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Digital "x"—Charting a Path for Digital-Themed Research

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Abstract. As of late, the use of "digital" as a qualifier to established research concepts is increasing. However, we have yet to clearly establish what makes a "digital x" concept distinct from an "IT x" concept when "x" stands for well-established concepts such as strategy, infrastructure, innovation, or transformation, among others. In this paper, we review the need for, and merit of, labeling focal concepts in our field as "digital x" in contrast to using the dominant, incumbent label of "IT x." We position the shift as a call to attend to new salient features that characterize contemporary settings of information technology use and its effects. Recognizing this need, we develop guidelines for future research by arguing what novel phenomena the label of "digital x" foregrounds and how insights gained through such foregrounding contribute to scholarship in ways that the term "IT x" does not. By doing so, this paper promotes clarity for the use of the digital x concepts and introduces explicit guidelines to delineate between the nascent stream of digital x research and established modes of IT x research. We hope that the essay helps information systems scholars and scholars in neighboring disciplines attending to digital phenomena identify novel research opportunities grounded on sound conceptual foundations that will foster cumulative generation of knowledge around digital x.

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Keywords: digital x • IT x • digitalization • digitization • conceptual clarity • information systems (IS) theory • context shifts • guidelines

1. Introduction

"Digital," "digitization," and "digitalization" have recently emerged with increased frequency as terms used in information systems (IS) research and practice. Their escalating use appears to result in an uncritical renaming of well-established concepts into new formulaic forms of "digital x," when "x" stands for any past IS research stream's pivotal categories. Examples abound such as "digital" plus "innovation," "transformation," "strategy," and "infrastructure," just to name a few (Yoo et al. 2010a, Bharadwaj et al. 2013, Henfridsson and Bygstad 2013, Baiyere et al. 2020a). Indeed, Rodriguez and Piccoli (2018) show that the degree of usage of the term "digital x" over the past 17 years has increased, whereas the opposite trend has occurred in the usage of the information technology (IT) focused "IT x" term. So are we experiencing yet another hype wave of buzzwords (Swanson and Ramiller 1997), or is something deeper going on?

The challenge in answering this question is whether we can surface consequential reasons that enough has changed that we, as a field, are justified in adopting a new label "digital x" for some class of phenomena for which we would have previously reserved the term "IT x." The new label should convey something essential and novel about this class of phenomena that the "IT x" term fails to capture and, therefore, comes with significant theoretical consequences. Without such justification, it is hard to reach beyond a faddish sale of "old wine in a new bottle" (Yoo et al. 2010a, Baiyere et al. 2017). We call providing such a basis justified or reasoned if there is a *context shift* and a *qualitative difference*.

With context shifts, new features, entities, and properties that were neither present, visible, nor salient in the

previous context should come to our attention, and the differences should be significant. To be justified, the change of the label needs to convey that the previous ways of accounting for some IT properties and resulting individual, organizational, and societal behaviors and impacts are not adequate anymore; that is, we fail to get into the heart of the matter without making such a shift (Kohli and Grover 2008, Yoo 2012, Bharadwaj et al. 2013, Grover and Lyytinen 2015, Peppard 2018). Davison and Tarafdar (2018) echo this idea with their emphasis on shifting baselines that disciplines need to heed. Parmiggiani et al. (2020, p. 584) frame this as a question for the discipline: "[what] might [digital] mean for the information systems (IS) discipline: would IS groups consume business schools (and perhaps even beyond) or would, conversely, digital become so pervasive that we would not need a standalone IS discipline any longer?"

Thus, attending with new theoretical vigor to digital x comes with a tension: it is an opportunity and a threat for the IS field. When framed as an opportunity, IS discipline is historically well-positioned to champion digital x research given its decades-long history of engaging intimately with digital phenomena. Given the growing use of the "digital" label in neighboring disciplines, we as a field should be well-positioned to recognize and articulate novel theories about the phenomena. This offers the potential to situate the IS field as an intellectual engine for other disciplines and enter into fruitful dialogues with them. This will help alleviate nagging issues raised in past IS identity debates (Benbasat and Zmud 2003, Galliers 2003, King and Lyytinen 2004) and build IS as a pivotal reference discipline in the increasingly broad scope of research on the digital phenomena. Bypassing this opportunity and continuing to confine attention on the safer IT x research spells a missed opportunity for the field.

Digital x research also represents a threat. It constitutes a new "shifting baseline" (Davison and Tarafdar 2018). Such shifting baselines threaten the relevance of the field by fragmenting what constitutes the core of the field's intellectual capital. These threats can be realized if we, as a community, fail to recognize and engage with the ongoing shift. With the nascent positioning of digital x as a novel topic of significance and interest to scholars beyond IS and traditional IT departments (Berry 2012, Colbert et al. 2016, Dave and Ellis-Chadwick 2019), this topic arguably carries the hallmark of an impending shift. Consequently, the IS discipline can lose its distinctiveness as every discipline in the business school participates in the gold rush to come up with their own flavor of digital x. This is especially so if this takes place without a need to recognize or acknowledge the wealth of accumulated knowledge in the IS field around digital.[1] Under this scenario, deans may start questioning the benefit of having IS departments or groups studying digital innovation, digital strategy, or digital marketing when the school already has innovation, strategy, and marketing departments/groups who also examine digital. There is also the danger that the term "digital" loses its distinctiveness, whereby everything and, thus, nothing is considered digital.

Essentially, this essay calls for carefully unpacking and theorizing what digital signifies, resonating with what Habermas (1984, p. 2003) calls scholarly "rational reconstruction" of empirical phenomena. Central to such efforts is the creation of a lexicon, a shared vocabulary of pivotal concepts: digital x in our case. Such a vocabulary captures the assumptions, operationalizations, interpretations of observations, and logics of inferences around the focal phenomena shared by a scholarly community. The rise of the term "digital" suggests that the field's lexicon is shifting. This urges us to articulate anew the conceptual nature of digital that differs from IT by refining its ontological status. Getting the foundational element of the lexicon right is critical and urgent if we are to advance novel theoretical contributions to account for the complex, unprecedented ways in which digital now operates in the human enterprise (Habermas 1984, Berente et al. 2019).

For the IS field, the need for a shift in labeling is not new; IT has, through its short history, changed its properties and colors like a chameleon (Yoo 2012). When some of this paper's authors entered the field, we were focused on electronic data processing and "computers." We have seen other waves, such as virtual x, cyber x, IS x, electronic-/e-x, to mention a few. The need for the current label shift reflects our constant struggle to come to grips with the field's essential features as the field continues to advance at an impressive pace in enterprise and society. In this regard, valid and cogent claims for a proper context shifting are central to the salience of the field's empirical and theoretical discourse so that we do not lose our relevance and we deal with phenomena that matter.

Essentially, context shifting invites new, alternative explanations of the agency of the focal IT, its affordances, and its conditions of use and effects. This calls for fresh accounts of how such uses and effects emerge through the dynamic interactions with embedded social structures within the development and use contexts (Sarker et al. 2019). The relentless infrastructural expansion of IT constantly highlights the need to attend to the emergence of unexpected components, relationships, and social elements demanding new explanations (Yoo et al. 2010a, Bharadwaj et al. 2013, Tumbas et al. 2018, Baiyere et al. 2020a).

The aim of this essay is to identify salient reasons for the recent context shift that are coalescing around the escalating use of digital x. We advocate conceptual clarity—"conceptual clearance"—in how we apply the term "digital" as we move forward. The future use should harness rather than dilute the theoretical and practical value of the new label and the shift it embodies. To be more precise, our objectives are twofold:

1. Given that digital is now extensively used in the extant literature and in popular parlance, our first objective is to trace and highlight the ontological foundations and usage of "digital" as a conceptual label. In doing so, we offer a meta-framing for the different ways of framing the ontological stance of the digital.

2. Many foundational concepts that underlie the use of digital x ultimately draw upon research done in the IS or neighboring disciplines. Therefore, the border between the digital x and the IT x or even x schools of thought remain nuanced and obfuscated. We recognize that exact definitions vary across contexts[2] with different theoretical and empirical consequences. Thus, our second objective is to develop guidelines on how to justify that the use of a "digital x" label conceptually differs from the use of an "IT x" label in a chosen domain.

In line with these goals, we assert that "digital x" serves as a signifier of (a) a context shift and (b) a qualitative difference from IT x. At the same time digital x is *not* (a) a synonym for IT x, (b) unrelated to IT x, or (c) a totally new conceptual label.

The remainder of the paper advances our argument as follows: In the next section, we address our first goal and review the varied uses of "digital" and its derivatives in the prior work and clarify our conceptualization of the term. This urges us to articulate the ontology of "digital" and to show how the ontology has evolved as IT has advanced. The analysis is followed by a short juxtaposition of the linkages and differences between "digital" and "IT" terms. This helps address our second goal to identify and to illustrate the context-shifting attributes of digital as well as mark the qualitative differences that distinguish digital x from IT x in conjunction with several established "x" categories of the field. This lays a foundation to formulate guidelines for future research on key considerations that help clarify and delineate the uses of a digital x concept in contrast to and instead of common IT x concepts. We conclude by identifying broad themes and foci for future digital x research.

2. Ontological Foundations of Digital

The meaning and etymology of "digital," that is, defining what is digital or, in academic parlance, the ontology of digital forms the necessary premise discussing when the use of the term "digital" is warranted. Therefore, we need to start with a simple question: what do scholars generally mean when they evoke the term "digital"? Whereas several articles in our field have recently offered useful clarifications and arguments in favor of the concept (see, e.g., Tilson et al. 2010, Yoo et al. 2010b, Kallinikos et al. 2013, Ross 2017, Faulkner and Runde 2019, Baskerville et al. 2020, Wessel et al. 2021), there remains still a lot to be clarified in how the "digital" label should be productively used in conjunction with other key categories that define the field's phenomena. A broad review of the prior uses of the term highlights two separate viewpoints on "digital," which we refer to as (a) the digitization view, the idea of "digital" arising in the digitizing or technical sense, and (b) the digitalization view, the idea of "digital" arising in the contextual (social, organizational, etc.) sense (Tilson et al. 2010, Ross 2017, Sambamurthy and Zmud 2017). We can trace these two distinct usages back to two paradigms of thought that have coevolved in scholarly and popular parlance around the use of computers and IT: the engineering (or computer science) paradigm and the management (or social science) paradigm.

2.1. Digitization

The digitization view of digital starts with and considers the phenomenon primarily as the process and outcome of efficient encoding information in bits as zeros and ones (Goblick and Holsinger 1967). In this view, converting a physical or analog information-carrying object into bitstrings makes the resulting new object digital or digitized by virtue of its acquired state as a discrete, abstract, and mathematic object that can be manipulated, stored, and transmitted independent of its material realization (Brennen and Kreiss 2016). Generally, any meaningful representation of information (such as a bookkeeping entry, transaction, book, record, or film) can be encoded in bits and can then be called a digital object (Faulkner and Runde 2019). The conversion and its prerequisite technical innovations to decode analog representation into digital representation are referred to here as digitization (Smith 1999, Tilson et al. 2010).

This way of treating the digitized/digital object (henceforth digital object) as an abstract engineered artifact with specific technical qualities aligns with an engineering paradigm. Traditionally, the digitization view recognizes the status of abstract, nonmaterial digital objects in the form of bitstrings, which, because of their homogenous nature, can be stored, processed, transferred, and presented in a variety of material bearers and related technologies using a wide range of mathematical (and related material) operations (Faulkner and Runde 2019). As abstract artifacts, digital objects are subject to social processes of editability that sustain their form and variety as digital objects, semiotically expressed in a specific structure of zeros and ones outside any specific physical bearer.

Additionally, the notion of digital under the digitization view denotes not only the nonmaterial bitstrings of zeros and ones, but also the embodying material bearers (Tilson et al. 2010, Ross 2017). As noted by Ross (2017), digital in this sense of digitization—which she refers to as to digitize—also covers the physical computing systems forming the backbone of contemporary organization's information processing capability. In this view,

digital refers to the variety of material technologies and social arrangements surrounding them that embody or enable the storage, manipulation, and transmission of bitstrings in terms of cost, speed reliability, and so on (Ross et al. 2017, Sambamurthy and Zmud 2017, Fürstenau et al. 2019).

2.2. Digitalization

The digitalization view draws upon and expands on the digitization view. It shifts the focus from the bitstrings and related material technologies to the applications; processes of embedding; and related organizational, industrial, and societal outcomes of deploying bitstring as socially embedded digital objects in particular (socio-technical) contexts (Tilson et al. 2010, Bharadwaj et al. 2013, Gray and Rumpe 2015). In the digitalization view, actors pursue specific societal, strategic, organizational, or individual goals, and whereas seeking to satisfy their interests within a given social and economic context, they leverage various material and abstract features of digital objects as meaningful semiotic entities. This digitalization view (Tilson et al. 2010, Brennen and Kreiss 2016, Sambamurthy and Zmud 2017) covers manifold social, organizational, and regulatory processes necessary to engender a shift toward a desired outcome by deploying a select set of digital objects and their operations (Gray and Rumpe 2015, Ross et al. 2017). Broadly speaking, digitalization reaches beyond the digitization view in that it focuses on the ongoing reorganizing and inventing of novel social and technical structures and their elements and relationships that leverage the novel properties of digital objects in pursuit of agents' goals (Yoo et al. 2010b, Salmela et al. 2022).

Digital, in the sense of digitalization, is viewed as application of digitization to achieve specific, often novel, organizational or societal goals. This is accomplished by agents, who, through digitizing, can bring together and rearrange into new and novel relationships elements of the digitized objects and how they relate to the social and physical worlds. The process aligns the elements across these three worlds in original ways, offering new capacities for accomplishing things. During digitalization, there are prior changes in digital objects and how they consequently shape the social setting. Digitalization not only assumes that material representations of information using digital encoding change (digitization), but the social facets and processes of using of digital objects change and consequently shape the social setting (Hylving and Schultze 2013). Statements such as "we digitalize our process" rather than "we digitize our process" place an emphasis on change in the social and organizational facets of processes that seek to take advantage of outcomes of digitizing. Essentially, digitalization centers scholarly attention on how actors leverage new affordances (what actors can do or have a potential to do in a given setting) enabled by digital objects (Malhotra et al. 2021) and, hence, manifest new forms of agency. This allows actors to do things differently to achieve their goals that hitherto was not possible (Gray and Rumpe 2015).

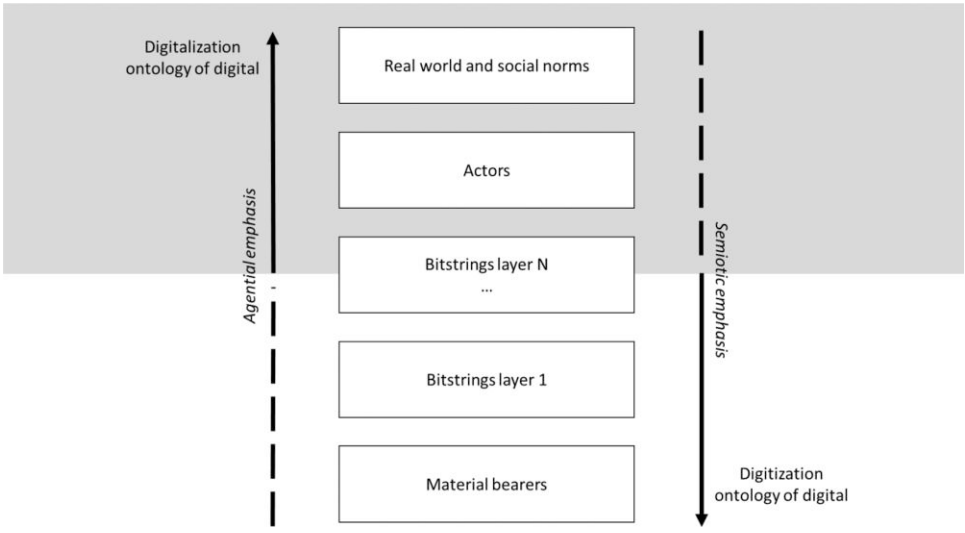
2.3. Relating the Two Ontological Foundations—Coconstitutive Ontology

Figure 1 provides an overview of how the two views are construed in prior literature and also provides a foundation for integrating and reconciling them. The figure depicts how digitization channels scholarly attention to bitstrings and their material bearers whenever the "digital" label is being evoked. This view is consistent with Faulkner and Runde's (2019) conceptualization of digital objects from first principles in which each nonmaterial bearer (notably bitstrings) forms a layer borne out of another nonmaterial bearer and so on (e.g., as represented in the internet stack) (Tilson et al. 2010, Yoo et al. 2010b). The layering derives from the semiotic nature of the digital that combines the technical and the sociotechnical; the latter shows different social interests and demands for the structures of the bitstring as technical objects. The resulting set of layers of bitstrings (depicted in Figure 1 from one to *N*) ultimately is borne out and grounded in a material bearer. This binding highlights the semiotic emphasis of how bitstrings are related technically and gain meaning in the world and how they, during this process, materialized and are represented in potentially multiple material bearers. This gives salience to the digitization sense when evoking the digital label.

On a similar footing, Lyytinen (2021) persuasively lays out a model of digital representations consistent with the digitalization view. According to this view, the emphasis needs to be placed on the meaningful application of the bitstrings as digital objects in a real-word context such that it gives new options and possibilities for the actors to act in that context given the new affordances. This is aptly termed "contextual embedding" by Lyytinen (2021). Such a perspective highlights the agential character of digitalization in which actors perform digital objects in some social and material context whenever the digital label is used. The focus on the novelty is brought to bear by involved actors who, by innovatively performing with the digital object, unlock the latent potential within it and give a meaning to the object in each sociotechnical context.

Overall, prior literature establishes that digitization and digitalization differ conceptually. Ergo, the digitization of documents does not imply that a company executes a digitalization strategy. Digital in the digitalization sense would come with the idea that actors need to unlock the latent and novel possibilities surfaced by digital objects, which can be treated in ways that were not conspicuous and apparent prior to digitizing the representation. As Ross (2017) puts it eloquently, digitizing everything will not, by itself, make a business a digital

Figure 1. Digitization, Digitalization, and the Ontological Views of Digital



business. This can be achieved only through continuing waves of digitalization that trigger waves of successive innovations in social and organizational settings (cf. Boland et al. 2007).

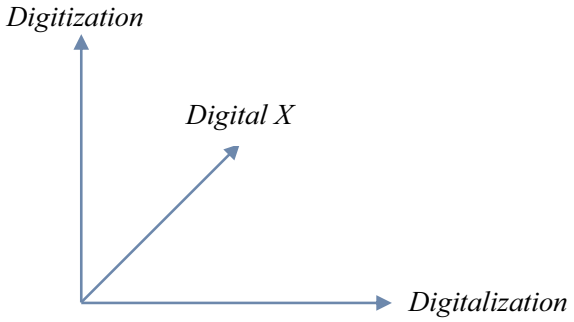
The ontological foundations illustrated in Figure 1 highlight how invoking the term "digital" in the proposed integrated view opens a continuous space in which any point in the continuum can be selected and highlighted using the term "digital." In the proposed conceptualization, the two views, though analytically opposite and separate, do not exclude the presence of the other. Both views are sociotechnical in that they encompass levels of technical and social contextual elements as indicated by the dotted parts of the arrows in Figure 1. Though the digitization view is premised on a semiotic/technology-centric emphasis and related bindings, agents still play a key role in actualizing and using the semiotic representations when digitizing. Similarly, though the digitalization view is premised on the agential emphasis, with which actors enact and unlock the latent potential of the digital objects in the form of affordances, the view recognizes the critical role of (new) digital objects as semiotic representations and their material bearers that form a bedrock for creating such agential possibilities.[3] In line with this, we propose a shift from the ontological division of digital that is premised on the implicit assumption that digitization and digitalization form opposite ends of a spectrum (see Figure 2).

We advance an alternative position that recognizes that digital x assumes the simultaneous coexistence of both the digitization and digitalization views rather than considering them as opposite, separate dimensions (Figure 3). As digitizing advances (more digitized objects), the more varieties and potential for digitalization (more uses, affordances, action potential). Digitization is a necessary but not sufficient condition for such process to unfold. Both views are intrinsically intertwined and jointly shape the emergence and understanding of a digital x concept. We refer to this mutual, coentangled view as the coconstitutive ontology of digital.

When the conceptual positioning of digital x is considered coconstitutive, it becomes difficult to precisely separate between the level of digitization and digitalization. In line with this, despite the strong emphasis on the technology/character of bitstrings in digitization, the context remains relevant because of the necessary semiotic binding of all bitstrings to make them useful (Nambisan et al. 2020). The semiotic emphasis captures the fact that bitstrings need to have a connection to some real-world phenomena by standing for them as representations. For example, whereas the initial concept of a digital twin can be positioned within the digitization ontology of digital, it is ultimately about faithful semiotic representations of a real thing in a real-world setting, which resonates with the notion of digital too and idea of ontological integration (Baiyere et al. 2020b). Similarly,

Figure 2. (Color online) Prior Ontological View of the Foundations of Digital x

Figure 3. (Color online) Coconstitutive Ontology—Ontological Shift in the Foundations of Digital x



it is equally important to note that the digitalization view is derived from and dependent on the digitization view. This resonates with the notion of digital first and associated ontological reversal (Baskerville et al. 2020), in which the enactment of a digital object is implicated first in the semiotic (material) realm prior to its manifestation within the sociotechnical change. Per Figure 1, the two views can only be analytically separated; they coexist in conceptualizing and forming digital x. Sensitivity to this ontological foundation is important for creating a cumulative tradition in the study of digital x as we demonstrate.

3. Juxtaposing Digital and IT—Conceptual Linkages and Differences

3.1. Context Shifts—What Has Changed to Warrant a New Label?

With this backdrop, it is useful to review how the ontological foundations of digital relate to and are reflected in the evolving notions of IT and reflect contextual shifts in the field's study of IT. For the most part of IT's history, IT has been conceived as a "box" of hardware and software—a tight coupling between bitstrings, their operations, and material bearers—which captures specific flows of data, its processing, and related information yields in specific organizational settings (Lyytinen et al. 2004, Peppard 2018). The view foregrounds hardware and its concrete configurations and how the specific software functions are manifested in a concrete material configuration. In contrast, the code and the semiotic nature of bitstrings as digital objects embedded in the configuration remained in the background.

In the 1960s, as digitization was taking root, the box was the mainframe. It helped manage and automate routine, batch-oriented transactions, such as payroll or inventory control, and established standardized data flows and related representations (e.g., creating payroll and inventory records). The 1970s saw the emergence of more innovative systems (still boxes) that made available more versatile applications of computing and related digital representations to improve decision making in organizations (often called management information systems). These systems would connect users with organizational information processing tasks in ways that were not possible without creating new types of bitstrings and tying them with new kinds of material bearers (e.g., real-time transaction systems). They were programmed to input transactional data at the source of origin, automate related activities, and periodically produce managerial summary reports for internal control purposes. The systems were accompanied with novel innovations around digitizing digital objects (such as databases, transaction processing) and enabled new affordances (such as real-time decision analysis). In the 1980s, the advent of the Personal Computers (PC; new kind of box) localized bitstring recording and manipulation to common office settings. A hugely growing range of digital objects and their manipulations (such as email, document repositories, etc.) reached most pockets of organizations. A string of IT innovations produced a growing pool of tools to digitize most facets of office information and to represent and manipulate it through a rich variety of digital objects (such as spreadsheets and word processing). These objects provided managers and a growing number of knowledge workers with increasingly flexible information representations and tools to automate office tasks (Peppard 2018). The period saw also the emergence of highly connected strategic systems (again conceived as boxes) exemplified in integrated airline reservation or supply chain management systems that facilitated and streamlined interactions between customers and suppliers, using standardized digital objects (e.g., electronic data interchange messages).

In the 1990s the enterprise resource planning (ERP) systems went a step further in relating the bitstrings and boxes. They standardized and integrated the multifaceted ways in which data, processes, and applications connected across a majority of an organization's key activities. This was accomplished by creating an organized collage of semiotic bitstrings (e.g., customer data and operations) that could be made visible, shared, and manipulated across the corporation. The innovation loosened the early tight connection within the box of hardware and software and bitstring operations. At the turn of the millennia, the advances in networking, including local area networks, wide area networks, and the internet, moved the bitstrings one step further away from the box. The advances made it feasible to access a wide range of internal and external digital objects from anywhere in the network and share data (and operations) across a network (e.g., URL and internet stack). Now, digital objects could be shared and manipulated at great speed and low cost from a distance and across organizations and contexts, creating unprecedented means for large-scale

collaborations (e.g., open source) for sharing of standardized bitstring objects (e.g., e-commerce). It also introduced convergence whereby the tight coupling between earlier analog representations and their bearers could be broken (digitized music, news, publishing, film) (Tilson et al. 2010, Malhotra et al. 2021). Since then, we have witnessed the emergence of diverse types of radically innovative digital objects manifested in new kinds of content (e.g., social media) and transaction platforms (e.g., Uber, AirBnB, internet of things (IoT), robotics, robotic process automation, and so on) enabling new types of affordances.

So where does the recent rise of the digital x fit in all this? During the short history of IT, we have faced several times the need to forge a new story around the technology and its use. But we posit that a profound and fundamental context shift around digital x (through processes of digitization and digitalization) has taken place over the last two decades. It is a new context with which we need to reckon that was truly accelerated with the advent of the internet around 2000 (Hanseth and Lyytinen 2010, Tilson et al. 2010).

In this regard, the accelerated change experienced in the last 20 years is uncommon in the history of technology studies. In the broad realm of social science discourse around technology over the last 150 years, major changes in the capability and scope of technology have been infrequent and only detected within long economic waves that took multiple decades (50–70 years) to realize (see, e.g., Hughes 1989). In fact, most dominant economics and sociology-based explanations of technology effects in the past come with the assumption that technology remains relatively fixed for a relatively long time, and therefore, the language of how the social embraces and connects with technology does not change significantly even when the technology advances rapidly in relative cost or performance (Nambisan 2017). Hence, in past accounts of technological change, the organizing logic, social/managerial practices, and related explanations could mostly be fixed for a relatively long period given the relatively stable technological "underbelly" (Yoo 2012).

However, given the recent progress of information technology capabilities, such fixed notions and related explanations do not appear to work. Since the mid 1990s, the exponential growth in connectivity, computing power, and storage capacity of and related expansive IT use has produced new realms of digitizing with new digitalization outcomes expressed in truly novel phenomena (e.g., e-commerce, platforms), new fields of inquiry (e.g., social computing), and original business concepts (e.g., agility, distributed organizing, open innovation). In the first two decades of the 21st century, IT reached an unprecedented critical infrastructural presence in most industrial societies. It is now everywhere and mostly invisible; it shapes all forms and pockets of social behavior and order, including economics, politics, civil society, and the rest (Tilson et al. 2010). This unprecedented and fast infrastructuring has produced, at a growing pace, novel features, functions, and capabilities that have been or are being integrated into the expanding digital fold of organizing including web 2.0, web 3.0., mobile, IoT, cloud, and big data just to name few (Ross et al. 2016, Sebastian et al. 2017). All these rest on forms and processes of digitization and digitalization and pose the question of how they can be performed and applied effectively across contexts.

3.1.1. Key Context Shifts—IT to Digital. We next synthesize what we deem are the pivotal characteristics in this new epoch that justifies the use of the label "digital x." Many of these have been recognized in the nascent literature seeking to motivate the change of label from "IT" to "digital." Per our review, we condense these into four ongoing shifts, which we proffer as foundational: (1) agential, (2) semiotic, (3) infrastructural cum combinatorial, and (4) economic shifts. Whereas each of the shifts comes with a unique thread of beliefs and assumptions, they interact and are jointly implicated in most digital endeavors.

3.1.1.1. Agential Shifts. The shift from IT x to digital x reflects the ever-present, growing need to account for multiple, emergent, and new (systemic) properties of digital technology and the ways in which actors leverage these properties. This reflects the focus on identifying, presenting, and manipulating a growing variety of heterogeneous digital objects (the so-called "data as the new oil"). The extremely complex and fluid assemblages of material bearers and digital objects present in organizational settings have changed the role, properties, and relationships of IT use across most social and business settings. This has transformed the agential emphasis that the social and the technical elements involved in digitalization now jointly exhibit. Simply put, they produce novel sociotechnical arrangements and associated behaviors with new agencies, affordances, and related outcomes (Tilson et al. 2010, Yoo et al. 2010a, Sarker et al. 2019). To put this in another way, actors can now act differently because of deep changes in IT properties, functions, and features. They now radically expand and reallocate the scope and range of affordances for involved actors and are changing or have changed the idea of agency to include both human and technology (Baird and Maruping 2021, Lyytinen et al. 2021). This a new type of joint agency that cannot be accounted for by explaining human uses of well-defined and isolated technology functions characterizing the use of IT during the IT era.

For example, IT as an object in the IT x story is commonly attributed to specific and circumscribed technical properties of the IT part of the digitization process, such as the access to a PC, its user interface, networks, and

properties of the mainframe backend having database and transaction capabilities. This configuration of technology gave involved actors, such as organizations, the ability to conduct transactions at scale or exchange email at low cost, long distance, and high scale. In the digital x story, infrastructural technology elements configure dynamically, for instance, by integrating multiple mobile applications, high bandwidth and permanent connectivity, sensors, application programming interfaces (APIs), and cloud computing, which then confer an unprecedented level of programmability, addressability, communicability, traceability, and associability for involved digital objects (Yoo et al. 2010a, Kallinikos et al. 2013, von Briel et al. 2018). The agency to create such changes and modifications has also shifted. The emergence of new kinds of digital objects and their manifold uses are now reckoned by involved social actors as important dimensions of the digital x story. Many, if not most, of such changes enable, anticipate, or assume deeper transformations in the deployment of digital objects in social settings, such as a call to change business logic, the speed of organizational responses, and the scope of innovation outcomes (Yoo et al. 2010a, Nambisan 2017, Chanias et al. 2019, Baiyere et al. 2020a). Moreover, agency itself can change dynamically from human agency to varied forms of technology agency (i.e., machine learning, robotic process automation, etc.) as part of the deeper transformation (Baird and Maruping 2021, Lyytinen et al. 2021).

In the IT x story, the IT did mostly something for the actor; in the digital x story, digital does what IT could do, but the narrative expands the actor's flexibility, potential for action, and speed given the manifold affordances at its disposal. For instance, sensors can autonomously keep track of the status of a machine and learn to alert users to act when necessary. Combining sensors with machine learning allows predicting when maintenance is needed and triggering other actors to act on it. This happens now to such an extent that it has the potential to produce novel organizational outcomes, including new business models (Weill and Woerner 2015) (often in unpredictable ways)—a feature coined as generativity (Lyytinen et al. 2017, Fürstenau et al. 2019). The new type of agency is viewed as being joined, combined, or hybrid because it is difficult to pin down when the social starts and technology ends and vice versa.

3.1.1.2. Semiotic Shifts. Digital objects qua semiotic representations express both behaviors (program code) and states or events (data) of the world. Generally, within a digital object, neither of its elements, either code or data, has much value without the other. Nor do they have value unless they become contextualized (Lyytinen 2021). Such contextualization underlies all digitalization processes in that a chosen form of materialization (mapping to material bearer) is a critical enabling mechanism to contextualize the digital object and its behaviors. Such contextualization entails that actors can account for digital objects as something meaningful to use; that is, they are able to build up some type of affordance from the use of digital object, such as the "like" in Facebook, "trade" in high-frequency trading systems, or a "game move" in Go.

The need for contextualization entailed by the semiotic quality of digital objects has become highly pronounced during the digital x era. This is due to the manifold number and nature of digital objects available to actors as well as the ability to transform and interact with these objects. This widens agential core of organizations and expands the uses of digital objects to a wider range of settings in which they can be used and what they possibly represent (Lyytinen 2021). The scope, nature, and quality of these semiotic bindings is not similar to the physical binding between physical components (such as an engine and a power train). Because of the social nature of the semiotic binding, the bindings remain institutionally and socially mediated and socially approximate. When the bindings change by agreement, fiat, or negotiation, they mold surrounding social institutions (Oshri et al. 2018). Given this unaccounted and indeterminate nature of semiotic bindings, digital objects can promote innovation through constant repurposing by which actors discover alternative and unexpected ways of binding the digital objects in the same setting, and/or expanding them to other social settings. Actors can discover alternative and unexpected ways of binding the digital objects (and expanding them) to other social settings or invent new digital objects that draw upon other available digital objects, thereby promoting generativity (Hukal and Henfridsson 2017). For example, a digital object representing a weather forecast can be displayed in a mobile weather app, on a home Echo device, or on a screen on an umbrella. These varying bindings each can have varying manifestations on social structures and result in different behaviors. Hence, traditional economies of scale and scope that characterize industrial-era technologies and their uses hardly apply fully given the semiotic shift (Chandler 1990).

3.1.1.3. Infrastructural cum Combinatorial Shifts. A profound context shift around conceptualizing digital started after the advent of the internet and the related service stack (Hanseth and Lyytinen 2010). Instead of cramming an additional narrow spectrum of functionality into a single programmed box or a monolithic technology configuration (such as an ERP system), the technology enabling digitization now became distributed and infrastructural (Tilson et al. 2010). This was later enabled by novel digitizing architecture innovations that now enable loosely coupled interactions between manifold digital objects using open technical standards, such as APIs and representational state

transfer protocols resulting in the emergence of cloud service stacks (e.g., Amazon Web Services, Azure, Google Cloud Platform).

Consequently, this has enabled new combinatorial possibilities in how companies and innovators leverage and use digital objects. The presence, access, and use of myriad digital objects and their configuration and manipulation across a wide range of settings and technological systems have become the guiding principle and organizing logic to innovate and operate enterprises, industries, and society. Essentially, each digital object made possible via the infrastructural base becomes a potential building block for creating another digital object via combining and (re)combining digital objects with near infinite possibilities. This combinatorial character of digital objects comes with sweeping consequences.

Today, innovation—inventing original forms of digitization and implementing them in innovative ways, resulting in novel organizational structures and operations (digitalization)—is primarily about how to pool together a range of new (derived) and old digital objects and affordances and organize them for contextual delivery in ways that add value. The installed base of (digital) infrastructure facilitates the creation and fast diffusion of innovative combinations of digital objects and their operations. The integration and pooling happens mainly through open interfaces (APIs) and standardized mechanisms of their use (interface protocols). Beneath the surface, the infrastructure still consists of boxes, but they come in multiple heterogeneous sizes, forms, and configurations. These configurations are highly dynamic and range from hidden big and powerful systems (e.g., such as enormous server clusters running Hadoop) to tiny hardware (e.g., sensors on physical objects). But they are now largely virtualized and can be rearranged for better connectivity, which constantly produces new sets of digital objects, their embeddings, and new affordances (Kohli and Grover 2008, Tilson et al. 2010, Henfridsson and Bygstad 2013, Lyytinen 2021, Piccoli et al. 2020, 2022).

This infrastructural cum combinatorial shift differs from innovating in the IT era. Consider the evolution of musical devices from the 1980s to the streaming infrastructure of the 2020s. Earlier, the music encoding on a CD could be played only on the CD player: the box. However, if we reduce the functionality of this product to its digital core as an affordance, it is about a user's ability to listen to music in any selected sequence while moving. The shift to digital was in creating first the core affordance that could leverage the capacities of the digital infrastructure to pool together other affordances. In this setting, songs become first a shareable digital object that offers the same function as the CD/cassette offered as a box for listening to songs. The first fully digital solutions, outside the box, such as Rio (for playing mp3 files), did exactly this (Tilson et al. 2021). But, as the same affordance is now enabled by a wide range of digital solutions, such as a growing variety of mobile devices, the internet access (websites), related digital assets for storing and retrieving songs, the services offering the initial core affordances now are bundles of digital capabilities that offer in varying forms the basic functionality (e.g., iTunes, Spotify, Pandora). At the same time, the core affordance of listening to a song is augmented with an expansive set of new affordances, many of which involve combinations of new and other digital objects. These include among others playing at random, offering nearly limitless information and comments about the song, creating alternatively ordered playlists, automatically playing selected songs at different times, creating favorite playlists across all available music, automatically searching for music with specific profiles, ranking and recommending music, and so on, apparently endlessly. All these affordances result in new expanded versions of digital objects of songs and their listening experience through enacting those affordances. The digital infrastructure allows users to combine and (re)combine digital objects to create new innovative possibilities, such as sharing music listening interests and information among friends (by sharing playlists) and across other devices (such as listening to the playlist via a refrigerator or in an Uber ride). It is worth noting that each of these combined digital objects can subsequently be recombined with other digital objects to create new innovations across manifold contexts. In this case, the digital core of encoding music and playing it on single material technology (the CD player) that formed the starting point for digitizing has been expanded by a constant provisioning of novel affordances, including the ability to even create new music by sampling digital parts of accessible music.

Such a shift raises the need to theorize more cogently of the new kind of combinatorial value generation afforded by cumulative expansion of infrastructural capabilities. Value and innovation are less about creating specific functions in new boxes and more about the fluid emergence of new embeddings and affordances enabled by the constantly expanding digital infrastructure with new combinations of digital objects. Digital is less about adjusting sociotechnical relationships around a set of fixed technology functions (IT) and more about how sociotechnical elements and relationships constantly emerge, intermingle, and change, whereas new forms of innovative digitization emerge in a combinatorial fashion calling for deeper digitalization in new affordances, contexts of use, etc. (Yoo et al. 2010a, Henfridsson and Bygstad 2013).

3.1.1.4. Economics Shift. Another fundamental context shift is that digital x comes with unique economics. The cost of computing in the (IT) box world was characterized by a tight coupling between hardware

and software and related costs. They both had relatively high cost (to produce software and acquire the hardware and then install it). In the digital x world, we are experiencing a shift to crowdsourced open-source software and related innovations, cloud solutions, and service-oriented computing. These shifts have radically accelerated the decline in the cost of moving and processing bits to create value and how to monitor and control such costs (different from the decline resulting from Moore's law though Moore's law is necessary for this to happen). These shifts have moved the cost structure from fixed cost toward variable costs with costs declining during both design (cloud-based service applications, microservice architectures) and use (cloud computing). More important though is that the digital objects and their behaviors can be easily replicated, combined, and shared many times over at minuscule or no cost (Yoo et al. 2010a). So, once reified into a digital object, any process or behavior related to that object can be replicated throughout the organization, the (digital) product itself can be replicated (even customized) across a varied customer base, and digital objects can be combined to create additional objects and affordances, all at minimal cost with little or no capacity constraints. This has tremendous implications for value creation and business strategy (Kenney and Zysman 2015, Weill and Woerner 2015).

In sum, as infrastructural technology, in which digital objects and bitstrings have become the key resource and capability, digital and its use has gained the power to cut across the organizational, social, or natural fabric in unprecedented ways. It allows for the generation and consolidation of swaths of data, which, in turn, enables new types of social connections and behaviors (Yoo et al. 2010a, Henfridsson and Bygstad 2013, Grover et al. 2020). This creates new powerful feedback loops for growth and scaling. Because of the unique economics, data has become highly valuable, but at the same time, it can be shared (made a common good), analyzed, combined, repurposed, or gamified at little or no cost (Brennen and Kreiss 2016, Ross et al. 2017).

3.1.2. An Illustrative Example—Context Shifts in IT to Digital x. Within specific organizational domains, the main context shifts that warrant a move from thinking in terms of IT notions to digital vary. We next briefly highlight how the four outlined context shifts justify the change in the vocabulary used in relation to when x is transformation in the prior literature. Specifically, we survey research on digital transformation and IT-enabled organizational transformation at the organizational level using the illustration in Table 1.

IT transformation at the organizational level is characterized by the process of implementing technologies that allow internal organizational processes to be digitized. The aim is to improve operational efficiency among other productivity gains. Typical examples are well-documented ERP implementation initiatives (Morton 1990, Barrett and Walsham 1999, Crowston and Myers 2004). Within this setting, the ERP technology helps enterprises to unlock value when organizational actors exercise their agency in the use of ERP systems by creating structures that leverage affordances embedded in the system (Markus and Benjamin 1997, Crowston and Myers 2004). The primary path to value creation is to create structures and other complementary assets (process and human capital changes) that can leverage the technology (Kohli and Grover 2008). Such IT transformation efforts help others minimize the limitations of (human) bounded rationality (Simon 1972) by enabling human actors to make decisions that leverage the swift processing and delivery of a vast amount of condensed information (Morton 1990, Gregory et al. 2015).

However, recent context shifts challenge the appropriateness of drawing on the IT transformation concept, signaling that our conceptual vocabulary needs to evolve if we are to better capture recent observations without being limited to the constraints of the prior concept. Hence, there is a need to discuss digital transformation (Vial 2019, Baiyere et al. 2020a, Wessel et al. 2021). The nascent thinking about organization-level digital transformation is that such transformations—usually in the constant state of emergence given the fluidity of digitization and digitalization—now leverage an array of digital objects to redefine the organization's value propositions, markets, offerings, etc., to the point of reshaping its established organizational identity. This is in sharp contrast with the earlier notion of IT transformation that leveraged digital technology to support an organization's current value proposition, eventually reinforcing its existing organizational identity.

When looking at organizational transformation through the lens of agential shift, we are likely to detect two differences per the current literature. First is IT transformation focused on a central piece of technology (e.g., the ERP, customer relationship management, and other interorganizational systems). However, now we see transformations involving a wide family of technologies, so much so that it has become increasingly difficult to highlight how a singular technology functions as the pivotal artifact for the transformation. The focus has changed and results in a drastic expansion in the action possibilities. Second, the actors in current transformation stories are no longer merely subjects to the possibilities offered by a single focal technology (e.g., ERP). Rather, we witness an unlocking of the agential potential of actors confronting an array of digital technologies offering an abundance of (often unknown) affordances. With digital x, the emphasis shifts from overcoming bounded rationality with IT to overcoming bounded imagination in the use of digital objects (Baiyere and Rosenstand 2019). This creates a new frontier for organizational actors: they need to unlock their creative capabilities in

Table 1. The Context Shifts Illustrated with IT vs. Digital Transformation

In IT transformation …	Context shift description	In digital transformation …	Contrasting illustration
	Agential shifts		
The agency is primarily with the human as change initiatives are conducted around a fixed technology (e.g., ERP) and folding structures are created to leverage the technology's potential.	Technology affords actors expansive action possibilities, that is, it expands the agential potential for combined actor and technology agency.	A large and open repertoire of digital technologies/artifacts expand the action possibilities for the human actor but also enables autonomous technology agency (e.g., machine learning). The objective is not to leverage given technology functions, but to build up a transformative vision through effectuating this dual agency.	IT transformation of the call taxi service took place when cellular human-operated dispatch services were replaced by a centralized database of drivers and customers that offered a service through a website. This allowed customers make reservations and taxis to be dispatched algorithmically based on the status recorded in a database. The agency remains largely human but is supported by an algorithm to select the driver. The semiotic shift occurs through informating/automating the call and selection process; combinations of technology use a network to connect the call service to the database. These technologies were developed using proprietary interfaces across a variety of taxi operators resulting in a proprietary dispatching solution to run of the distributed platform which make driver use and allocation faster and more effective (economics). Digital transformation of the call taxi service when Uber recognized a need to connect excess capacity in private automobiles with latent customers demand for inexpensive transportation. The vision was realized through the integration of multiple digital objects (i.e., maps, cellular location services, navigation software, payment, recommendation systems, etc.) on a platform and a mobile app shared by both drivers and users. Agency belongs to both the human actors as well as the digital objects (software/data) that produce a dynamic matching process of drivers and users that is efficient and effective through the use of (learning) algorithms and a set of semiotic representations covering process tracking metrics, forewarnings, rewards, etc. The combination of digital objects has expanded on the platform, whereas more services are being offered (e.g., UberEats). Most of the cost is borne by the existing IT infrastructure (i.e., the mobile internet).
	Semiotic shifts		
The manifestations of technology are restricted to process pathways that can be enhanced or reconfigured. Data automates, informates, or transforms within the confines of these pathways.	There is an expansion of the type, variety, and number of digitally represented states and events that expands the range of possibilities.	A large variety of digital representations builds a greater variety of semiotic links to the social world affected through changes in the representations. Data can be repurposed to generate new ways to represent and consequently transform the way an organization positions its digital offerings.	
	Infrastructural cum Combinatorial shifts		
Combinations of technologies are constrained through standard interfaces or proprietary designs or middleware that allows innovative front-end systems to interface with legacy back-end systems.	The digital object becomes a modular building block, which, when connected to and combined with other digital objects, creates a new digital object (hence, new affordances).	Combinations of multiple digital objects and semiotic links provides unlimited ways to build new value propositions that can give an organization a new identity or shift the basis of competition in a digitally transformed industry.	
	Economics shift		
Investments in software or networks transform companies and their relationships, introducing extended competition. Process and operational efficiency are central. Most efficiencies and differentiation advantages are obtained through cutting coordination costs.	The radical decline in the cost of processing bits creates, captures, and delivers value because of cheaper and more flexible possibilities to process, store, and transfer data.	Value creation is radically expanded by the possibility of recombining of digital objects to lower costs, add revenue sources such as complementary services (delivered on a platform), increase the speed to market, and facilitate new relationships with customers or partners, all enabled by the core infrastructure (internet).	

imagining possibilities that can be realized by deploying an array of digital objects and technologies at their disposal (Weill and Woerner 2018, Baiyere and Rosenstand 2019). This is evidenced in the outward-looking purview of these transformations that position such organizations to have digital offerings akin to a digital tech company regardless of the industry (e.g., manufacturing, pharmacy, media etc.; Utesheva et al. 2016, Svahn et al. 2017). Thus, regardless of the industry, unlocking digital capabilities producing digital innovations need to be placed among the organizations' new value offerings. This is also reflected in the structural shift from having the functional role(s) of chief information officers to adding new roles such as chief digital officers (CDOs), and decentralizing IT units to new kinds of digital units separate from IT units (Tumbas et al. 2018, Jöhnk 2020). Whereas the IT units continue to exercise oversight to assure operational excellence in IT services and maintain the organization's IT backbone, the new digital units are tasked with entrepreneurial responsibilities that leverage digital innovations to create and capture value—often at warp speed (Salmela et al. 2022).

Transformation from the perspective of the semiotic shift expands the range of any real-world context to be represented and encoded in bits and encompassing multiple types of data. This expansion can be contrasted to more circumscribed business process representations typical to IT transformation (Davenport and Short 1990, Brynjolfsson and Hitt 2000). We are now witnessing a radical expansion in the type, variety, and number of items of interest; business contexts are semiotically represented beyond what has been hitherto the norm (Lucas et al. 2013). Today, the representations include things such as regular daily objects equipped with sensors (e.g., IoT), virtualization or digitized replicas of real-life objects (e.g., digital twins), among several others (Sebastian et al. 2017, Wimelius et al. 2020). The consequence of this is a rise in the range of repurposing of data uses and increased generativity. This semiotic shift opens expansive opportunities to build, store, and manipulate digital objects that changes the idea of what is possible. It also transforms the way in which organizations represent themselves and their environments. Whereas still relevant in limited contexts, the inherited vocabulary of IT transformation is not versatile enough to encompass the plethora of mixed and varied representations that have become the norm in the ongoing digital transformation (Ross et al. 2019)

The lens of infrastructural cum combinatorial shifts, when applied to transformation, highlights the expansion of possibilities that can be brought to bear when transforming organizations and their operations. Whereas limited combinatorial possibilities were present during the previous IT transformations that originated from expanding system functionalities and evolving data content (Lucas et al. 2013), this was mainly accomplished by establishing interface standards or designing proprietary interfaces gateways (Hanseth and Lyytinen 2010). Today the available options eclipse what was the norm in the past, resulting in hugely expanded potential for discovery and (re)combination of digital objects. This is creating manifold digital objects and affordances promoting repurposing and generativity. A digital object is now not treated as a finished piece, but also as a building block that, when combined with other digital objects, creates novel digital objects akin to an infinite version of the Russian nested doll (Faulkner and Runde 2019). For example, a manufacturing firm's IoT innovation of enabling machines to autonomously interact can be combined with a product platform, a digital twin, a 3-D printer, a virtual reality device, or an artificial intelligence agent, and each combination yields an entirely new innovation (Endres et al. 2019, Baiyere et al. 2020a). When compared with the limited application of combinatorial innovation during IT transformation, the vast increase in combinatorial possibilities afforded by multiple digital objects and their integration potential signals a change warranting a new label.

Finally, with the ongoing economic shift, the nature of value creation and capture is changing in organizations. The past dominant economic narrative for IT transformation has been inward-looking. It emphasized improving the efficiency of operations and business processes: the logics of scale and scope (Chandler 1990) using standardized functions of the boxed software (Morton 1990). However, in conjunction with the other shifts, organizations now face an accelerated diminishing cost in creating and capturing value by digitizing and creating new digital objects. The cost of creating and delivering value has evolved from implementing packaged software to an economic logic with which combinations of digital objects create value by lowering costs, adding revenue sources through expanded services, increasing speed to market, forging novel relationships with customers or partners, or any combination thereof (Woerner et al. 2022). This differs from the era in which ERPs were mainly accessible to large corporations. Similarly, the supply of digital infrastructure has been opened to a larger group of organizations. Previously expensive elements of IT infrastructure and other technologies are now widely accessible, leading to a situation in which the creation of value is increasingly democratized and not limited to a few large and advanced organizations (Westerman et al. 2014). In essence, this economic shift has ushered in a new wave of digital transformations that questions the traditional logics of value creation, capture, and delivery (Yoo et al. 2010b). These forms have erected a bedrock of digital disruptions initiated by new and unexpected competitors and made digital transformation a do or die situation for many organizations (Utesheva et al. 2016, Svahn et al. 2017, Weill and Woerner 2018, Salmela et al. 2022). In contrast, IT

transformation was, in many contexts, viewed as a mere operational necessity.

3.2. Qualitative Difference Between Digital x vs. IT x

At the heart of this essay is a call to engage in a well-reasoned process in how to conceptualize what amounts to digital x in future IS research. The prevalence of the four context shifts is indicative that things have substantially changed, suggesting that the use of the label "digital x" is warranted. However, even though such shifts are becoming prominent, they do not provide an adequate conceptual vocabulary to characterize a new setting and what is different therein. Therefore, we next articulate the qualitative difference that a digital x has in comparison with an IT x. Given the evolutionary linkages between digital x and IT x, we posit that there needs to be distinct and salient qualitative differences that signify to scholars when they should draw on the notion of digital x instead of IT x. Such articulation of minimal necessary differences shields future scholarship from diluting the theoretical benefit of the digital x label and averts the danger of diminishing its conceptual merit to a faddish buzzword.

We next draw upon a sample of prior studies in both the digital x and IT x spaces to identify illustrative examples and related criteria that demonstrate how digital x can be evoked to signify a qualitative difference from IT x (Table 2). The examples were purposefully sampled to delineate how the digital variant of an x concept clearly differs from its prior IT (and nondigital) equivalent. Table 2 summarizes the examples and identified differences.

The notion of qualitative difference suggests that the distinction between a digital x and IT x concept is not only a change in degree but rather a change in kind. For example, the study by Wessel et al. (2021) provides a clear and seasoned justification for why the digital label differs from the IT label and unpacks digital transformation at an organizational level. The qualitative difference being signified with the use of digital transformation lies in how digital technology plays a fundamentally different role in redefining an organization's value propositions rather than supporting an existing value proposition. This effectively leads to the emergence of an organization with a digital valence in their identity. Hence, organizational digital transformation captures a transformation that imbues an existing identity with elements akin to a tech company rather than seeking to reinforce an existing organizational identity. Baiyere et al. (2020a, p. 253) provide an apt analogy: "While IT-enabled organizational transformation (such as implementing an ERP) can be likened to 'a cub transforming into a lion'—that is into a faster and more efficient version—digital transformation … can be likened to 'the metamorphosis of a larva into a butterfly.'" This explains why the digital transformation label invokes a conceptual apparatus that can explain how a manufacturing company transforms itself into a digital high-tech company. The use of the term "digital" captures the qualitative change of the transformation beyond being a faster and more efficient organization (usually the goal of an IT transformation).

In a similar vein, Bharadwaj et al. (2013) signify a qualitative difference between a digital and an IT strategy. They contrast the central tenet of digital strategy as an intrinsic component of business strategy with the alignment logic of IT strategy as a functional-level strategy supporting the firm's strategy. They crystallize the difference by highlighting differences in the scale, scope, and speed dimensions that characterize strategic choices as well as sources and means of capturing value in digital strategy. The qualitative differences signaled with the label "digital strategy" mark the shift from the functional focus of IT strategy to how to accommodate the increased organization-wide engagement with digital objects as an intrinsic element of contemporary strategizing. Digital strategy can no longer be relegated to the IT department and derived from firm strategy; digital strategy is "the" strategy of the organization. It is no longer a business-aligned strategy that follows the organizational strategy. In effect, these scholars provide a clear delineation that paves the way for a cumulative generation of digital strategy knowledge. Later scholars engaging with the notion of digital strategy show clearly how a digital strategy differs from IT strategy in terms of its organizing logic (Yeow et al. 2018). This averts the danger of comparing apples and oranges and provides a foundation for generating cumulative knowledge around digital strategy.

Several studies provide examples of little or no delineation that warrants the use of digital x in contrast to IT x concepts. As indicated in Table 2, the term "IT x" could serve better some of the studies that have adopted the "digital x" label.[4] In these instances, the studies do not provide an account of a qualitative difference that is being signified when using "digital" that warrants a shift from the established "IT x" label. For example, Fürstenau et al. (2019) advance a compelling analysis of the evolution of digital infrastructures. However, they do not indicate any qualitative difference that the term "IT infrastructure" would not adequately capture and that necessitates the use of the digital label. The same applies to the use of "digital" in the digital transformation work of Raouf (2021).

The analysis of Faulkner and Runde (2019) provides a justified case to use "digital" when discussing digital objects. Although they do not make an explicit delineation between IT objects and digital objects, they provide a well-calibrated exposition on what a digital object is and what can justify the use of the "digital" label. Piccoli et al. (2022, p. 6) further clarify the digital object distinction as follows: "Note that, while it is tempting to treat any form of IT as a digital object, such interpretation is

Table 2. Illustrative Examples of Qualitative Difference Signified in Digital x Concepts

Sample concepts from prior literature	Premise	Is there a qualitative difference signified?
Digital transformation; Wessel et al. (2021) (see also Baiyere et al. 2020a)	Transformation is characterized in terms of deep structure change, necessary generativity of involved technologies, dynamic (re)composition of actors, and substantial impact on organizational identity.	Yes. Digital is evoked to signify that technology is being leveraged to redefine (rather than support—as in IT transformation) an organization's value propositions, and the transformation leads to a new organizational identity (rather than reinforcing identity as during IT transformation).
Digital transformation; Raouf (2021) (See also Agarwal et al. 2010)	Transformation is described as an implementation of families of well-defined technologies (e.g., ERP, HIT, etc.) to transform processes toward operational excellence and efficiency.	No. There is no qualitative difference being signified, and the notion of digital (digitize) refers here to ideas of digitizing existing processes (e.g., with ERP). IT transformation could be used.
Digital strategy; Bharadwaj et al. (2013) (see also Yeow et al. 2018)	Strategizing about technology shifts from functional strategy (IT strategy) to business strategy (digital strategy), heralding a substantial contextual shift in organizational activity scale, scope, and speed.	Yes. Digital is evoked to signify that digital strategy is an organizational or business-centric strategy, which is distinct from IT strategy that focuses on alignment with (given) organizational or business strategy.
Digital units; Jöhnk (2020) (See also Tumbas et al. 2018)	Organizations set up autonomous units called digital innovation/business units in addition to their existing IT units and establish the role of CDO in addition to the role of chief information officer.	Yes. Digital is evoked to signify the need to create new organizing logics that harness the value of digital technology as an intrinsic component of the business objectives. This contrasts with prior organizing logics of IT units geared toward harnessing technology to support business objectives.
Digital objects; Faulkner and Runde (2019) and Lyytinen (2021) (See also Piccoli et al. 2022)	The increased liquefaction of material and nonmaterial technologies raise questions about ontological differentiation in which all IT artifacts are categorized in a single homogenous category despite some artifacts being ontologically distinct.	Yes. Digital is evoked to signify the emphasis on the semiotic binding of bitstrings to contexts and its performative character in conjunction with the varying embodiments of the material bearers in contrast to earlier categories of IT objects that refer primarily to material bearers, for example, a computer.
Digital infrastructure; Fürstenau et al. (2019)	Digital infrastructure refers to a set of interconnected information systems, highlighting the use of the term "digital" in alignment with the digitization ontology.	No. IT infrastructure could be used as well. There is no qualitative difference being signified with regard to digital infrastructure.

incorrect. Specifically, hardware components (e.g., a bricked Amazon speaker, a motherboard, a CPU) are not digital objects, but they are indeed IT. Digital objects are substantiated only when hardware is coupled with software. While such bitstrings always ultimately need hardware, as the material bearer of lowest level (Faulkner and Runde 2019), the reverse is not true. Hardware does not need software to exist."

4. Three Guidelines for Digital x Research

In what follows, we draw on our exposition and outline a set of guidelines that seek to provide a foundation for IS scholars who intend to draw on the digital x concept in their future research regardless of the specific research question, phenomenon, or domain of interest. We acknowledge that advocating for a singular view that can encompass all digital x research is tantamount to a slippery slope of oversimplification. Scholars should be open to draw on the distinctiveness of their study context, their background, and intellectual inclinations in driving their research agenda and specifying in a detailed and more nuanced way what digital x exactly means in their domain of inquiry. They should also continue to refine this distinction to establish better delineated boundaries between IT x and digital x. Hence, rather than striving for a universal and strict delineation, we consider it valuable to steer the energy and attention of the discipline toward engaging in a reasoned conceptualization of digital x that is likely to raise important and novel questions and help promote cumulative generation of digital x knowledge. To this end, we next formulate three guidelines for a reasoned and justified use of the "digital x" label. These are (a) sensitize to

ontological orientation, (b) justify context shifting, and (c) articulate signified qualitative difference. These guidelines are synthesized in Table 3 and discussed in detail. Also, see Appendices A.1–A.3 for two detailed examples.

4.1. Guideline 1: Sensitize to Ontological Orientation

A starting point for any study situating itself within a digital x framing is to be sensitive to its unique ontological positioning. Whereas we posit that a digital x framing needs to have, in practice, both digitization and digitalization as its fundamental dimensions (see Figure 2), we recognize that these dimensions can and need to be analytically separated for practical purposes. It is important to be sensitive to and aware of both viewpoints and to properly situate the chosen viewpoint and identify the focal conversations that the study intends to join.

Depending on the chosen view, the arguments and implications will vary. Studies subscribing to the digitization view need to draw from what we refer to as the engineering paradigm and clarify the unique digitization valence of the digital at stake. In this view, the emphasis is on the character and properties of bitstrings of the technology as represented by its semiotic character and how it is materialized in specific ways. At the same time, studies subscribing to the digitalization view need to emphasize the agential elements and the dynamics of the context in which versions of the digital objects and their material bearers are situated and performed. The emphasis is not on fixating ontological choices, but a call for sensitivity to the ontological underpinnings that emanate from diverse literature streams and traditions and how they treat bitstrings, their semiotic qualities, and material instantiations (see Appendix A.1).

4.2. Guideline 2: Justify Context Shifts

Our second guideline calls on authors to justify the presence of context shifting and warrant the use of the "digital x" label. A reasoned and justified demonstration of a shifting context is necessary to warrant the use of the "digital x" label. The author must ask: has enough changed, when compared with previously held beliefs or assumptions concerning focal IT features and their use within a given context, that would warrant moving from IT x to digital x? The demand to justify context shifting means crafting a compelling argument that enough has changed and that not using a "digital x" label will cause us to miss salient aspects of the focal phenomenon and keep us from capturing the novel phenomena under study. The merit of such justification is to outline how the contextual shifts detected imply that we can no longer do justice to the focal phenomenon and will fail to faithfully capture it using prior IT x concepts. The four outlined shifts—agential, semiotic, infrastructural cum combinatorial, and economics shifts—provide a minimal set of anchoring points that authors can leverage when arguing for the need for context shifting.

Each of the four shifts captures specific arguments that are used in recent studies (Tumbas et al. 2018, Baiyere et al. 2020a, Lyytinen 2021, Wessel et al. 2021). The agential shifts call for analyzing the formative impact of the creation of digital objects and their behaviors and the role of the new type of agency in a sociotechnical setting. For the semiotic shifts, scholars need to articulate the structure, behaviors, and nature of digital objects and their semiotic relationships and the semiotic representations that are being mobilized and performed as part of the technology deployment. Rather than focusing on the system and boxes, the scholar needs to account for what is being performed and enacted by the use of versatile digital objects and how they expand or enable new or modified affordances in the setting. An infrastructural cum combinatorial argument needs to focus on the fluidity of digital objects, enabling expansion and combination, and how the new objects endow new agential capabilities to the technology with related affordances that change context and organizing logic. In terms of unique economic shifts, it is important to clarify the radical economic logic that underlies digital technology, primarily characterized by increased variable costs and the nearly infinitesimal cost of data and its individual processing. These four anchoring points are not exhaustive but provide initial minimum guidance on how to articulate a justified context shift for applying the digital x lens. Whereas all four anchoring points may be present, the root anchor may drive how the other anchors shape. For example, if economic shift is the root anchor, it may require different shifts rather than when it is a consequence. For many, locating one or several of these outlined shifts should suffice in justifying the context shift that characterizes their focal phenomenon and domain (see Appendix A.2).

4.3. Guideline 3: Demonstrate the Signified Qualitative Difference

Studies drawing on the "digital x" label need to articulate clearly the focal qualitative difference being signified and update the conceptual lexicon accordingly. The key criterion is to demonstrate a change in kind, not just a change in degree. This guideline forms an important starting point in advancing theorizing around digital x. It calls for detailed and nuanced conceptual development of the qualitative differences that come with digital x phenomena and related explanations. Many times, such explanations cannot be derived from established theory (Grover and Lyytinen 2022). IS scholars need to identify the novelty arising from the qualitative differences that call for ingenuity in theoretical accounts of the new digital x IS phenomena. The delineation of such theoretical

Table 3. Guidelines for Delineating Digital x from IT x in Future Research

Guidelines	Guiding question	Actionable suggestions
Guideline 1: Sensitive to ontological position	What ontological positions does the study subscribe? 1a. Coconstitutive ontology (digitization + digitalization sense): Would this stance best characterize your digital x context? 1b. Digitization view: Would this stance best characterize your digital x context? 1c. Digitalization view: Would this stance best characterize your digital x context?	• Articulate the ontological standpoint adopted. • Outline why it is the appropriate view for your x inquiry. • Alternatively, offer a new ontological stance if relevant.
Guideline 2: Justified context shifting	What is new/has changed about the x context that warrants a new label? 2a. Agential shift: How has the agential characteristics of x shifted to warrant a digital x label? 2b. Semiotic shift: How has the semiotic nature of the x context shifted to warrant a digital x label? 2c. Infrastructural cum combinatorial shifts: How has the combinatorial makeup of the x context shifted to warrant a digital x label? 2d. Unique economics shift: How has the economics of the context shifted to warrant a 'digital x' label?	• Identify the observed context shift(s) in your specific x domain. • Justify why the observed shifts warrant a new label. • Draw on the four outlined context shifts. • Formulate other reasoned context shifts to support your arguments.
Guideline 3: Signified qualitative difference	What is the salient qualitative difference between digital x and IT x that is being signified? 3a. Identification pathway: How can the qualitative difference be justified using (empirical) evidence? 3b. Construction pathway: How can the qualitative difference be justified using logical inference? 3c. Synthesis pathway: How can the qualitative difference be justified based on prior literature?	• Outline the prior knowledge or assumptions of your chosen domain. • Propose the digital x variant for conceptualizing the phenomena in your domain. • Identify the qualitative difference between the prior knowledge and the digital x concept through careful juxtaposition. • Demonstrate the conceptual merit, empirical insight, and practical value of the applied digital x concepts.

novelty ultimately determines whether the digital x concept put forward serves as a useful analytical lens that is sufficiently distinct to chart a path for new inquiries and reaches beyond the traditional IT x knowledge. Such an endeavor will open up and identify research opportunities that unlock latent, revelatory type theorizing (DiMaggio 1995) not possible without the digital x type of conceptualization. To claim the use of a digital x concept, the qualitative difference delineating digital x from IT x needs to be identified and their consequences for IS theory and practice.

The difference needs to highlight, for example, how the combinatorial or infrastructural elements and consequent qualitative change in digital objects and their performances needs to be accounted for in alternative ways or how the new economics allows us to organize and coordinate activities radically differently. Demonstrating this often calls to put the prior IT x account side by side with the alternative digital x account. Such juxtaposition provides a clarifying exposition on how the change in vocabulary truly engenders a qualitative difference that carries conceptual merit, generates empirical insights, and improves the practical value of IS scholarship. We outline at least three pathways that can be adopted in articulating the qualitative difference signifying a warranted shift from using IT x to digital x. These are identification, construction, and synthesis.

4.3.1. Identification Pathway. This pathway justifies the qualitative differences based on evidence (typically empirical evidence). The evidence provides grounding to show that the qualitative difference exists and as means to articulate what the difference is. An exemplary work adopting this pathway is Wessel et al. (2021). This article unpacks the difference between IT-enabled organizational and digital transformation by drawing on two ethnographies that juxtapose and identify the difference in kind between the two transformations. Importantly, they draw on rich empirical evidence to formulate and articulate what is distinct about digital transformation as opposed to the received

knowledge of IT-enabled transformation. This pathway lends itself to situations that reveal that the current conceptual vocabulary fails to do justice in adequately explaining a phenomenon or to capture the context shifts observed in an empirical context.

4.3.2. Construction Pathway. In contrast to the identification pathway's reliance on evidence, the construction pathway draws its justification from logical inferences and theoretical imagination. The pathway involves justifying and articulating the qualitative difference based on logical arguments and reasoning. Rowe (2011, p. 491) presents this pathway as an approach that "spans boundaries and pushes the envelope into a new domain of inquiry and the development of new paradigms." Bharadwaj et al. (2013) provide an exemplar of this approach. Based on well-argued conceptual development, they offer a compelling justification of what qualitatively delineates digital strategy from IT strategy. In their essay, they draw heavily on illustrative examples, parallels from prior studies and general observations in putting forward their articulation of what digital strategy signifies in contrast to prior views on IT strategy. The pathway can serve scholars in domains in which the digital x is still in its nascent phase, but there are indications of sufficient context shifts to warrant the use of a "digital" label.

4.3.3. Synthesis Pathway. This pathway involves drawing on prior literature to highlight the qualitative difference being signified within a particular digital x. The objective of such synthesis is not merely to collate and organize prior literature. Rather it serves as a grounding for abstracting insights that help to infer the qualitative difference being signified with the digital label. This is a highly creative process that seeks to offer insight into the qualitative difference above and beyond the synthesis (Leidner 2018). In line with Webster and Watson (2002), this involves analyzing the past to pave the way for the future. Kohli and Melville (2019) present an exemplar of this pathway. Their work highlights how digital innovation differs from IT innovation with its expanded purview to cover a product-centric perspective involving new combinations of physical and digital products to form new products as opposed to the adoption of existing IT artifacts that are new to an organization to drive new IT-enabled processes, products, and services. Beyond highlighting the distinction, they deepen their conceptualization of what digital innovation is based on a thorough synthesis of the prior literature. Following this pathway makes sense when there is already a growing use of the "digital x" label to indicate a shift in a domain, but there is yet to be an articulation of the qualitative difference signified.

To demonstrate the utility of the guidelines, we present in the appendix two examples of how the guidelines can be used to argue for specific digital x instances. These cover phenomena related to digital money and digital disruption. Whereas our examples so far juxtapose digital x with IT x, we have picked up money as an x that does not necessarily have a clear IT equivalent to further demonstrate the cross-disciplinary opportunity of using the "digital x" label beyond the shores of the IS discipline. For both examples, we apply the guidelines to showcase how one can demonstrate sensitivity to digital x ontology, justify a context shift that warrants the "digital" label, and argue for the qualitative difference that is being signified (see Appendix A.3).

5. Conclusions

5.1. Foundations for Cumulative Digital x Research

Whereas growing pockets of IS research have recently adopted the "digital x" label, many of those explorations have not heeded carefully what warrants the choice. Lack of clarity in this commitment is creating a growing lot of disparate IS research making it difficult to state what digital x amounts to. Such disparity prevents the creation of a cumulative tradition and learning as a community. The call for sensitivity to the different ontological stances provides a starting point for delineating different ways to conceptualize the digital and consequently advancing different streams of digital x research. We recognize that, in research practice, the proposed coconstitutive view offers a flexible meta-framing for articulating the ontology of digital. Yet it allows IS scholars to clarify which of the two views—digitization or digitalization—they foreground and recognize the presence of the other without the challenge of attempting to isolate one over the other with clinical precision.

Sensitivity to the ontological underpinnings is important if we want to sharpen the locus of digital x research in ways advancing a cumulative tradition. When adopting a digitization view, technical novelty and advanced capacities of digital objects dominate and how they are enabled and constrained by the material bearer axis. Nevertheless, this does not preclude the need to understand that this novelty assumes and enables new kinds of sociotechnical interactions and action potential enacted in practice (digitalization view). In the same vein, studies adopting the digitalization view emphasize the social and technical ramifications of contextualizing the digital objects and their performances' yet still being grounded on understanding the key aspects of technological change (digitization view) that would enable such performances.

These insights have implications for whether a digital x study should adopt the "digital" label as a way to

signal particularities of the focal digital technology or if it is adopting the label to signal the particularities that emerge from the manifold interactions between the social and the technical within a context. For example, Faulkner and Runde (2019) adopt a view that gives salience to the digitization as they unpack the nature of digital objects as relatively independent components from their material bearers. Related studies, such as Fürstenau et al. (2019), highlight the unique characteristics of digitization in the current digital x form as their ontological premise. They emphasize the abstract, mathematical, and semiotic features of digital technology as powerful carriers and manifestations of increasingly fluid and large collections of digital objects. In contrast, studies such as Baiyere et al. (2020a) and Wessel et al. (2021) adopt the digitalization view as their ontological standpoint. Whereas the studies recognize new characteristics of digital objects (flexible, scalable, combinatorial), they try to unpack the features, relationships, and behaviors of the new sociotechnical environment created by the emergent interactions and dependencies for using such digital objects. At the heart of this ontological deliberation is the view that the digitization and digitalization senses of digital x coexist within most objects of inquiry. To isolate one dimension is to take an extreme ontological position, and if this is the case, we advocate for sensitivity to such choices.

5.2. Digital x and IT x in Future Research

As digitalization advances, the inevitable need to account for and explain emerging digital phenomena will grow (von Briel et al. 2018, Wessel et al. 2021). Therefore, it is critical that we recognize what the use of the term "digital" entails for the field's empirics and theory. This is not necessarily easy because digital x and IT x share significant commonalities. They both are founded on the idea of the critical role of computing in enabling and improving human enterprise. They share common baseline phenomena, including the concepts of digitizing, algorithms, and semiotic relationships, which form the foundation for any use of a computer-based information system. Hence, it would be futile to attempt to exclude all the assumptions, concepts, and reasonings guiding IT x when conducting digital x studies. At the same time, we posit here that it would be a categorical error to commit to all assumptions and logics that have guided IT x studies when one engages in digital x studies. In cases in which the authors provide no valid justification and analysis of the assumptions for adopting the "digital" label (such as studying ERP use or an implementation of a cloud system), the IT x concepts may just be sufficient to express the message.

As an analogy, water and steam are made up of the same elements (i.e., hydrogen and oxygen), and laws of chemistry of how hydrogen and oxygen atoms relate apply to both. However, it would be a mistake to treat them as though they are the same. Similarly, we advocate that studies adopting the "digital x" label need to pay due diligence in clarifying the difference between the digital x concepts and the prior IT x (or even x) concepts under study. Beyond the ontological positioning of the focal phenomenon in terms of digitization and digitalization planes, germane context shifts need to be explicated to indicate what it is about the digital at hand that makes the inquiry distinct from those using IT x notions. The guidelines proposed can help scholars position their contribution whether it is about a digital x or IT x phenomenon. We also note that, whereas the four identified shifts are general, scholars need to recognize the context specificity of the shifts idiosyncratic to their particular domain of study.

Failure to recognize entailments that follow from not using the assumptions and related concepts leads to errors of inclusion and exclusion in both IT x and digital x studies. Errors of inclusion happen when authors apply "digital x" labels when they should have applied the "IT x" label. Generally, this leads to ambiguity in contribution as well as dilution in the value of the contribution resulting from misplacement in a wrong discourse. Errors of exclusion happen when authors use the "IT x" label when they should have used the "digital x" label. These are harder to find as such errors result in counterfactuals: what would have happened if we had used the other label and related concepts and assumptions? However, there are several examples in the recent literature of the merits of avoiding such error (Lyytinen et al. 2016, Baskerville et al. 2020, Wessel et al. 2021, Piccoli et al. 2022). For example, the Baskerville et al. (2020) article coined the idea of the digital first principle. The idea posits that with the digital reading of the way in which digital objects and their material bearers connect now, digital comes before its material bearer, whereas with the IT x concepts, it was the opposite. Likewise, managerial studies demonstrate that drawing upon assumptions and rationale undergirding IT x leads to undesired practical outcomes when managers follow IT x assumptions and logics when dealing with digital x issues (Baiyere et al. 2020a).

5.3. Future Research

In this essay, we have only begun to scratch the surface of how to deal with digital x. The winds of change are currently so strong that we are primarily now observing, recording, and noting the novelty with a narrow window for more extensive theorizing. Ample opportunities abound, and associated research is necessary to advance generalizable knowledge on digital x topics. We next highlight a few salient avenues that open opportunities for research that can advance knowledge in the digital x area.

5.3.1. Continue Clarification of the Ontological Foundations of Digital. There is still a lot to be done in articulating the ontology of digital and how it relates to past ontological views of computing and digital phenomena. Recent research has just begun to highlight in detail the manifold interrelationship between the emerging ontology of digital, the unique properties and relationships that digital objects carry, their dynamic and elusive relationship to material bearers, and how different digital objects are performed with specific effects (see, e.g., Kallinikos et al. 2013, Faulkner and Runde 2019, Baiyere et al. 2020b, Baskerville et al. 2020, Lyytinen 2021, Piccoli et al. 2022). These works advance multiple angles through which the community needs to shine light on the nature of digital if it hopes to deepen our understanding of how the unique, emerging features of digital play out in increasingly complex roles in shaping the human enterprise.

5.3.2. Unpack Qualitative Difference(s) in Select Domains of x to Help Delineate Between IT x and Digital x. Future studies can provide the foundation for the cumulative development of digital x–themed IS research around various topics. It is increasingly important that we have a disciplined account of how digital x is distinct from IT x across various streams of IS research, including strategy, innovation, project management, governance, system design and development, adoption, and diffusion to name just a few. Such analyses would help foreground when the differences really matter and when such differences are not significant for theory and empirics. This work also helps forge connections between different streams of digital x research inside and outside the IS field.

5.3.3. Elaborate Context Shifts Characterizing Digital x. Possibilities of digital technologies continue to advance at warp speed with new emerging ideas such as the metaverse, web 3.0, blockchain, or IoT pushing the frontiers of digitization and digitalization. The community's task is to monitor and identify such changes, theorize around new phenomena that emerge from such changes, analyze the impacts of such changes, and explain how they manifest in specific IS research contexts. In particular, we need to ask if they reveal novel and significant shifts in agency, semiotic qualities, combinatorial nature, or unique economics. Studies of this sort provide us with frameworks that help recognize and capture emergent context shifts warranting updating the lexicon of the field.

5.3.4. Explore New Domains of Digital x. The idea coined in this essay, that x conveys a variable that stands for the field's pertinent and long-standing phenomena and related concepts but which, at the same time, can be used as an input to alternative forms of theorizing (IT x versus digital x), is, to our knowledge, novel. Although, in this essay, we focus on the benefits of contrasting digital x with IT x in situations in which the benefit is obvious, we are sure that there are other untapped values for x that either we missed (e.g., governance, development) or may not have an IT equivalent but are currently emerging. For example, we note an increased use of monikers such as digital entrepreneurship, digital marketing, digital money, etc., but such terms were unknown in the format of IT x (IT entrepreneurship, IT marketing, or IT money). This suggests that there is ample room to expand the import of digital—and indeed grow the field—beyond the current shores of IS phenomena.[5] By doing so, exploratory digital x research has the potential to align IS research with new communities and advance digital x research as a reference point to other disciplines.

The focus of this essay is on central elements of digital that enable agents to act and perform in ways that differ from the ways they did in the past; that is, what new affordances and joint interactions are emerging from novel ways of combining the social and technological? These elements and affordances have opened or are opening a plethora of opportunities for future research. It is difficult to say where the digital universe is ultimately heading because of its fluidity. But we are certain that it will continue to rise forward with unexpected outcomes given the recent rise of new digital capacities, including AI, IoT, and blockchain. We live in exciting times that offer ample opportunities for fresh theorizing at the nexus between the social and technical as we digitize and digitalize. Furthermore, as the digital x phenomenon spreads unencumbered to other disciplines, it is important for the IS field to lead the charge in theorizing about digital x. This is critical for the field's future as several management disciplines face the need to adopt their theoretical positions that connect digital to the x within their domain. How the IS field can successfully advance the new positioning as part of the emerging discourse around digital is a critical research quest for the discipline in the coming decade and beyond.

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Appendix A. Examples of Applying Proposed Guidelines

A.1. Guideline 1: Sensitivity to Ontological Position

With digital money, the emphasis is on the semiotic representation and further abstraction of money (Dodgson et al. 2015, Pshenichnikov and Babkin 2017). Scholars that focus on this dominant technical valence of digital money draw on the "digital" term with a technological underlay provided by the bitstring form of money.

With digital disruption, the emphasis is on the agency exercised by actors to alter a status quo in a domain by leveraging digital technology (Riemer and Johnston 2019). This can be seen from a digitalization perspective in terms of the paradigm shift that is unveiled by applying digital technology to rethink or upend established norms within a given sociotechnical context. See Table A.1. for a summary.

A.2. Guideline 2: Justify Context Shifting

The semiotic shift captures a key context shifting that warrants the move from the traditional notion of money to digital money. In essence, the articulation and construction of digital money as a concept became salient when the notion of money as a tangible resource (i.e., cash/bills) was no longer sufficient to capture the semiotic representation of money in terms of bitstrings (Dodgson et al. 2015, Adrian and Mancini-Griffoli 2021). Whereas the semiotic shift is arguably the most salient shift in the case of digital money, other shifts could also be argued for.

In contrast, the agential shift is a core shift that necessitates the move from IT disruption to digital disruption. Whereas the IT disruption conception focused on disruptions caused by technology breakdown or technology-related issues (Dynes et al. 2009, Qu and Jiang 2019), the notion of digital disruption elevates the agent's role in unlocking disruption via the novel application of technology, which alters established norms and confounds the prior organizing logics that have characterized a context before (Skog et al. 2018, Riemer and Johnston 2019, Baiyere and Hukal 2020). Whereas the agential shift is arguably the most salient shift in this case, other shifts, such as infrastructural cum combinatorial, and unique economics are enabling shifts that make agential shifts possible. See Table A.2 for an overview of both examples.

A.3. Guideline 3: Demonstrate the Signified Qualitative Difference

A key delineation that the concept of digital money brings to the fore is that value is encapsulated in bitstrings as a bearer of value whereas the established assumption of money is that it is encapsulated in the form of physical cash (bills) as a bearer of value whereas its digital presentations (as those of money on bank accounts or when using credit cards) are secondary. This is the digital first notion by which the digital money precedes the physical money and the latter can have multiple incarnations (Baskerville et al 2020). As opposed to seeing money as a physical tender (cash), digital money signifies a qualitative difference reflecting a view of money as a legal tender despite abstracting it into a bitstring form. With the liquefaction of physical money into its bitstring form, digital money as a conceptual label signifies an extension in the thinking about money such that it can be spatially separated from the location of a transaction and open up new modes of value exchange across media and material bearers (Dodgson et al. 2015, Adrian and Mancini-Griffoli 2021).

With digital disruption, a key delineation from IT disruption is that it entails a paradigmatic shift in modus operandi brought about by the application of digital technology (Riemer and Johnston 2019) instead of disruptions brought about by the breakdown of IT systems or infrastructure (Qu and Jiang 2019). This signifies a qualitatively different scale, scope, and source of disruption between digital and the IT equivalent. Essentially, the location of technology in both disruptions is fundamentally different such that attributing the phenomena captured by digital disruption with IT disruption amounts to a misallocation of agency. See Table A.3 for an overview.

Table A.1. Ontological Position Illustration for Digital Money and Digital Disruption

Guidelines	Guiding question	Actionable suggestions
Guideline 1: Ontological position	What ontological positions does the study subscribe to?	• Articulate the ontological standpoint adopted. • Outline why this is the appropriate view for your specific x inquiry. • Alternatively, offer a new ontological stance, if relevant.
Digital money	Illustration • Ontological standpoint: Coconstitutive view with emphasis on digitization. • Why? Emphasis is on the semiotic representation of money abstracted from the physical form (notes) to the varied bitstring forms.	
Digital disruption	Illustration • Ontological standpoint: Coconstitutive view with emphasis on digitalization. • Why? Emphasis is on the agential possibilities to unlock new affordances from a technology in order to profoundly change a status quo in a context.	

Table A.2. Justified Context Shifting Illustration for Digital Money and Digital Disruption

Guidelines	Guiding question	Actionable suggestions
Guideline 2: Justified context shifting	What is new/has changed about the x context that warrants a new label?	• Identify the observed context shift(s) in your specific x domain. • Justify why the observed shifts warrant a new label. • Draw on the four outlined context shifts or formulate other reasoned context shifts to support your arguments.
Digital money	Illustration • Example of identified context shift(s): Semiotic shift and infrastructural cum combinatorial shift. • Justification: • Semiotic shift: the shift from the view of money as a tangible resource to a semiotic representation. • Infrastructural cum combinatorial shift: Emergence of new forms of value unlocked by the novel potentials of the digitized form of money, such as cryptocurrencies (e.g., bitcoin) and derivatives such as nonfungible token	
Digital disruption	Illustration • Example of identified context shift(s): Agential shift and unique economics shift. • Justification: • Agential shift: The shift from the view of technology breakdown leading to disruption to a view in which agents unlock disruption based on novel application of technology to alter established norms/status quo and organizing logic. • Unique economics shift: The economics around disruption shift from the technology as the nucleus that determines the scale and scope of impact to the extent to which the paradigmatic change upends past economic models in sociotechnical contexts. For example, the economic impact of the digital disruption of streaming to the video and music industry is not limited to Netflix or Spotify but applies to the whole industry.	

Table A.3. Qualitative Difference Illustration for Digital Money and Digital Disruption

Guidelines	Guiding question	Actionable suggestions
Guideline 3: Signified qualitative difference.	What is the salient qualitative difference between digital x and IT x that is being signified?	• Outline the prior knowledge or assumptions of your chosen domain. • Propose the digital x variant for conceptualizing phenomena in your domain. • Identify the qualitative difference between the prior knowledge and the advanced digital x concept through careful juxtaposition. • Demonstrate the conceptual merit, empirical insight, and practical value of the applied digital x concepts.
Digital money	Illustration • Prior assumptions of money concept: Money is encapsulated in the form of physical cash (bills being printed) as a bearer of value. • Proposed conceptualization of digital money: Means of exchange by which value is encapsulated exclusively in bitstrings as a bearer of value. • Qualitative difference between money and digital money: for example, change in form from physical to bitstrings, paradigmatic change in modes of value exchange, a foundation for technology-based derivatives of money such as cryptocurrencies, nonfungible tokens, etc. • Value of digital money conceptualization: Digital money's conceptualization frees scholarship and practice from the limitations of prior conceptualization of money—as a physical means of exchange and bearer of value that by necessity is tethered to the bearer for exchange to happen—to a concept that embraces the spatially void idea of money enabling new modes of value exchange.	

Table A.3. (Continued)

Guidelines	Guiding question	Actionable suggestions
Digital disruption	Illustration • Prior assumptions of IT disruption concept: Disruption occurs as an alteration of normal functions because of the breakdown of IT systems or infrastructure. • Proposed conceptualization of digital disruption: Disruption occurs as a profound alteration of a dominant paradigm or the established norms/status quo of a context because of novel applications of digital technology. • Qualitative difference between IT disruption and digital disruption: for example, engenders a change in a dominant paradigm that upends the prior modus operandi and logics of a context as opposed to IT disruption, which is primarily a discontinuity because of technology malfunctions. Another core difference lies in the scale, scope, and source of disruption as well as a fundamental distinction in the location of technology in the disruption process, etc. • Value of digital disruption conceptualization: Digital disruption conceptualization frees scholarship and practice from the limitations of prior conceptualization of IT disruption—as an IT-induced alteration—to a concept that embraces the possibilities for disruption to be induced by the actions of agents afforded by technology.	

Endnotes

[1] One example of such interest is the ongoing AACSB funded project, MaCuDe – Curriculum for the Digital Era, that seeks to establish new digital curricula to all management disciplines (see https://macude.org/).

[2] Our goal is not to come up with a precise, universal delineation between digital and IT. One reviewer eloquently characterized such a goal as akin to nailing jelly to the wall. The term "digital" is now commonly used and has acquired multiple and contextual meanings that are impossible to reverse. Our objective is more humble, that is, to chart a path for a reflective use of the term in our research so that it does not lose its conceptual benefit. Attending to this provides direction and conceptual clarity to the field's research and helps us handle responsively the emerging digital phenomena.

[3] It is useful to note that both digitization and digitalization are implicated in digital x. If we do not digitize, our semiotic linkages to the social world are based on IT boxes of hardware and software rather than digital objects (IT x). If we do not give the bitstrings and their material bearers meaning in the context, then we have no action potential.

[4] This is in no way a statement of the quality of the study or its value in the IT x context. We just contrast these studies with digital x studies.

[5] Some IS departments are renaming their departments and programs with the digital moniker. Of course, such labels are replete with not only definition issues but a variety of political manifestations.

References

Adrian T, Mancini-Griffoli T (2021) The rise of digital money. *Annual Rev. Financial Econom.* 13:57–77.

Agarwal R, Gao G, DesRoches C, Jha AK (2010) Research commentary—The digital transformation of healthcare: Current status and the road ahead. *Inform. Systems Res.* 21(4):796–809.

Baird A, Maruping LM (2021) The next generation of research on IS use: A theoretical framework of delegation to and from agentic IS artifacts. *Management Inform. Systems Quart.* 45(1):315–341.

Baiyere A, Hukal P (2020) Digital disruption: A conceptual clarification. Bui TX, ed. *Proc. 53rd Annual Hawaii Internat. Conf. System Sci.*, (HICSS, Hawaii), 5482–5491.

Baiyere A, Rosenstand CAF (2019) Digital "x": Beyond bounded rationality, toward a theory of bounded imagination. Bitran I, Conn S, Gernreich C, Heber M, Huizingh E, Kokshagina O, Torkkeli M, Tynnhammar M, eds. *Proc. XXX ISPIM Innovation Conf.: Celebrating Innovation: 500 Years Since Da Vinci*, (ISPIM, Florence, Italy).

Baiyere A, Salmela H, Tapanainen T (2020a) Digital transformation and the new logics of business process management. *Eur. J. Inform. Systems* 29(3):238–259.

Baiyere A, Grover V, Gupta A, Woerner S, Lyytinen K (2017) Digital "x": A new tune for IS research or old wine in new bottles. *Proc. 38th Internat. Conf. Inform. Systems* (Association for Information Systems), 2236–2240.

Baiyere A, Topi H, Venkatesh V, Wyatt J, Donnellan B (2020b) The internet of things (IoT): A research agenda for information systems. *Comm. Assoc. Inform. Systems* 47(1):21.

Barrett M, Walsham G (1999) Electronic trading and work transformation in the London insurance market. *Inform. Systems Res.* 10(1):1–22.

Baskerville RL, Myers MD, Yoo Y (2020) Digital first: The ontological reversal and new challenges for information systems research. *Management Inform. Systems Quart.* 44(2):509–523.

Benbasat I, Zmud RW (2003) The identity crisis within the IS discipline: Defining and communicating the discipline's core properties. *Management Inform. Systems Quart.* 27(2):183–194.

Berente N, Seidel S, Safadi H (2019) Data-driven computationally intensive theory development. *Inform. Systems Res.* 30(1):50–64.

Berry DM (2012) Introduction: Understanding the digital humanities. Berry DM, ed. *Understanding Digital Humanities* (Palgrave Macmillan, London), 1–20.

Bharadwaj A, El Sawy OA, Pavlou PA, Venkatraman N (2013) Digital business strategy: Toward a next generation of insights. *Management Inform. Systems Quart.* 37:471–482.

Boland R, Lyytinen K, Yoo Y (2007) Wakes of innovation in project networks: The case of digital 3-D representations in architecture, engineering construction. *Organ. Sci.* 18(4):631–647.

Brennen JS, Kreiss D (2016) Digitalization. Jensen KB, Rothenbuhler EW, Pooley JD, Craig RT, eds. *The International Encyclopedia of Communication Theory and Philosophy* (John Wiley & Sons, New York), 1–11.

Brynjolfsson E, Hitt LM (2000) Beyond computation: Information technology, organizational transformation and business performance. *J. Econom. Perspect.* 14(4):23–48.

Chandler A Jr (1990) *Scale and Scope: The Dynamics of Industrial Capitalism* (Belknap Press of Harvard University Press, Cambridge, MA).

Chanias S, Myers MD, Hess T (2019) Digital transformation strategy making in pre-digital organizations: The case of a financial services provider. *J. Strategic Inform. Systems* 28(1):17–33.

Colbert A, Yee N, George G (2016) The digital workforce and the workplace of the future. *Acad. Management J.* 59(3):731–739.

Crowston K, Myers MD (2004) Information technology and the transformation of industries: Three research perspectives. *J. Strategic Inform. Systems* 13(1):5–28.

Dave C, Ellis-Chadwick F (2019) *Digital Marketing* (Pearson, UK).

Davenport TH, Short JE (1990) The new industrial engineering: Information technology and business process redesign. *Sloan Management Rev.* 31(4):11–27.

Davison RM, Tarafdar M (2018) Shifting baselines in information systems research threaten our future relevance. *Inform. Systems J.* 28(4):587–591.

DiMaggio PJ (1995) Comments on "what theory is not." *Admin. Sci. Quart.* 40(3):391–397.

Dodgson M, Gann D, Wladawsky-Berger I, Sultan N, George G (2015) Managing digital money. *Acad. Management J.* 58(2):325–333.

Dynes S, Pixley S, Madory D (2009) Managing risk of IT disruptions in healthcare settings: A continuity of operations planning process. *AMCIS 2009 Proc.*, 161.

Endres H, Indulska M, Ghosh A, Baiyere A, Broser S (2019) Industrial internet of things (IIoT) business model classification. *40th Internat. Conf. Inform. Systems*, 2988.

Faulkner P, Runde J (2019) Theorizing the digital object. *Management Inform. Systems Quart.* 43(4):1279–1302.

Fürstenau D, Baiyere A, Kliewer N (2019) A dynamic model of embeddedness in digital infrastructures. *Inform. Systems Res.* 30(4):1319–1342.

Galliers RD (2003) Change as crisis or growth? Toward a transdisciplinary view of information systems as a field of study: A response to Benbasat and Zmud's call for returning to the IT artifact. *J. Assoc. Inform. Systems* 4(1):13.

Goblick T, Holsinger J (1967) Analog source digitization: A comparison of theory and practice (Corresp.). *IEEE Trans. Inform. Theory* 13(2):323–326.

Gray J, Rumpe B (2015) Models for digitalization. *Software Systems Model.* 14(4):1319–1320.

Gregory RW, Keil M, Muntermann J, Mähring M (2015) Paradoxes and the nature of ambidexterity in IT transformation programs. *Inform. Systems Res.* 26(1):57–80.

Grover V, Lyytinen K (2015) New state of play in IS research: The push to the edge. *Management Inform. Systems Quart.* 39(2):271–296.

Grover V, Lyytinen K (2022) The pursuit of innovative theory in the digital age. *J. Inform. Tech.* Forthcoming. https://doi.org/10.1177/02683962221077112.

Grover V, Lindberg A, Benbasat I, Lyytinen K (2020) The perils and promises of big data research in information systems. *J. Assoc. Inform. Systems* 21(2):268–291.

Habermas J (1984) *The Theory of Communicative Action*, vol. 1 (Beacon Press, Boston, MA).

Hanseth O, Lyytinen K (2010) Design theory for dynamic complexity in information infrastructures: The case of building internet. *J. Inform. Tech.* 25(1):1–19.

Henfridsson O, Bygstad B (2013) The generative mechanisms of digital infrastructure evolution. *Management Inform. Systems Quart.* 37(3):907–931.

Hughes T (1989) *American Genesis: A Century of Invention and Technological Enthusiasm, 1870–1970* (University of Chicago Press, Chicago).

Hukal P, Henfridsson O (2017) Digital innovation—A definition and integrated perspective. Galliers RD, Stein M, eds. *The Routledge Companion to Management Information Systems* (Routledge, New York), 360–369.

Hylving L, Schultze U (2013) Evolving the modular layered architecture in digital innovation: The case of the car's instrument cluster. *Proc. 34th Internat. Conf. Inform. Systems* (Association for Information Systems), 1–17.

Jöhnk J (2020) Managing digital transformation: Challenges and choices in organizational design and decision-making. Unpublished doctoral dissertation, Universität Bayreuth, Rechts-und Wirtschaftswissenschaftliche Fakultät, Germany.

Kallinikos J, Aaltonen A, Marton A (2013) The ambivalent ontology of digital artifacts. *Management Inform. Systems Quart.* 37(2):357–370.

Kenney M, Zysman J (2015) Choosing a future in the platform economy: The implications and consequences of digital platforms. *Kauffman Foundation New Entrepreneurial Growth Conf.*, vol. 156160.

King JL, Lyytinen K (2004) Reach and grasp. *Management Inform. Systems Quart.* 28(4):539–551.

Kohli R, Grover V (2008) Business value of IT: An essay on expanding research directions to keep up with the times. *J. Assoc. Inform. Systems* 9(1):23–39.

Kohli R, Melville NP (2019) Digital innovation: A review and synthesis. *Inform. Systems J.* 29(1):200–223.

Leidner DE (2018) Review and theory symbiosis: An introspective retrospective. *J. Assoc. Inform. Systems* 19(6):552–567.

Lucas H Jr, Agarwal R, Clemons EK, El Sawy OA, Weber B (2013) Impactful research on transformational information technology: An opportunity to inform new audiences. *Management Inform. Systems Quart.* 37(2):371–382.

Lyytinen K (2021) Innovation logics in the digital era: A systemic review of the emerging digital innovation regime. *Innovation Organ. Management* 24(1):13–34.

Lyytinen K, Nickerson J, King J (2021) Meta-human systems = humans + machines that learn. *J. Inform. Tech.* 36(4):427–445.

Lyytinen K, Sørensen C, Tilson D (2017) Generativity in digital infrastructures: A research note. Galliers RD, Stein M, eds. *The Routledge Companion to Management Information Systems* (Routledge, New York), 253–275.

Lyytinen K, Yoo Y, Boland R (2016) Digital product innovation within four classes of innovation networks. *Inform. System J.* 26(1):47–75.

Lyytinen K, Varshney U, Ackerman MS, Davis G, Avital M, Robey D, Sawyer S (2004) Surfing the next wave: Design and implementation challenges of ubiquitous computing environments. *Comm. Assoc. Inform. Systems* 13:697–716.

Malhotra A, Majrczhak A, Lyytinen K (2021) Socio-technical affordances for large-scale collaborations. *Organ. Sci.* 32(5):1371–1390.

Markus M, Benjamin R (1997) The magic bullet theory in IT-enabled transformation. *Sloan Management Rev.* 38(2):55–68.

Morton MS, ed. (1990) *The Corporation of the 1990s: Information Technology and Organizational Transformation* (Oxford University Press, New York).

Nambisan S (2017) Digital entrepreneurship: Toward a digital technology perspective of entrepreneurship. *Entrepreneurial Theory Practice* 41(6):1029–1055.

Nambisan S, Lyytinen K, Yoo Y (2020) Digital innovation: Toward a transdisciplinary perspective. Nambisan S, Lyytinen K, Yoo Y, eds. *Handbook of Digital Innovation* (Edward Elgar Publishing, UK), 2–13.

Oshri I, Henfridsson O, Kotlarsky J (2018) Re-representation as work design in outsourcing: A semiotic view. *Management Inform. Systems Quart.* 42(1):1–23.

Parmiggiani E, Teracino E, Huysman M, Jones M, Mueller B, Mikalsen M (2020) OASIS 2019 panel report: A glimpse at the "post-digital." *Comm. Assoc. Inform. Systems* 47(1):29.

Peppard J (2018) Rethinking the concept of the IS organization. *Inform. Systems J.* 28(1):76–103.

Piccoli G, Rodriguez J, Grover V (2020) Digital strategic initiatives and digital resources: Construct definition and future research directions. *Proc. Internat. Conf. Inform. Systems*.

Piccoli G, Rodriguez J, Grover V (2022) Strategic initiatives and digital resources: Construct definition and future research directions. *Management Inform. Systems Quart.* Forthcoming.

Pshenichnikov VV, Babkin AV (2017) Digital money as a product of the development of information and telecommunication technologies. *Quality Management, Transport and Information Security, Information Technologies*, 259–265.

Qu XS, Jiang Z (2019) A time-based dynamic synchronization policy for consolidated database systems. *Management Inform. Systems Quart.* 43(4):1041–1057.

Raouf MA (2021) Contract guidelines and scope building for digital transformation and ERP projects. *Innovative and Agile Contracting for Digital Transformation and Industry 4.0* (IGI Global), 240–264.

Riemer K, Johnston RB (2019) Disruption as worldview change: A Kuhnian analysis of the digital music revolution. *J Inform. Tech.* 34(4):350–370.

Rodriguez J, Piccoli G (2018) Uncovering the digital "x" phenomena in the IS field: A text analysis approach. *Proc. 31st Bled eConf.*

Ross J (2017) Don't confuse digital with digitization. *MIT Sloan Management Review Online* (September 29), https://sloanreview.mit.edu/article/dont-confuse-digital-with-digitization/.

Ross J, Beath CM, Mocker M (2019) *Designed for Digital: How to Architect Your Business for Sustained Success* (MIT Press, Cambridge, MA).

Ross J, Beath C, Sebastian I (2017) Digitized ≠ digital. *MIT CISR Research Briefing*, vol. XVII, no. 10.

Ross JW, Sebastian I, Beath C, Mocker M, Moloney K, Fonstad N (2016) Designing and executing digital strategies. *Proc. 37th Internat. Conf. Inform. Systems* (Association for Information Systems), 1–17.

Rowe F (2011) Toward a greater diversity in writing styles, argumentative strategies and genre of manuscripts. *Eur. J. Inform. Systems* 20(5):491–495.

Salmela H, Baiyere A, Tapanainen T, Galliers RD (2022) Digital agility: Conceptualizing agility for the digital era. *J. Assoc. Inform. Systems* 23(5):1080–1101.

Sambamurthy V, Zmud RW (2017) *Guiding the Digital Transformation of Organizations* (Legerity Digital Press, Tallahassee, FL).

Sarker S, Chatterjee S, Xiao X, Elbanna A (2019) The sociotechnical axis of cohesion for the IS discipline: Its historical legacy and its continued relevance. *Management Inform. Systems Quart.* 43(3):695–719.

Sebastian IM, Ross JW, Beath C, Mocker M, Moloney KG, Fonstad NO (2017) How big old companies navigate digital transformation. *Management Inform. Systems Quart. Executive* 16(3):197–213.

Simon HA (1972) Theories of bounded rationality. *Decision Organ.* 1(1):161–176.

Skog DA, Wimelius H, Sandberg J (2018) Digital disruption. *Bus. Inform. Systems Engrg* 60(5):431–437.

Smith A (1999) Why digitize? *Microform Imaging Rev.* 28(4):110–119.

Svahn F, Mathiassen L, Lindgren R (2017) Embracing digital innovation in incumbent firms: How Volvo cars managed competing concerns. *Management Inform. Systems Quart.* 41(1):239–254.

Swanson EB, Ramiller NC (1997) The organizing vision in information systems innovation. *Organ. Sci.* 8(5):458–474.

Tilson D, Lyytinen K, Sørensen C (2010) Digital infrastructures: The missing IS research agenda. *Inform. Systems Res.* 21(4):748–759.

Tilson D, Sørensen C, Lyytinen K (2021) Digitally induced industry paradoxes: Disruptive innovations of taxiwork and music streaming beyond organizational boundaries. *Interdisciplinary Dialogues on Organizational Paradox: Learning from Belief and Science, Research in the Sociology of Organizations* (Emerald Publishing, Bingley, UK), 175–196.

Tumbas S, Berente N, Brocke JV (2018) Digital innovation and institutional entrepreneurship: Chief digital officer perspectives of their emerging role. *J. Inform. Tech.* 33(3):188–202.

Utesheva A, Simpson JR, Cecez-Kecmanovic D (2016) Identity metamorphoses in digital disruption: A relational theory of identity. *Eur. J. Inform. Systems* 25(4):344–363.

Vial G (2019) Understanding digital transformation: A review and a research agenda. *J. Strategic Inform. Systems* 28(2):118–144.

von Briel F, Davidsson P, Recker J (2018) Digital technologies as external enablers of new venture creation in the IT hardware sector. *Entrepreneurial Theory Practice* 42(1):47–69.

Webster J, Watson RT (2002) Analyzing the past to prepare for the future: Writing a literature review. *Management Inform. Systems Quart.* 26(2):xiii–xxiii.

Weill P, Woerner SL (2015) Thriving in an increasingly digital ecosystem. *MIT Sloan Management Rev.* 56(4):27.

Weill P, Woerner SL (2018) Is your company ready for a digital future? *MIT Sloan Management Rev.* 59(2).

Wessel L, Baiyere A, Ologeanu-Taddei R, Cha J, Blegind-Jensen T (2021) Unpacking the difference between digital transformation and IT-enabled organizational transformation. *J. Assoc. Inform. Systems* 22(1):102–129.

Westerman G, Bonnet D, McAfee A (2014) *Leading Digital: Turning Technology into Business Transformation* (Harvard Business Review Press, Boston).

Wimelius H, Mathiassen L, Holmström J, Keil M (2020) A paradoxical perspective on technology renewal in digital transformation. *Inform. Systems J.* 31(1):198–225.

Woerner SL, Weill P, Sebastian IM (2022) *Future Ready: The Four Pathways to Capturing Digital Value* (Harvard Business Review Press).

Yeow A, Soh C, Hansen R (2018) Aligning with new digital strategy: A dynamic capabilities approach. *J. Strategic Inform. Systems* 27(1):43–58.

Yoo Y (2012) The tables have turned: How can the information systems field contribute to technology and innovation management research? *J. Assoc. Inform. Systems* 14(5):4.

Yoo Y, Henfridsson O, Lyytinen K (2010a) Research commentary—The new organizing logic of digital innovation: An agenda for information systems research. *Inform. Systems Res.* 21(4):724–735.

Yoo Y, Lyytinen KJ, Boland RJ, Berente N (2010b) The next wave of digital innovation: Opportunities and challenges: A report on the research workshop "digital challenges in innovation research." Preprint, submitted June 9, https://dx.doi.org/10.2139/ssrn.1622170.