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Digital "x"

Beyond Bounded Rationality, Toward a Theory of Bounded Imagination

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Digital "x": Beyond Bounded Rationality, Toward a Theory of Bounded Imagination

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Abstract: Digital is increasingly affixed to known concepts across different management disciplines – for example digital innovation, digital disruption digital strategy – in essence digital "x". We advance the theory of bounded imagination as a conceptual lens for illuminating conceptualization of digital "x", and a delineation between digital from digitization and digital from digitalization. We specifically argue that the advances in digitization has largely diminished the core challenges of bounded rationality (time, knowledge, and resources). However, the next cognitive frontier is bounded imagination, which is the challenge for digitalization. The proposed theory of bounded imagination provides conceptual clarity for engaging with the digital "x" phenomenon in future research. We further articulate the implications for innovation managers by outlining bounded imagination milestones for digitalization.

Keywords: Bounded Imagination, Digital x, Digitization, Digitalization, Bounded Rationality

1 Introduction

We are in a digital era and this is evidenced by the increasing relabeling of existing concepts as digital "x" such as digital innovation, digital capability, digital marketing, and digital strategy to mention a few (Baiyere et al. 2017; Rodriguez & Piccoli 2018). Yet we do not have a clear articulation of what it entails to be digital. In particular, there is a vagueness and absence of conceptual clarity on what is distinctive in adding a "digital2 label to an existing concept. Furthermore, there is a struggle in expressing what exactly the distinction is between prior well documented "x" or IT "x" and the emerging digital "x" concepts (Rodriguez & Piccoli 2018, Yoo et al. 2010). Perhaps, this is just another fad that will fade away? There is an inkling that this is not the case and the digital phenomenon is distinct from what we have previously studied (Henfridsson & Bygstad 2013, Hinings et al. 2018; Yoo 2010). The rising trend in the use of the digital term across several academic disciplines as well as practitioner discourse signals that there is perhaps a notable shift underway (Rodriguez & Piccoli 2018). We are however, yet to

fully grasp the scope, scale, and peculiarity of insights or change that characterizes this emerging shift. This paper is positioned to engage in contributing to sharpening our understanding about the uniqueness of digital as a theoretical concept. To do this, we draw on the theory of bounded rationality (Simon 1972) as a foundation for proposing a theory of *bounded imagination* and using this to illuminate our conceptualization of the digital phenomenon.

   Our main thesis is that with advances in digitization, which aligns largely with prior conception of IT (Ross 2017; Tilson et al. 2010), we have largely diminished some of the challenges of bounded rationality. However, with digitalization, which aligns with our conception of digital (Ross 2017, Sambamurthy and Zmud 2017), the challenge is less about bounded rationality but what we theorize as bounded imagination. We suggest that our theory of bounded imagination helps in providing conceptual clarity for future research when engaging with the digital "x" phenomenon. We acknowledge that although digitization has diminished the bounded rationality challenge, the challenge is not eliminated. However, more and more domains will move from a primary problem of bounded rationality towards a primary problem of bounded imagination due to the global megatrend of digitalization of perhaps all domains.

2 Theoretical Premise

Foundations of Digital: Digitization versus Digitalization

To unpack what digital is, it is helpful to first unpack the process that underlies it. For conceptual clarity, digital as a dictionary word can be considered to emerge from both the process of digitization and digitalization. However, the idea of digital from digitization draws from similar conception as what we have conventionally typified as IT. Digital from digitalization on the other hand lends itself to the concept of digital "x", which is an abstraction at a different locus from digitization (Ross 2017, Sambamurthy & Zmud 2017).

   Digitization: Can be conceptualized in its basic form as the process of converting analogue or physical artifacts to a digital state. This basically describes the transformation from atoms to bits. This is the initial view with which digital has been conceived historically. However, the recent view of digitization, abstracts the concept to also include technology that is used in handling (converting, processing, transmitting, storing, manipulating e.t.c) digital "bits" (Brennen & Kreiss 2016, Ross et al. 2017). In other words, digitization refers to our conception of IT as this is generally evolved in our description as the technology for processing data and managing information. Digitization is applied in practice through the two first digital waves (Choi & Whinston, 1997). The first wave emerged in the 1980s where digital solutions were introduced to support internal work processes regarding e.g. inventory, salary, and, human resource management. The second wave emerged in the 1990s where digital solutions were introduced to support external work processes to customers and other business regarding e.g. customer relations, supply management, and financial transactions. One important impact of the two first digital waves, which are integrated through ERP (Enterprise Resource Planning) systems, are business based on digital platforms with smart algorithms such as Amazon, Airbnb, and Uber. These two waves are still growing.

Digitalization: On the other hand, can be conceptualized as the process of leveraging and sociotechnical application of digitization in a particular context (Gray & Rumpe 2015; Tilson et al. 2010). Digitalization deals with the re-organization, re-conceptualization, and creation of new sociotechnical structures that are abstracted from the functionalities and attributes of digitized artifacts (Yoo et al. 2010). In essence, digitalization implies the leverage of digitization in order to open up new possibilities or attain specific goals by drawing upon the affordance of the digital in conjunction with the sociotechnical properties of the context. To this point digitalization is applied in practice through the third digital wave which emerged in the late 1990s (Choi & Whinston, 1997). In the third digital wave the product (including services) itself is turning digital known from companies like Google (digital information), Spotify (digital music), and Netflix (digital video). The third wave is emerging from the two previous waves; resulting in what figuratively speaking could be termed a 'perfect digital storm' (Rosenstand & Ivang, 2018).

Digitization and Bounded Rationality

The bounded rationality problem describes our limitation to make rational decisions or to process information required to make a rational decision because of limited access to time, knowledge and resources (Simon, 1997). However, with the rapid advances in digital technologies such as big data analytics, cloud computing, artificial intelligence among several others, we increasingly have access to time, knowledge, and resources. And because digitilization is a global mega trend, more and more areas are becoming digital.

In recent times we have abundance of (calculation) time; where the prices-performance has been growing exponentially since the end of the 19th century (Kurzweil 2005, 2012). In what we as humans' experiences as real-time (near real-time), we can reduce complexity with sophisticated algorithms and digital tools; we can reduce uncertainty with simulations and predictive systems; among many others. We also have abundance of knowledge in the digital domain, with near real time access to on-line knowledge where AIs such as IBM's Watson can scan millions of papers and thus give better advice than e.g. a lawyer. Furthermore, digital resources are becoming more and more abundant where e.g. storage, transmission, and processing power as a utility are on exponential price-performance trajectories, where the price at some point is practically near zero (abundance). In short, with digitization we have increasing abundance of time, knowledge, and resources to deal with the bounded rationality problem. To this end, digital abundance is continuously on an exponential growth trajectory; hence unfolding in a rapid pace. We are however, not yet in a situation with absolutely abundance of time, knowledge, and resources required for full rational decision making; however, we are on a fast trajectory towards a situation, where we are increasingly less bounded by rationality as we have historically been.

But if we are less bounded by rationality due to digitization, what are then the boundaries for decision making in a digital age? What is the next frontier? Rationality based on abundance of time, knowledge, and resources are all anchored in past information; however, their exist uncertain and incomplete information about the future and at best we can only imagine what it may be. The uncertainty of the future in the digital domain is much more uncertain than in the analogue (non-digital) domain; simply

because the price-performance of digital technologies develops with exponential pace, where the price-performance in the analogue domain develop with linear pace. Therefore, we argue that, we are in a progression from the decreasing and previously dominant problem of bounded rationality to an increasing demand and problem of bounded imagination.

Digitalization and Bounded Imagination

By definition, digitalization embodies the capacity to re-conceptualize and apply a digital artifact beyond its basic affordance. It captures the ability to go beyond, to visualize what is not apparent, and abstract new possibilities out of an existing digital artifact (Ross 2017, Tilson et al 2010, Yoo et al. 2010). This we argue is a challenge of imagination. Digitalization requires starting from what a digital artifact offers and recombining it in innovative ways to unleash and enable affordances or application possibilities that were not previously apparent. We posit that while digitization focuses on taking advantage of what is possible in a digital artifact, digitalization raises the bar to consider the application beyond what is currently considered possible.

The ability to digitalize is bounded by the capability to imagine. The digitalization challenge is not only about making use of digital technologies to solve bounded rationality problems – digitization does that increasingly well. Digitalization is more a challenge about how to stand on the shoulders of the bounded rationality solutions and look beyond. It is within this endeavor that we see bounded imagination as the core problem that needs to be addressed and articulated in digital "x" studies regarding innovation management. We draw on the elements of bounded rationality (time, knowledge and resources) to further theorize how bounded imagination shifts the frontier of thinking about the limitation of the human rationality to the limitation of the human imagination.

3 Toward a Theory of Bounded Imagination

It is argued that imagination is the single most important thing that differ humans from other species. We can far better than other species imagine different possible futures, and with an effort we can make some of these possible futures real, where some futures exclude others (Harari 2014). To this end, imagination is paramount in order to navigate towards successful futures and avoid unsuccessful ones. However, if we cannot imagine a successful future, then we cannot navigate towards it (and avoid less successful alternatives), and we will most likely make decisions which actually prevent this future (Rosenstand, 2018) . As an example, if an entrepreneur cannot imagine expanding to other regions; then he will probably organize his company in a way, which is not easy to expand to other regions. To this point, the entrepreneur might even strategize not to expand to other regions, and as a self-fulfilling prophecy this will actually not happen. This is why the future of an organization in the digital domain is ultimately limited by the imagination of its management (and other key stakeholders in power). With the third digital wave and the many exponential developing and converging digital technologies, this challenge is bigger than ever and still growing; no matter the type of organization as long as it operates in the digital domain – a project, a start-up, an incumbent, a new organizational unit, a nation, an institution, an association, a union etc. Top-

management's bounded imagination is therefore the ultimate organizational boundary for how successful a future an organization can reach. Simply because, if top-management cannot imagine a possible future, then it will not support ideas imagined about a future from outside the organization or from lower organizational levels.

Herbert Simon has taught us that human (and animal) rationality is bounded (Simon, 1997), and consequently managers cannot run an organization fully rational. Simon's argument is as mentioned that the rationality of decisions is bounded by limited access to knowledge, resources, and time: The world is a risky place with increasing complexity and uncertainty, and the reasoning in any organization is thus limited by its access to knowledge, resources, and time. We do agree with Simon's argument at the time it was developed; however, the argument we put forward is that, that advances in digitization and the exponential increasing capabilities of converging digital technologies give us potent apparatus to cope increasingly better with bounded rationality.

Resources: The once huge barrier of access to resources is reduced in the digital domain, where access to digital resources are democratized. This is evidenced with the accumulation and exchange of digital resources over the internet; moreover, the internet also supports a much more easy easy access to resources in form of experts all over the world than in the analogue domain. Close to free access to numerous resources is facilitated by the exponential price-performance development of core digital technologies such as internet bandwidth, processing-power, data storage, artificial intelligence, cloud-computing etc. Many of these advances are overlapping and converging – e.g. a self-driving car is a type of a self-guiding drone, which uses pattern recognition, which effectively can be powered by machine-learning as a type of artificial intelligence. Moreover service-platforms creates highly effective digital markets with smart algorithms such as Amazon (goods), Uber (taxi), Airbnb (rooms), Momondo (flights and hotels), Netflix (video), Google (search), Wikipedia (knowledge) gives cheaper, faster, better, and more flexible and scalable access to supply and demand.

Knowledge: Complexity is a measure of accessible information, and uncertainty is a measure of lack of access to information (Matthiessen, 1998). Even today real data-driven organizations reduce both internal and external complexity and uncertainty in near real-time. Because products and services are cloud-based, organizations have near real-time access to information to such an extent, that these organizations e.g. ask their products about their customers, and not the customers about their products; however be aware, that these data do not give any insights in "… *why* customers make the choices that they do" (Christensen et.al., 2016, p. xi). The lot-size in customized mass production is going towards one; and to cope with the uncertainty of unique product-configurations organizations simulate and calibrate products, productions, and delivery virtually in digital twins – all in a split of a second – before they actually configure, produce, and deliver physically.

Time: The abundance of time we are looking into in the digital domain is actually the exponential developing computer-based calculation time. In brief algorithms reduce complexity and simulations reduce uncertainty. Artificial intelligence, which also reduces complexity, is also a type of algorithm – actually it is second order algorithms because the mathematical result of artificial intelligence is an algorithm for discrimination, e.g. can the result of machine-learning based on millions of pictures of faces be an algorithm for face recognition. However, we do not (yet) have computer based second order simulations; we do not have (at least human like) artificial imagination, where the mathematical result would be creative simulations. Because the price-performance of

computer-calculation is on an exponential trajectory, and because more and more are digitalized and converged, will we also be increasingly exponential better at coping with bounded rationality in organizations by leveraging the abundance of access to (calculation) time. At some point we will be able to cope with close to all relevant organizational information in near real-time. Of course, it will still be the case that we (and artificial intelligences) do not know, what we do not know; and consequently, the wrong information can and probably will be chosen as relevant. The argument is not stronger than, that we already have increasingly better means to reduce the organizational problems caused of bounded rationality; and that the means to do this is becoming better with exponential pace.

With abundance of knowledge, resources, and (calculation) time we can practically create anything we can imagine in the digital domain; however, as argued above; if we cannot imagine a specific future, then we cannot navigate towards or away from it. Consequently, a new boundary is becoming more and more significant to the success of organizations: Bounded imagination! Bounded imagination is caused by one single important fact: There are rarely definitive information about the future and how it will unfold; there is no possible access to future knowledge, resources, and time; but we can imagine a future constituted by knowledge, resources, and (calculation) time and then do an effort to create it. Imagination is not enough to create the future, action is also a prerequisite. The claim we support is that imagination increasingly is becoming the most important strategic and innovative organizational capability regarding the digital domain; the new frontier for innovation managers.

Juxtaposing Bounded Imagination and Bounded Rationality with Digital

Figure 1 shows a model of the juxtaposition of digitization and digitalization and their interrelation with bounded rationality and bounded imagination. Essentially, in order for organizations to deal with bounded imagination and bounded rationality, there is a need to leverage both digitization and digitalization. The model presents four modes in which an entity (e.g organization or innovation managers), can position themselves when dealing with bounded imagination and rationality based on their engagement with digitization and digitalization.
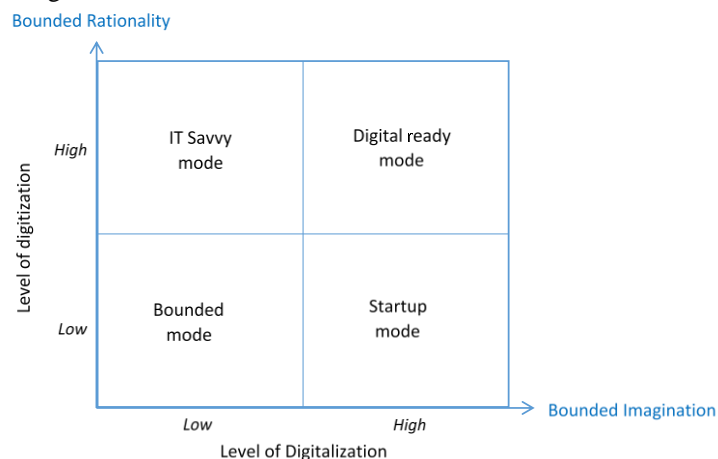
Figure 1 Juxtaposing bounded imagination and bounded rationality with digitization and digitalization.

The x- and y-axis in Figure 1 represent how big managers' problem of bounded imagination and bounded rationality is, respectively.

Bounded mode reflects organizations that could be typified as Stone Age business where IT and digital play significantly little or no role in their operations. In this quadrant the organization is limited in its capacity to deal with bounded rationality as well as bounded imagination; however, this boundary might not be experienced as a problem to the existing business. An example of this would be a hawker or street trader (Mayhew 1985). We consider organizations in the bounded mode to be limited in their capacity to process large amounts of information under the constraints of time, knowledge, and resources in their decision making. In addition to this, with the lack of basic digitization and thus digitalization, such organizations are limited in their capacity to digitalize or imagine what could be possible with regards to how they leverage digital technologies.

Startup Mode reflects organizations that have limited digitization but are highly endowed with the capacity to imagine and re-conceptualize new opportunities out of their limited digitized assets. Operation in this mode can break frontiers but may still be limited in their ability to deal with the problem of bounded rationality because internal and external processes are not yet formalized and thus digitized. Typical example of organizations in this quadrant would include tech startups. The digitization limitation of organizations in this quadrant places a constraint on decision making capacity due to the constraints of time, knowledge and resources required to make better informed choices. This may explain why very few startups succeed to a point of maturity and why pivoting (change of strategic and / or tactical direction) is the norm despite having brilliant digitalization initiatives or advanced digital imaginations.

IT Savvy Mode reflects organizations that are highly digitized with access to digital technologies that enable them to resolve some of the core limits of bounded rationality. However, operation in this mode implies that the organization is leveraging the basic potential of the technology; however, bounded in its digitalization efforts. This places them in a quadrant where they are bounded by lack of imagination. Many established traditional companies fall under this category. They may have all the latest technology and be highly digitized with digital technologies such as ERP, CRM (Costumer Relation Management), HRM (Human Resource Management) and many other sophisticated digital solutions. However, while these tools are valuable in combatting the challenges of bounded rationality regarding internal and external processes, the technology in themselves fare less in helping the organization to overcome the problem of bounded imagination. This suggests that digitalization is essentially dependent on the imaginative capacity of the actors (e.g innovation managers) to envision what is possible with a digital technology beyond the basic affordance of information technology. This thinking shifts the attention from the power of the technology and bestows more importance on the human agency such as an innovation manager in charting the bounded imagination dimension. These types of organizations are often digitally mature regarding digital standards and techniques; and skilled managers have created this maturity which have resulted in business success through many years of hard work; however, exactly because of this experience of being successful innovation managers, their bounded imagination can very well be characterized as unknowingly incompetent.

Digital Ready Mode reflects organizations which is both highly digitized and digitalized. Organizations in this quadrant are typically pushing the envelopes in their industry with regards to being digital with new business models and smarter to market solutions. Companies such as Amazon would fit into this category. They can be seen as being highly digitized but at the same time rethinking the application of different technologies e.g. the internet as a bookshop and data storage as a cloud business among others. Indeed, neither did Amazon create the internet nor did they create the art of selling books. However, they imagine what could be possible by inventing the art of selling books online (including digital books). A similar story can be told of the emergence of their AWS (Amazon Web Services) cloud business. Other notable examples would be Netflix, Google, or even simpler examples such as Mobile pay by Danske bank or M-PESA by Vodafone. The latter and simpler examples show that an organizational unit of an organization can be in *Digital Ready Mode|,* while other parts of the organization can be in other quadrants of Figure 1. The key identifying characteristic of this quadrant is the possession of digital technologies to minimize the bounded rationality challenge while also leveraging the propensity of the human agents such as innovation managers' capability to imagine future possibilities based on the existing knowledge of what current digital technologies can and will do due to technology convergence and exponential price-performance development.

Digitalization milestones for bounded imagination

We further articulate four bounded imagination milestones that should be essential considerations in the process of digitalization. These are

- Envisioning (Comprehension) milestone
- Contextualization milestone
- Reconceptualization milestone and
- Enactment milestone

Envisioning/Comprehension milestone: This is a bounded imagination milestone that involves trying to make sense of a digital technology and what it is capable of. This is a necessary milestone that seats at the first attempt at comprehending the underlying technology on which the process of digitalization will rest on (Peppard, Edwards and Lambert 2011). This is a pertinent milestone in that it sets the foundation for the subsequent imagination that would characterize a digitalization context. It essentially entails a search for knowledge and a quest for understanding; however, be aware that there is no shortcut to experience. To this point, recruiting innovation managers with actual digitalization experience can be essential. For example, organizations are typically good at their core area of business but the pace of advancement of digital technology is such that organizations cannot easily keep up to date with all the latest technology. This implies there will always be an envisioning milestone to be transgressed in order to take advantage of digital technology in a digitalization process. Examples of technologies in recent times that may not initially be in the scope of most organizations on inception include, AI, cloud computing, IoT, Robotics, 3D printing, blockchain, virtual/augmented reality among many others. Before organizations can start imagining what is possible based on these technologies, the first milestone would be to understand digital

technologies and envision affordances plus what is possible with the technology on a general level.

Contextualization milestone: After crossing the envisioning milestone, the next bounded imagination milestone involves trying to abstract from the general possibilities of the technology to the specific context of the organization. Essentially, the contextualization milestone, captures the voyage of trying to relate the affordances of a digital technology to the existing or familiar domain of an organization. In other words, this milestone is characterized by imagining how a digital technology could be relevant for an organization (Nylen and Holmström 2015). It is easy (although at times valuable) to fall into the problem of bounded imagination and dismiss a digital technology at this milestone as irrelevant, due to the simple fact that innovation managers cannot imagine, what they cannot imagine. For example, a manufacturing company that has crossed the envisioning milestone of 3D printing would begin to attempt to imagine how the technology could be relevant for their manufacturing process. A bank on the other hand may not readily find attaining the contextualization milestone of 3D printing technology to be relevant. Contextualizing a 3D printing into a banking industry, while not readily conceivable, is intrinsically an exercise of imagination. This implies that even though a technology may appear irrelevant for a context, it takes breaking away from the challenge of bounded imagination to see what is possible in the digitalization goals of such a context.

Reconceptualization milestone: This is a milestone that is at the very core of the imagination concept. Reconceptualization milestone is an important, if not critical, phase in navigating bounded imagination in the digitalization process. Reconceptualization basically means imagining the existing aspect of an organization in light of the affordance of a technology in other to create a future state. At this point it is important not to reject imagination because it is not close to core business, because that would limit radical business models and digital solutions such as changing from consultancy by the hour to a platform subscription. To this end, we suggest a change from a core business to a core knowledge focus. This is the milestone where after the envisioning and contextualization milestones have been attained, innovation managers needs to re-evaluate, rethink, and reconceive the current structure, practices or properties of the organization as well as different capabilities of a digital technologies in order to imagine a desired digital state (Westerman, Bonnet and Mcafee 2014). In contrast to digitization, where the emphasis is on adopting a technology and using it as prescribed, the reconceptualization milestone places emphasis on going beyond the basic affordance of the technology and imagining what is possible within the context of the organization. This is the point where the peculiarities of the organization as well as the attributes of the technology are interlaced together in order to attempt to imagine something that prior to that milestone did not exist. Netflix is an example of an organization that did not limits its imagination of what is possible with the internet to merely having a static website. But rather, Netflix reconceptualised its way of working, its value proposition and its way of delivering value to its customers by relating its business of renting movies and the potential of the internet to imagine a future of online movie streaming on a subscription basis.

Enactment milestone: The notion of bounded imagination should not be seen as a call for fantasizing without roots in reality. On the contrary, in other for digitalization to take place not only is there a need to envision, contextualize, and reconceptualise but there is a need to enact the imaginations formulated in these earlier milestones. Enactment milestone can be seen as the implementation milestone towards attaining digitalization (Kane et al. 2015, Westerman et al. 2014). In this milestone, the emphasis is on executing or bringing to reality the imagined future. For innovation managers this requires leaps of faith, because as mentioned, there is no data about the future. To this point, it might be smart to enact with MVPs (Minimal Viable Products) to ensure fast learning and avoid big and expensive failures. To this end, innovation managers will often fail, when they base actions on imagination rather than rationality; and if the failures are relatively inexpensive and fast (fail fast), they will in a healthy organizational culture be considered as valuable learnings instead of expensive mistakes. The enactment milestone inherits its activities from the preconceived consideration in the reconceptualization milestone. This means that although attaining the earlier milestones is important, they need to be done within the limits of what is feasible. It may be easy to conjure visions of fantastic imaginations that are unrealistic; e.g. due to bad timing regarding the price-performance or market demand of the considered digitalization. Our call is digital imagine within the constraints of what is realistic, and this is the essence of the enactment milestone. This milestone calls attention back to assessing the possibility of realizing imagined futures. This thereby sets up a process of looping back through the other milestones to re-imagine the intended digitalization based on the constrains of reality. For example, Googleglass is a digitalization initiative that is born out of surpassing the limits of bounded imagination, and the failure could probably have been avoided by a smaller MVP-setup without massive marketing. A similar concept will probably be successful in the future. The journey of Googleglass through the milestones is indicative of a successful attainment of the envisioning, contextualization, and reconceptualization milestones; however, it had to reckon with the enactment reality in achieving its desired imagination. In other words, the enactment milestone ensures that the bounded imagination concept is not rooted merely in conceptual clouds of innovation managers, but it equally recognizes and adopts a grounding on pragmatic application.

Conclusion

In this conceptual paper, our objective is to advance the theory of bounded imagination as an extension to the theory of bounded rationality and to unpack how the theoretical notion of bounded imagination can be used to delineate between digitalization and digitization in the digital "x" debate. Specifically, the theory of bounded imagination argues that digitization has largely minimized the barriers of bounded rationality in terms of time, knowledge, and resources required for decision making, while the next frontier for us and particularly for innovation managers to cross is the bounded imagination, which is a prerequisite for digitalization. Based on this premise, we conclude that digitalization is more a challenge about how to stand on the shoulders of solutions based on bounded rationality and look beyond our bounded imagination. It is within this endeavor that we see the bounded imagination as the core challenge that needs to be addressed and articulated in digital "x" studies. We therefore call for future studies that

engage in enriching our understanding of how to deal with the limitations of bounded imagination and harness the power of digitalization.

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