apps designed by individuals and third-party developers operating outside the control of large hierarchical firms. As Parker et al. (2017) succinctly note, the firm is inverted (Baldwin 2024).

We see several opportunities moving forward. First, the works of scholars like Chandler (1990), Yates (1993), and Langlois (2002) have provided detailed accounts of how industrial logic emerged and shaped the organizing logic as heterogeneous actors, including industrialists, employees, labor unions, and investors, dealt with new technology such as steam engines, trains, and telephones and telegraphs. Scholars like Castells (2002), Kallinikos (2007), and Tuomi (2002) have done similar work with the internet and how it has reordered organizational and social arrangements. Just as the Industrial Revolution and the internet led to profound changes in organizational and societal structures, the contemporary digital revolution is reshaping our institutional landscape in ways that we are still trying to comprehend. There is a growing body of work on this topic (Gillespie 2010, Grabher 2020, Stark and Pais 2020, MacKenzie 2021, Power 2022, Alaimo and Kallinikos 2024, Baldwin 2024). These studies point to the emergence of new institutional arrangements that are not based on traditional ownership of assets, but instead based on algorithmically arranged flows of fleeting relationality and value. Clearly, more research on the institutional transformation underway in the wake of digital innovation is needed.

Second, digital innovation scholars should investigate how the locus of control of the interfaces and overall layered modular architecture influence how value is created and captured. The starting point here is to make a distinction between *decentralization* and *distribution*. Although we have witnessed a significant distribution of innovation activities through the generative power of LMA, the control of digital innovation has not been distributed (Dixon 2024). In fact, one can argue that the control has become even more centralized than ever before. Now, we are seeing the emergence of a broad spectrum of decentralized web technologies (also known as Web 3.0), challenging the hegemony of distributed web technologies (also known as Web 2.0). These decentralized web technologies enable decentralizing the control of interfaces, user identities, and execution of protocols, among others.[2] We argue that the convergence of decentralization and LMA will help us address some of the negative consequences of the current LMA with centralized controls (Ellinger et al. 2024, Gregory et al. 2024, Halaburda et al. 2024). Future research must unravel the impact of decentralization on value creation and capture among different stakeholders.

Third, no digital innovations are created in a vacuum. They are outcomes of deliberate human actions and choices. Therefore, one must carefully examine the socio-technical design of decentralized web technologies. They bring several unforeseen challenges in scale, verifiability, and security. We have yet to fully understand how the unique structural conditions of digital resources shape the design choices of innovators and, conversely, how these choices influence the evolution of digital architectures and ecosystems. The layered modular architecture provides high-level contingent design choices. Some platform providers opt to envelop popular third-party modules on their platforms by tightly coupling those into their core modules (Eisenmann et al. 2011, Zhu and Iansiti 2012). The decisions made by platform providers regarding the coupling of modules or the design of interfaces have far-reaching consequences, yet our understanding of these design practices remains limited. We need to deepen our understanding of how such choices—whether they are individual applications, APIs, metadata, and contracts and rules on digital ecosystems—are made and what the social and ethical consequences of such choices are (Chatterjee and Sarker 2013, Becker et al. 2023).

3.2. Externalities

Given the dominance of platform-based settings in prior work on digital innovation (Tiwana et al. 2010, Yoo et al. 2012) and the unique growth dynamics of digital platforms in terms of "rapid scaling" (Huang et al. 2017), the literature in this domain has a close connection to the notion of network externalities (also referred to as network effects), which helps explain the exponential growth of digital platforms from an economic perspective (Parker et al. 2016, McIntyre and Srinivasan 2017, Jacobides et al. 2018). Externalities broadly describe scenarios wherein one party's actions have spillover effects, incurring costs or benefits to another third party (Karhu and Heiskala 2024). For instance, in the context of machine learning, platforms can create positive externalities by leveraging data from user interactions to enhance future experiences. This means that each interaction can improve the quality of subsequent interactions for the same user (within-user learning) and those of other users (across-user learning) (Hagiu and Wright 2023, Schaefer and Sapi 2023). One powerful instance of externalities is network effects, where the number of parties consuming a particular good or service has a spillover effect on another party's utility from consuming that same good or service (Katz and Shapiro 1985).

Expanding the notion of network effects, the concept of data network effects has recently emerged as a theoretical device to understand the role of data through the network lens, where the value of a network or platform increases as the ecosystem gains more data above and beyond the pure network effects. Data network effects is an emerging category of network effects focusing on the phenomenon that a user's utility of a platform is not only a function of the network, but also of data-driven learning and improvements realized with AI (Gregory et al. 2022, Hagiu and Wright 2023). For example, in Amazon's advertising network, Amazon leverages its massive data, which include users' browsing history, search records, and purchase behaviors, to target customers within its ecosystem. Individual vendors participating in Amazon's ecosystem enjoy the network effects of Amazon's scale and the power of its sophisticated AI system that helps target Amazon customers in a way that they cannot do otherwise. Although individual vendors have their customers' purchase history, Amazon has a complete history of customers' browsing patterns before and after their purchase decisions (Jones and Tonetti 2020). The more users and independent vendors buy and sell on Amazon, the more Amazon's ability to support individual vendors through its advertising network exponentially grows, creating a virtuous cycle of within- and across-user learning to generate spillover effects beyond the traditional network effects. The data network effects are rooted in the self-referential nature of digital innovation and the positive externalities associated with the diffusion of digital technology. As traditional players like Home Depot and LG begin to form their advertising network ecosystems, more research is needed to understand data network effects' positive and negative impact on firms and society.

By and large, IS research on digital innovation has focused on the positive effects of externalities created through the interactions of third-party complementors on the supply side of multisided platforms with platform users. However, externalities are not always positive; what can be positive for the platform owner may have negative implications for users and society. Negative externalities refer to situations wherein the private marginal cost of an action is lower than its public marginal cost, leading to overproduction relative to a welfare-maximizing ideal (Pigou 1924, Coase 1960). Early work in economics on digital platforms warned of the potential negative externalities of digital platforms, which may result in congestion, high search costs, the concentration of market power, and a reduction in consumer welfare (Katz and Shapiro 1985, Rochet and Tirole 2003). Society is now increasingly contending with that reality.

Therefore, IS scholars studying digital innovation must pay greater attention to the negative externalities of digital innovation and possible remedies. Although the economics literature offers a rich discussion of negative externalities and possible market-based or regulatory remedies (Hart and Moore 1990, 2007), traditional approaches face limitations in the modern digital context due to the unique characteristics of digital resources that underpin digital platforms (Van Alstyne et al. 1995, Shapiro and Varian 1999, Varian 2010). Scholars from different fields have recently begun to explore novel approaches to managing the negative externalities of digital platforms, identifying possible remedies and their impacts (Varian 2014, Frenken and Fuenfschilling 2020, Jones and Tonetti 2020, Van Alstyne et al. 2021, Acquisti 2022, Goldfarb and Tucker 2024). More such work is needed.

We see at least three complementary paths forward. First, scholars must investigate different forms of negative externalities of digital innovation. At the individual level, these include consumer lock-in (Bursztyn et al. 2023), digital addiction (Allcott et al. 2022), choice overload (Tucker 2018), overcrowding (Boudreau and Jeppesen 2015, Halaburda et al. 2018), and privacy violation (Acquisti 2022). At the societal level, they include anticompetitive behavior (Khan 2017), polarization (Boxell et al. 2017), and environmental costs (Istrate et al. 2024). More research is needed to estimate the true cost and value of digital innovation at all levels for all stakeholders.

Second, building on a large body of work in economics and public policy, scholars must scrutinize the efficacy of different regulatory approaches for addressing these negative externalities. For example, the Digital Market Act, the Digital Services Act, and the General Data Protection Regulation have been passed in Europe, and the AI Act remains under discussion (Wheeler 2024). In the United States, various government agencies, including the Antitrust Division of the Department of Justice, the Federal Trade Commission, and State Attorneys General, apply existing antitrust laws to address the issue. A debate about Section 230 of the Communication Decency Act is also ongoing, shielding digital platforms from liability for posted content (Van Alstyne 2023). Finally, China has introduced and rapidly begun to enforce its Anti-Monopoly Guidelines for the Platform Economy (Rong et al. 2024). Digital innovation scholars must carefully explore the efficacy and impacts of these efforts.

Third, it is crucial to explore new ways by which these negative externalities can be minimized. The governance and control mechanisms that platforms decide to implement can also have far-reaching consequences, extending beyond the platform itself. Consider Apple's recent introduction of privacy-preserving technologies and mechanisms in recent years, including intelligent tracking prevention and app tracking transparency. These changes, ostensibly introduced to aid the privacy of iOS/iPhone users, achieved that goal by hindering the ability of other players in the advertising ecosystem to target those users based on their online behavior. As a byproduct of its policy changes, Apple is uniquely situated to facilitate advertisers' access to those users by its data. Apple's own advertising business, previously a minor player in the online advertising industry, has thus benefited massively.[3] Future research on digital innovation is, therefore, needed to examine how different contract and governance structures leveraging decentralized architectures and platform designs can solve the issues of market concentration and power that stem from network externalities. Work is also needed to address the coordination problem and facilitate the transition to those novel technological solutions (Bakos and Halaburda 2022). As decentralized digital technologies and new forms of governance enabled by blockchain technology evolve, new possibilities may emerge for users to assume and maintain ownership of their assets and take control of value exchange, potentially resulting in less market concentration and more significant opportunities for each user to partake in value appropriation. Although negative externalities are theoretical constructs, they carry real human consequences. Therefore, all these considerations on externalities should be human-centered.

3.3. Data, Knowledge, and Organizational Change

The ideas put forward so far suggest that the link of data to innovation has largely remained implicit in the digital innovation literature. Data and data management continued until recently to be viewed as background operations necessary to support the smooth execution of tasks. It was only in the last 10 or 15 years that data came to be widely understood as an important source of value and a driver of organizational and economic transformation. Such a shift in the perception of data was certainly associated with the formation of the big data industry during the second decade of this century, the diffusion of data analytics, and, eventually, the advance of data science as a distinct scientific and practical skill (Swanson 2021, Vaast and Pinsonneault 2021). Although these developments signified a drastic change vis-à-vis data, reflections on the variety of functions that data perform in organizations are reencountered in earlier IS and Management scholarship (Chandler 1977, Zuboff 1988, Kallinikos 1999, Swanson 2020).

Several themes in the recent literature spin around the functions that data perform in organizations. To begin with, the advancement of powerful digital sensors and ubiquitous digital connectivity allows organizations to digitize tasks and processes, track the organizational use of resources, and monitor performance across several operations at scale. Digital data can be relied upon to establish comparisons across task groups, products, settings, and periods. Critically, digital data can be used to draw predictions about future occurrences and possibly prescribe desirable courses of action. Furthermore, the abundance of data renders possible the exploration of a much wider spectrum of conditions in and around organizations that, due to the lack of data, were previously virtually impossible (Chen et al. 2012, Brynjolfsson and McAfee 2014, Baesens et al. 2016). The availability of data thus expands the range of events that organizations can attend to and provides the means for mapping and, eventually, rethinking relationships to products/markets, value chain networks, and competitors. From this perspective, data become a critical medium for strategy formulation. Combined with a variety of external data sources, internal data acquire new value and can be used to spot market trends, establish comparisons within and across industries, and analyze competitive conditions (Markus 2017, Grover et al. 2018, Kitchens et al. 2020). Data can furthermore be used to develop new data products or services (e.g., recommendations, reputation scores, audience targeting), thus creating new or expanding existing markets (Lehrer et al. 2018, Aaltonen et al. 2021) or locking in existing customers (Baskerville et al. 2020).

The understanding of data as drivers of managerial and economic restructuring has been paralleled by research on the impact of data on organizational learning, expert knowledge, and the eventual reshaping of expertise (Abbasi et al. 2016, Jarvenpaa and Markus 2018, Parmiggiani and Monteiro 2019, Aaltonen et al. 2021). Although diverse in focus, this nascent literature shows that the diffusion of data makes available novel sources of evidence that shift attention to new objects of work and redefine the patterns by which knowledge is generated and expertise is exercised. For instance, data from social media and other online settings can be drawn upon to shape such diverse fields of expertise as legal practice (Ashley 2017), policing or criminal detection (Waardenburg et al. 2022), healthcare (Kallinikos and Tempini 2014), or finance (Begenau et al. 2018). The evidence provided by diverse and massive data sources is not simply an important element of optimizing internal operations, developing new products, rethinking corporate strategy, or even expanding network effects. It is, above all, a driver of far-reaching change that redefines the ways by which agency and expertise are exercised, remaking the processes of knowledge and learning across settings and organizations (Dourish and Gómez Cruz 2018, Swanson 2021, Alaimo and Kallinikos 2022).

Taken together, these observations indicate that data are an agent of far-reaching organizational and economic transformations that link to some of the key concerns we have outlined in this editorial. As claimed by the end of Section 2.3, the diffusion of data and the functions that data perform as a resource and vehicle of organizational and economic change sit uncomfortably with the ideas of modularity and recombinant innovation. Even though diverse data sets are frequently brought to bear upon one another to assist in understanding what is going on and developing new products/services, what is thus combined is not merely components of a product or an existing technological infrastructure. For instance, Facebook's "likes" can be combined with demographic attributes of users and their consumer habits to suggest relevant advertising audiences. It is evident from this example that data serve cognitive or representation functions and are used to derive narratives about the world (Zuboff 1988). Distinct from product or functional components, data operate at a far more granular level, and their contribution can seldom be accounted for in architectural terms. Data are generated, regularly piled up, aggregated, and computed to support the semiotic functions by which the world is perceived or narrated, knowledge is developed, and interventions are planned and carried out (Dourish and Gómez Cruz 2018). The implications of these developments are clearly shown, to use another example, in the use of diverse data types such as traffic, fuel emission, transportation services, and location data for managing metropolitan spaces.

Placed against this backdrop, a case could be made that the technological breakthroughs to which we have repeatedly referred in the preceding sections have progressively unleashed the generation and management of data/content from the other layers of LMA and conferred them an independent status as both a source of value (data-based products or services) and a driver of digital innovation. This independence is, of course, relative to the degree that all data are currently technologically produced or mediated. Yet, as with the separation of software from hardware, we argue, it is equally worth contemplating the dynamics set in motion as data become increasingly separated from the underlying technological infrastructure and serve several, often knowledge-based, functions and tasks. Although there is a burgeoning literature on these matters (Parmiggiani and Monteiro 2019, Aaltonen et al. 2021, Alaimo and Kallinikos 2022, 2024), the increasingly separate nature of the data layer from its digital substratum, along with the ways by which data are involved in digital innovation, requires further investigation, a task that becomes urgent as new technological breakthroughs (most notably AI) reweave the fabric of economy and society and redefine knowledge and expertise.

These developments, we suggest, are linked to structural change, the diffusion of platform-based ecosystems, and the importance of network effects touched upon in earlier sections. The generation, management, and use of large, often global, and interoperable data sources can seldom be achieved by means of the modern business enterprise (Chandler 1977), its predominant concern with the management of internal relations and the development of products understood as relatively stable bundles of physical or digital resources subject to economies of scale or even scope (Parker et al. 2017, Lyytinen 2022). New structural arrangements that can take stock of and respond to the unprecedented diffusion of data and, crucially, design, implement, and manage the *interactive forms* by which data are generated on a global scale are needed. By interactive forms, we mean data that require steady patterns of interaction with external users or buyers (social media, retail platforms, search engine platforms) and which can seldom be generated by operations internal to a system or an organization.

The diffusion of platforms and platform-based ecosystems can be interpreted from this standpoint (Alaimo and Kallinikos 2022, 2024). In essence, platforms are arrangements for handling dispersion and diversity, unique assemblages of operationally distributed, yet organizationally centralized, systems that use data to obtain inspection and, ultimately, control over a much larger array of operations and details than would have been the case otherwise. This explains the gatekeeping power of platforms, their economic prevalence, and the entry barriers they can raise, as noted earlier in this editorial. Save for a few exceptions (Gerlitz and Helmond 2013, Gregory et al. 2021, Alaimo and Kallinikos 2022, 2024), the link of data to structural change of this sort is seldom explored in the literature on platforms and ecosystems. The multisided nature of platforms and their global distribution can hardly be sustained apart from the data by means of which platforms engineer and monitor their operations, maintain and expand interactions with external others, and assess their outcomes. In this regard, data are more than neutral means for representing a preexisting reality and carrying out preformulated strategic intentions. In this view, data are central elements through which this reality is set up and performed and strategic intentions discovered. Rather than being in the detached minds of decision makers, strategic choices often emerge in the course of the events as data enable the orchestration of action and the exploration of possible and often-distant alternatives (March 2006). The design of metadata, defining what and how the reality will be encoded into digital data, ultimately determines what is included and excluded in the digital reality, decisions often made without much public scrutiny. These frontiers of change constitute some of the key challenges confronting future IS research and its relationship to the field of management and the social sciences more widely.

The links of data to innovation, expertise, and structural change have lately been recast by the march of artificial intelligence, the advance of deep learning, and, more recently, the diffusion of large language models (LLMs). The importance of data grows as AI diffuses throughout the economy and society. Data are massively drawn upon to set up and train AI-based systems and technologies. All AI training essentially depends on data that the neural networks of AI learn to assemble to recognizable objects (e.g., object or face recognition) and cultural outputs, as with LLMs (Mitchell 2019, Smith 2019). The exigencies of making sense of reality by machines are nonetheless such that the tasks that AI systems perform must pass through the relentless analytic decomposition of areas of life (image, audio, text, haptic information) into massive subconceptual or subperpetual data fields that the AI systems learn to recompose by recourse to statistical and data management techniques. Even though artificial neural networks emulate the neural networks of the brain (Mitchell 2019), they do not and cannot (due to the lack of a biological body and cultural references) respond directly to social objects and cultural outputs such as images or texts. Rather, encoding and decoding of various forms of data (image, sound, and text) result from the meticulous assembly of massive data points to which image, sound, or text objects have first been dissolved and later reconquered by suitably trained computer-based neural networks. These observations indicate that whenever they are used, deep learning and LLMs are prone to set up a disembodied, computationally anchored system of cognition that is essentially different from the prevailing social practices of cognition, knowledge development, learning, and expertise (Yoo 2024). These last, of course, have been shaped over the years by a variety of material artifacts and technologies, yet the current diffusion of AI marks an epochal change. An emerging body of early empirical work has raised concerns that AI technologies, when leveraged in creative, evaluative, and decision-oriented tasks, may lead to the homogenization of behavior and outcomes (Kleinberg and Raghavan 2021, Anderson et al. 2022, Doshi and Hauser 2024, Zhou and Lee 2024). A different body of literature has investigated the impact of the diffusion of AI-based systems on experts and expertise (Alaimo and Kallinikos 2021, Lebovitz et al. 2022, Waardenburg et al. 2022, Dell' Acqua et al. 2023, Burtch et al. 2024, Ritala et al. 2024). Yet, we currently know very little of the impact of these developments on social practices and even less about the broader institutional or structural changes that would likely result from their continuing diffusion (Yoo 2024).

Making data a pervasive element of expert practices raises serious ethical questions regarding how data are generated, collected, shared, verified, aggregated, and used (Chatterjee and Sarker 2013). These matters reverberate on the accountability of decisions that span from defining data dictionaries and ontology, shaping data standards to patterns of aggregating and using data to train AI models. It is important not to reduce these ethical concerns to specific roles, individuals, or even institutions, but to carefully examine how such serious ethical consequences emerge through complex patterns of seemingly innocent, sometimes well-intended, actions over time.

4. Concluding Reflections

> [W]e'll soon be able to work with AI that helps us accomplish much more than we ever could without AI; eventually we can each have a personal AI team, full of virtual experts in different areas, working together to create almost anything we can imagine. Our children will have virtual tutors who can provide personalized instruction in any subject, in any language, and at whatever pace they need. We can imagine similar ideas for better healthcare, the ability to create any kind of software someone can imagine, and much more.
>
> With these new abilities, we can have shared prosperity to a degree that seems unimaginable today; in the future, everyone's lives can be better than anyone's life is now. Prosperity alone doesn't necessarily make people happy—there are plenty of miserable rich people—but it would meaningfully improve the lives of people around the world.[4]

The promise of digital innovation endures, now fueled by the seemingly magical power of AI. Daring visions abound: cancers cured, poverty vanquished, universal happiness within reach. Yet, a starkly different reality unfolds: data rights violated, rare earth materials depleted by child labor, unseen workers exploited to train AI models. Energy and water consumption soar, threatening our climate and well-being. The fruits of innovation are disproportionately enjoyed by a privileged few. Valuable knowledge and expertise are sidelined or redefined, with consequences still unknown. Technology advances, yet the promises and problems remain, stubborn as ever.

Digital innovation research is standing at a crossroads. The power of digital technology continues to grow, and the scope of its application expands. And so do the potential negative consequences of digital technology. With the exponentially growing power of AI, this will only accelerate (Aschenbrenner 2024); we see opportunities for IS scholars to continue to engage with this topic for the foreseeable future. But the opportunities come with responsibilities. Our scholarly work cannot just settle on the status quo. Our work should strive to shape the future. We can continue to be a part of the problem or choose to contribute to solutions. It is in this spirit that we offer ways forward for our community, shifting our attention from unbounded generative digital innovation to a more balanced and responsible one. We call for more research on value capture and allocation among different stakeholders in the digital ecosystem. We call for balanced attention to both the positive and negative externalities of digital innovations. We call for deeper engagement with data as the fundamental components of the digital ecosystem, not just as technical objects, but also as social, cognitive, and epistemic ones.

Some sharp-eyed readers might wonder why we do not have a separate section on ethics. Simply put, it is too important to be limited to a single section. Instead, we try to integrate a few ethical concerns and issues that scholars must consider for each of the three highlighted areas. In 2019, one of us was asked by a leading global electronic manufacturer to study the "next big thing" by interviewing 15 global technologists. Surprisingly, ethical technology was the top response of every expert we interviewed. Many reflected that technologists often focus on the functional performance of technology, leaving ethical and social issues to others. However, experts interviewed argue that ethics must be directly baked into technology design. We realize that ethics is a vast and complex topic with competing views, theories, and philosophies, and this editorial cannot do justice to it. It is, however, vital to point out that ethics must take a much more prominent role than it did in the past.

Another important issue that we did not cover in this essay is how the structural conditions we discussed in this editorial mingle with human agency and established practices. Although powerful in shaping the landscape of digital innovation, the structural conditions we have outlined do not operate in isolation from human action and institutions. A rich tapestry of organizational and specific digital innovation practices interweaves with these structural elements, creating a complex and dynamic environment where innovation unfolds. It is, therefore, vital to recognize that the technological advancements outlined above don't function mechanically; they intertwine with social practices, and their effects are essentially shown up through the ways by which individual and collective agencies shape and are shaped by structural conditions. We call for more dialogue between scholars who focus on human agency and innovation practice and those who study the structural conditions covered in this editorial.

Just like technologists cannot ignore ethical and social issues, IS scholars cannot continue to step around technology. Too often, we complain that colleagues from other management fields do not appreciate technology, yet our scholarship does not reflect technology's complex and rich details either. Although we jump to notice the role of power, identity, and other familiar social constructs in light of new technologies, such as large language models in organizations, few bother to delve into the technology deeply enough to understand precisely how the new technology is different from previous as it interacts with social variables. This is a tricky balance, as we do not want to turn our work into descriptive technical work. It is a balance, nevertheless, that we must strive to achieve.

With these new challenges, we must embrace new theoretical foundations (Grover and Lyytinen 2015, 2023). The evolutionary and precarious nature of digital objects, the complex and evolving nature of digital ecosystems, and the increasingly semantic nature of digital communication demand fresh theoretical perspectives that can deal with evolution, temporality, ecology, complexity, liminality, and agency. We also need to embrace new methodologies. Scholars increasingly use various forms of computational tools to leverage large-scale trace data (Lazer et al. 2009, Berente et al. 2019, Miranda et al. 2022, Zhang et al. 2022). Notwithstanding these new theories and methods, we need more interdisciplinary and intradisciplinary collaborations. Instead of focusing on economics, behavioral, social, and design sciences, scholars from different traditions should use different methodological tools and theoretical perspectives to study increasingly complex and consequential topics.

We end our editorial on a cautionary note. We write this editorial in part because of our collective sense that the early vision of digital innovation was a mirage. Although we successfully foresaw the generative and creative potential of digital resources, we see firms that are bigger, more powerful, and more consequential. That led us to believe that the new frontiers of digital innovations involve being aware of and actively engaging with the potential negative consequences of digital innovation. However, we do not intend to promote an alarmist view. To the contrary, we maintain a fundamentally optimistic perspective on technology's potential to create societal value while recognizing the significant work required to ensure fair and equitable distribution of that value. We believe it is possible to create conditions of future digital innovation where the power of generative and distributed value creation of digital innovation is combined with a more balanced and fair distribution of value created and social justice. Such a future will demand the mobilization of our collective intellectual curiosity and creativity to study the design, deployment, use, and regulation of novel technology architecture and digital resources that promote more human-centered and ethical choices by all actors involved in the digital innovation practice. Although we acknowledge the importance of regulation in addressing market failures and protecting societal interests, we also believe that nuanced, human-centered, responsibly designed technological innovations themselves can play essential roles in addressing challenges.

All in all, the field of digital innovation continues to present rich opportunities for impactful research. We hope that this editorial and the emerging frontiers outlined above will stimulate scholars to contribute valuable insights that can guide the development of more equitable and sustainable digital futures.

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Endnotes

[1] In a bibliometric study of the use of "IT" and "digital" in all papers published in the journals included in the "AIS basket of 8," Rodriguez and Piccoli (2018) show that, in the span of 2000 to 2012, the usage of "digital" remained relatively low, whereas it took off significantly in the year 2013. It represented an inflection point. Since then, the terms "IT" and "digital" have had opposite trajectories, where the use of "IT" decreases, and "digital' increases.

[2] For more technical details, see https://www.w3.org/, https://identity.foundation/ion/, and https://developer.tbd.website/blog/what-is-web5/.

[3] https://techcrunch.com/2022/09/06/one-year-later-apples-privacy-changes-helped-boost-its-own-ads-business-report-finds/.

[4] https://ia.samaltman.com.

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