

# A Digital Perspective on Entrepreneurship

John P. Ulhøi<sup>1</sup>

<sup>1</sup>Aarhus University, Business and Social Sciences, Department of Management, Aarhus, Denmark | [jpu@mgmt.au.dk](mailto:jpu@mgmt.au.dk)

## Abstract

The wider impact of digital technologies on entrepreneurship has only recently begun to surface in the entrepreneurship literature. This situation invites for re-examining theory on digital technologies and theory on entrepreneurship while at the same time asking where to find critical bridging points that may allow for integrating the two domains. This paper answers this question by reviewing and subsequently analyzing core constituents of digital entrepreneurship and its *modus operandi*. Our analyses show that digital entrepreneurship not only involves entrepreneurial agency and digital technologies, but also affects previous conceptualizations of artifacts and of its modus operandi by applying a broader repertory of architectural arrangements. This implies that the employment of digital technologies in entrepreneurial ventures has effects that go well beyond using digital technology as a means-to-an-end. Before closing, implications for future research and relevant policy makers are briefly sketched out.

**Keywords:** Entrepreneurship, Digital Agency, Digital Structure, Digital Artifact.

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## 1 Introduction

Market projections for digital technologies (DTs) are remarkable (c.f. for example McKinsey, 2017; McKinsey 2018). Most, if not all, sectors have been affected at varying degrees and/or pace from traditional industries such as the steel industry (Herzog et al., 2017, Ghezzi and Cavello, 2018; Nambisan et al., 2020), the construction industry (Shibeika and Harty, 2015), over manufacturing (Holmström et al., 2016; Bajgar et al., 2019), retailing (Hagberg et al., 2016; Brynjolfsson, et al., 2013), to banking (Agrawal, 2017; Yanagawa, 2018), the music industry (Bourreau et al., 2013), healthcare (Bogue, 2011), education (Keren and Fridin, 2014; Bond et al., 2018) and the telecommunication sector (Valdez-de Leon, 2016). In a recent book, Yeung and Ulrich (2019) attempt to decode some typical features of highly effective and widely known internet-based companies. The two authors identify and describe a new type of organizational architecture which they referred to as a market-oriented ecosystem. An interesting feature of this architecture, they emphasized, is its ability to support scalability and rapid growth. What is also worth noticing is the fact that several of these successful internet-based companies have succeeded even without introducing new services. Instead, they catered to needs that already exist in the market by successfully redesigning and transforming the service in question to a digital form thus enabling it to meet the existing needs in new and more efficient ways.

Various core business functions are affected by the escalating digitalization. Studies have examined the digital effects on development and innovation (Lyytinen et al., 2016; Nambisan et al., 2020), marketing (Quinn et al., 2016; Dahiya, 2017), supply chain management (Zangiacomì et al., 2020), and the financial (Zhu and Zhou, 2016; Dandapani, 2017) and accounting functions

(Quattrone, 2016) to HRM (Parry and Strohmeier, 2014). Digitization has also affected entire business models (Nambisan, 2017; Sussan and Acs, 2017; Zaheer et al., 2019; Song, 2019) as well as markets (Autio et al., 2017; Kraus et al., 2019; Rippa and Secundo, 2019). Extraordinarily successful internet-based companies have materialized for example in e-business (Ebay), sharing economy (Uber), social media (Snapchat), streaming services (YouTube) and have showcased entrepreneurial growth rates not previously seen.

Scholars have maintained that DTs are capable of altering markets and society drastically (Rippa and Secundo, 2019). Others have insisted that the fast development of DTs and their associated infrastructures create new affordances that affect the very organization of economic activity (Autio et al., 2017). Essential properties of DTs deserve particular attention as: (i) they are reprogrammable (enabling a variety of functions), (ii) the involved homogenization of data provides a high flexibility (all digital content can be processed, transmitted through the same digital devices and networks and (iii) they are self-referential (by using the same digital technology) (Yoo, et al., 2010, p.726).

As research in digital entrepreneurship is still quite limited (Kraus et al., 2019), an obvious place to begin an examination is by focusing on the basic characteristics of DTs. Nambisan (2017), for example, has singled out some interesting features associated with DTs, namely that DTs have changed the organizational boundaries from being somewhat fixed and impermeable towards becoming increasingly fluid and penetrable across products, services and processes. Further, and in consequence of these changes, the locus of entrepreneurial agency seems to be less dependent on individual agents and/or pre-defined business ideas. Differently put, entrepreneurial agency appears to be increasingly dispersed and to include multiple agents involving interaction and cooperation in a variety of ways to secure favorable outcomes of their enterprising agency. Differently put, value creation increasingly takes place through the production of digital information (Sahut et al., 2019).

New fast-growing digital enterprises are demand-driven and their competitive power and related value-maximization are made possible by the large number of (existing) customers – in contrast to the ‘traditional’ supply-driven ventures, based on cost-minimization and scale-efficiencies (Song, 2019). Recent findings from an in-depth case-study of a ‘born digital’ financial service company (WeCash) have shown that the data-driven nature of digital entrepreneurial agency combined with immediate releases and swift transformation during the development process promote fast scaling (Huang et al., 2017). The study showcased how the digital component helped the management frame and monitor opportunities and risks by analyzing huge volumes of data. Instantaneous materialization and launching of commercial ideas prevented any unnecessary delay in the process from idea to deployment. Lastly, the study documented how an uncomplicated contextualization of the applied technologies seems to make swift transformations possible. From a transaction cost perspective, digital entrepreneurs have also been found to be able to reduce transaction costs without internalizing activities (Sussan and Acs, 2017, p.67).

As recently pointed out by Elia et al. (2020), existing research on digital innovation and digital entrepreneurship focus on firm and organization level analysis, thus leaving out the interlinkages to the structural and architectural arrangements. Notwithstanding, the dynamic and fertile attributes of DTs have left some breaches in the contemporary theory on entrepreneurship (Nambisan, 2017; Kraus et al., 2019). This situation invites for re-examining the theory on digital technologies and the theory on entrepreneurship. More specifically, this paper asks if there are important bridging points that can allow for conceptualizing digital entrepreneurship? This conceptual paper aims at identifying, specifying/defining key constructs (agency, structure and artifacts) and clarifying their inter-relatedness. This paper answers the research question by analyzing core

constituents of digital entrepreneurship and its *modus operandi*. We begin our analysis by a scoping literature review (Grant and Booth, 2009). In so doing, we identify key constructs and direct our attention to how digital agency is employed in order to pursue new and internet-based ways of opportunity exploitation. First, we review, identify and discuss generic constituents from the theory on entrepreneurship and DTs. These components include agency, structures and artifacts. Next, we analyze the structural arrangements that have been associated with successful digital entrepreneurship, comprising digital infrastructure, digital platforms, and digital ecosystems. We then show how digitalization affects the conceptualization of artifacts.

We wrap up our discussion by concluding that there is more to understanding growth-oriented digital entrepreneurship than a strong market-orientation and a choice of specific means to that end. Explaining digital entrepreneurship involves integrating core concepts from the theory on digital technologies and the theory on entrepreneurship. This does not imply, however, that the locus of human agency and related levels of self-efficacy are no longer relevant. Such agency is still necessary for and present in the digital entrepreneurship equation. Our analyses show that digital entrepreneurship, apart from involving entrepreneurial agency and DTs, also affects the previous conceptualization of artifacts. Further, our examination of digital entrepreneurship reveals that the *modus operandi* has been changed by adding a broad repertoire of architectural arrangements. This in turn implies that the employment of DTs in entrepreneurial agency has effects that go well beyond serving as a means-to-an-end. Before closing, avenues for future research and decision-makers are briefly sketched out.

## 2 Literature review

As recently pointed out by Jaakkola (2020) academic journals need conceptual papers that can “bridge existing theories in interesting ways, link work across disciplines, provide multi-level insights, and broaden the scope of our thinking”. (Contrary to empirical papers, conceptual papers do not have the same degree of consensual recipes for addressing the robustness of this kind of research, challenging the rigor dimension. Having said that, both empirical and conceptual and theoretical papers share in common the creation of new knowledge. In conceptual research, arguments and conclusions are not based on (own) data, but from previous conceptual, theoretical and empirical validated findings. A common approach taken in conceptual papers is to start from noting that “a particular concept, theory, or research domain is internally incoherent or incomplete in some important respect and then introducing other theories to bridge the observed gaps” (op.cit., p. 19).

More specifically, we have used a scoping review technique (Grant and Booth, 2009). It aims at identifying the nature and extent of existing research (within specified constraints) and share generic characteristics of the systematic review with regard to being systematic and transparent (p.101). Contrary to a systematic literature review, however, the completeness of a scoping review is determined by constraints. In our case, the following constraints have been used: (i) peer reviewed journals and (ii) individual-firm-ecosystem level focus. Moreover, contrary to systematic literature reviews, where quality assessment may determine inclusion/exclusion, there are no similar quality assessment requirements for scoping reviews (p.95). In our case, however, we have included studies where the existing research in the field focuses on the organizational level.

Moreover, the multi-disciplinary and integrative review was used to identify key constructs needed for our development of the theoretical framework by combining insight from different fields (Snyder 2019, p.335) – in this case digital technologies and entrepreneurship at the individual-firm and ecosystem levels. The review was conducted in two rounds. The first round of search was

conducted in December 2019 and a follow-up search was done in May 2020. The following databases were used: ABI Inform, Web of Science, and Business Source Complete. Only peer-reviewed journal papers (in English) were included. The key construct “digital entrepreneurship” was searched in combination with “technology”, “transformation”, “artifact”, “agent”, “agency”, “activity”, “architecture”, “structure”, “platform”, and “ecosystem”.

Up until today, surprisingly few attempts have been made to review the scarce and fairly scattered literature published in the unsettled field of what can be hosted under the term ‘digital entrepreneurship’. In a focused and narrow (mono-disciplinary-oriented) review of the literature in the field (n=35) Kraus et al. (2019) notice a conceptual lack of clarity as different concepts (digital venture, digital innovation, digital enterprise or digital business) are used to describe the phenomenon of digital entrepreneurship. Another recent and somewhat broader (interdisciplinary) review (n=133) documented that while this young field is offering quite a bit of dynamics, it tends to unfold along confined and rather fragmented trajectories with little consensus with regard to definitions of key concepts (Zaheer et al., 2019).

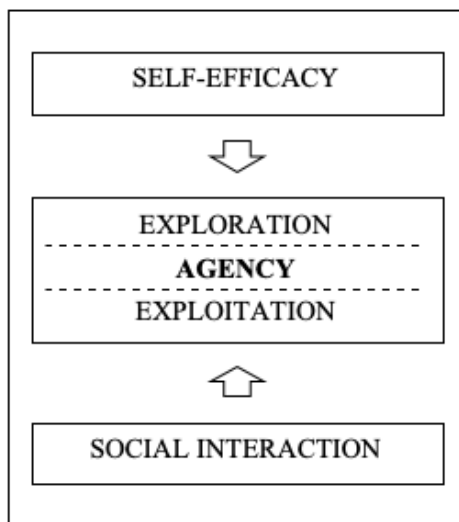
*Digital entrepreneurship* (DE) has been described differently in the literature. Rippa and Secundo (2019), for example, define DE as “a relevant socio-economic and technological phenomenon that can be considered as the leveraging of digital technologies to shift the traditional mode of creating and doing business in the digital era” (p.901). Sahut et al. (2019) define it as “the process of entrepreneurial creation of digital value through the use of various socio-technical digital enablers to support effective acquisition, processing, distribution, and consumption of digital information” (op.cit. p.4).

Other scholars have specified digital entrepreneurship as “any entrepreneurial activity that transfers an asset, service or major part of the business into digital” (Kraus et al., 2019, p.2) while others have narrowed down the scope by defining DE as “opportunities based on the Internet and the cloud and using big data and artificial intelligence” (Song, 2019, p.575).

We refer to DE as the individual and/or collective and deliberate use of DTs to orchestrate entrepreneurial processes, i.e. opportunity recognition, exploration, seizing and exploitation. Although this is a rather broad definition, it rules out an ad-on of DTs in later phases of the organizational lifecycle. We also need a suitable term to express the wider organizational effects that can follow from the integration and/or application of DTs in companies. *Digital transformation* has been defined as company-wide changes (Verhoef et al., 2021, forthcoming, p.4), i.e. fundamental changes in the business processes, the operational routines, the organizational capabilities as well as in the approaches to enter markets (Li et al., 2017). Unlike non-digital entrepreneurs who often have a significant need for start-up capital, digital entrepreneurial agency often has a smaller need for start-up capital for the physical production. In addition, many new digital ventures have demonstrated an exceptional capacity to scale up and grow fast in existing markets.

## 2.1 Agency

Entrepreneurship, be it digital or not, involves human agents and entrepreneurial activities and has long been acknowledged as an activity associated with risks (Drucker, 1959; Vereshchagina and Hopenhayn, 2009). Capable and persistent agents have always played a key role in entrepreneurship from the very inception of the business idea to its realization. Likewise, until recently the attention has mostly focused on the individual characteristics of the venturesome agent. Despite the fact that Savary (1723 in Redlich, 1949) has been singled out as the first individual to introduce entrepreneurship as a technical (dictionary) term, the work of Richard Cantillon tends to be perceived as the first author to assign entrepreneurs an independent space in economic theory and development (Carlsson et al., 2013). More recently, however, Loasby (2005) has emphasized



**Figure 1.** The generic individual elements of entrepreneurial agency.

that agents, objectively or in social isolation, do not simply decode information. Rather, they argued, agents subjectively interpret and process information under the influence of (i) other agents involved and (ii) means applied to meet their ends.

Skills coordination, motivations and emotions (individual agency) in combination with a sensation of being capable of handling a given task (self-efficacy) are recognized as foundational constituents in the theory on human agency and social learning. Bandura (1977) has based human agency on the concept of self-efficacy. The latter signifies that human agents' beliefs about their own capabilities to exercise control over events are likely to affect their lives significantly. This theory has framed human agency in its social cognitive context (Bandura, 1989), thus clarifying critical mechanisms that enable personal agency to surface within a structure of reciprocal causation. Bandura's theory is nested in the notion of emergent interactive agency (Bandura, 1986), implying that human agents are "neither autonomous agents nor simply mechanical conveyers of animating environmental influences" (...) [but instead are under the influence of reciprocal causation during which] "action, cognitive, affective, and other personal factors, and environmental events all operate as interacting determinants" (p.1175). The importance of efficacy is further illustrated by referring to a list of creative individuals, who persisted in pursuing and succeeding their endeavors despite multiple rejections. Conceptualizing agency through a self-efficacy lens is widely acknowledged as an approach to conceptualize entrepreneurship which not only involves "uncertainty, creativity, leadership and proactivity, but also requires persistence and passion" (Newman et al., 2019, p.404). The self-efficacy-mechanism thus drives agents' motivation, mental states and behavior, thus making them unique in terms of their ability to shape their life circumstances (Bandura, 2006).

Below, in Figure 1, the paper outlines the generic elements of entrepreneurial agency and how the individual dimensions of entrepreneurial explorative and exploitative agency involve self-efficacy as well as social interaction.

Effective entrepreneurial agency has changed from being primarily an outcome of individual agency towards involving a broader eco-systemic perspective (Cavallo et al., 2019). Although the role of personal character or 'trait approach' in entrepreneurship theory has not had overwhelming success in distinguishing successful entrepreneurs from others (Ulhøi, 2005), individual agency can still not be removed from occupying a central place in the digital entrepreneurship equation. DTs enable entrepreneurial agents to substantially increase their opportunities, ways of funding and

organizing entrepreneurial activities (Nambisan, 2017). Others have explicitly proposed, that the focus needs to go beyond the entrepreneurial team (Zaheer et al., 2019).

DTs have enabled innovative agents to produce “products or services that are either embodied in information and communication technologies or enabled by them” (Lyytinen et al., 2016, p.49). They permit entrepreneurs to offer products and/or services that are already part of information and communication technologies or made possible by them (Lyytinen et al., 2016). Based on a recent review of 133 papers, Zaheer et al. (2019) discovered that distributed and diffused entrepreneurial agency has been made possible by DTs and caused an expanded attention on the entrepreneurial team to also include the ecosystem. Technological entrepreneurship, it has further been argued, is a process that involves several agents and “is distributed across actors who are embedded in emerging technological paths” (Garud and Karnøe, 2003, p.279).

**Proposition 1.** Digital entrepreneurship is associated with risk-taking agency in collective arrangements.

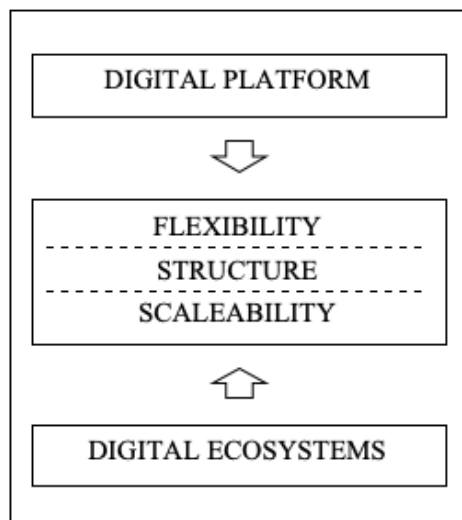
Having shown that digital entrepreneurship, also involves actors and activities, we continue our examination by examining the structural arrangements at play in a digital entrepreneurial context to ascertain possible characteristics following from digitalizing entrepreneurship.

## 2.2 Structure

Structural arrangement is introduced to refer to digital infrastructure, platforms and ecosystem. Different structural arrangements have been associated with digital technologies. Infrastructure in general includes “all services regarded as the essential basis for creating a modern economy: transport, communication, energy, water, education, health services, housing, and all kinds of public amenities” (Ray, 1971, p.47). *Digital infrastructures (DIs)* are understood as the basic information technologies and organizational structures, along with the related services and facilities necessary for an enterprise or industry to function. (Tilson et al., 2010, p.1). They cannot be defined through a distinct set of functions (unlike specific systems), or strict boundaries (unlike applications). They differ from traditional infrastructures by being extremely scalable and flexible (p.5). DIs can thus be seen as an assemblage of technological and human components, networks, systems, and processes that links systems and networks (Henfridsson and Bygstad, 2013). Sussan and Acs (2017) describe DIs as constantly alternating because of their diverse base of installed DTs and users who are designers or operators of these systems and having multiple layers of systems and processes at work simultaneously resulting in a decentralized, shared, and distributed. infrastructure (p.59). DIs, it should not be forgotten, also involve important external and macro-dimensions, such as internet speed and regulation (Zaheer et al., 2019).

**Proposition 2a.** Digital entrepreneurship is enabled by flexible and scalable digital infrastructures.

Competition has changed with the platform approach in digital entrepreneurship (Sussan and Acs, 2017) by permitting greater flexibility in relation to functions and configurations (Kraus et al., 2019). Digital platforms are created on top of digital infrastructures (Constantinides et al., 2018). Notwithstanding, the platform design has not been introduced by the ICT sector. Instead, it has been a long-held preferred choice in other industries such as for example the oil production industry leading to multipurpose production platforms (Cascio, 1980), allowing for drilling, production and living facilities in different configurations (Borse, 1979), and the space industry (Boudreault, 1988). Below, figure 2 sketches out the organizational dimensions, i.e. the structural arrangement associated with digital entrepreneurial agency.



**Figure 2.** The structural arrangements involved with digital entrepreneurial agency.

A *digital platform (DP)* has been defined as a “shared, common set of service and architecture that serves to host complementary offerings, including digital artifacts” thereby providing a range of entrepreneurial opportunities (Nambisan, 2017, p.4). Others have defined the digital platform as a technology-enabled business model allowing producers and consumers to exchange value (Mancha et al., 2018, p.55). DPs represent those elements that are reused across implementations (Boudreau, 2010). Various types of platforms have been identified ranging from innovation over transaction and to integration DPs (Hsieh and Wu, 2018). The degree of openness in a platform is controlled by the platform-ownership (Boudreau, 2010), indicating that ownership controls access to and use of the platform. Such users then will be responsible for securing that these components are legally and technically operationable across the platform and its users. DP ecosystems have been described as involving economic as well as structural components (Hein et al., 2019), where the former describe the type of complementarities of products and services and the structural components characterize how actors interact during value proposition and creation. Zahra and Nambisan (2012) conceptualize business ecosystems as networks, resulting from lengthy processes during which relationships among industry players are established. Given the nature and ontology of digital technologies, they are capable of driving innovations across industries, ecosystems and communities (Nambisan et al., 2020).

**Proposition 2b.** Complementary entrepreneurial opportunities are made possible by shared digital platforms.

Recent work from the field of open innovation and entrepreneurship has further exposed other interesting properties associated with open entrepreneurs, digital infrastructures and platforms that enable and promote transfer of agency. Bogusz and Morisse (2018) for example found that such structures are associated with an ‘anchoring effect’ that helps the participating entrepreneurs to build strategically important boundaries while at the same time allowing them to cooperate with partners outside the DIs and DPs (p.1196).

A *DP’s ecosystem* has been introduced as the collection of the platform and the modules specific to that platform (Rippa and Secundo, 2019). Platform architecture normally has clear divisions between its various components. This modularity feature (Yoo et al., 2010) provides increased opportunities to explore and exploit complementary modules in alignment with the overall architecture of the platform (Srinivasan and Venkatraman, 2018). Taking into account the context of entrepreneurship, entrepreneurial ecosystems have been described as “communities of

stakeholders and external resources organized around the process of entrepreneurial opportunity discovery, pursuit, and scale-up” (Autio et al., 2017, p.91).

To better understand the relationship between DPs and ecosystems, the former have been introduced as the ‘technical infrastructures whereas the latter are made up by the social agents and they are changing entire industries (Hein et al., 2019). The structural arrangement, in other words, reflects the technological interactions that coordinate exchanges between the supply and demand sides of the ecosystem. The actor-dimension of the system deals with agents that act as complementors and consumers (p.4). Others have defined digital platforms as “shared, common sets of services as well as architecture that serves to host complementary offerings, including digital artifacts” (Rippa and Secundo, 2019, p.902). Kallinikos et al.(2013) characterize digital ecosystems as being made up by artifacts and operations and their functional relations. Others suggest that a distinction is maintained between digital platforms and infrastructure, reserving platforms for the common set of services and architecture enabling complimentary offerings and infrastructure to describe the digital technology tools and systems that enable entrepreneurial communication and collaboration (Nambisan, 2017).

### 2.3 Artifact

The notion of artifact has been used in an IT context since the early days of computing technology and cybernetics. McKay (1950), for example, about seventy years ago investigated “the extent to which an artificial organism could parallel human activity” (p.164). More recently, digital artifacts (DAs) have been described as specific components, applications, and/or media content that are part of new products or services and hereby offering a pre-defined functionality and value to the end-user (Ekbia, 2009). Physical properties of physical materials represent a fundamental element in human perception. Technologies that have promoted the fabrication of tangible materials have also been characterized to involve a non-tangible substance (Simon, 1973). More recently, DTs have been described as the introduction of a conversion from ‘atoms-to-bits’ (Kwon et al., 2014, p.651) capable of blurring the lines between the physical (material) forms and the virtual (dematerialized) forms of artifacts. DAs differ from physical artifacts in that their distinctiveness as a form has been fundamentally altered (Ekbia, 2009). They are discoverable, assessable and actionable by other digital objects only (Kallinikos et al., 2013). Contrary to their physical counterparts, DAs tend to be in a state of continual fluidity and development.

In his essay on the history of bits, Blancette (2011) points out that without a fundamental acceptance and understanding of the material constraints under which ICT works, the vital dynamics that brings life to the built environment of the virtual will remain imperceptible and unaccounted for (p.1055). Regardless of it being perceived as immaterial, however, information cannot exist outside of given instantiations in material forms, thus indicating a physical dimension. In taking up the argument for a material dimension when conceptualizing digital artifacts, Leonardi (2010) reminds us that this situation is somewhat similar to conceptualizing phenomena such as for example routines, and institutions. He further emphasizes, in the case of DAs, that what is really most important about ‘materiality’ is the fact that artifacts and their consequences are created and shaped through social interaction.

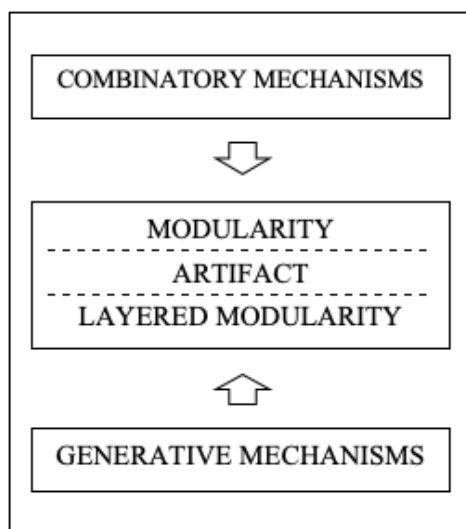
**Proposition 3.** The materiality dimension of digital artifacts is determined by social interaction.

Separating information from physical forms and/or devices seems to have increased the applicative flexibility of DAs (Nambisan, 2017). DAs display some interesting properties in this respect. First, they are lacking the independence and steadiness normally associated with physical



artifacts. DAs are dependent on other DAs and structures to work. An example most readers probably recognize may be a DA such as an app for a smartphone. For applications to function, a device (a smartphone) and infrastructures (e.g. a smartphone store) are required (Cavallo et al., 2019). The editability of DAs allows for expanding the original opportunity at a lower marginal innovation cost, thereby adding new levels of flexibility (Nambisan, 2017). DAs involve two critical mechanisms (von Briel et al., 2018a): (i) combinatory mechanisms facilitate the creation of new artifacts by bundling resources and (ii) generative mechanisms involved to produce new artifacts by changing existing artifacts (p.54). For this to work, Briel et al. emphasize that the DTs need to connect with an agent that secures access to complementary resources, which can be bundled with already posed resources.

Modularity is an interesting feature of DAs that has attracted considerable attention. The importance of modularity in relation to information technology, however, has long been a well-acknowledged design principle. Almost half a century ago, modularity was seen as an extremely important concept in relation to memory organization and mass storage structure (Hoagland, 1962, p.1067). The principle of a 'standard unit' was introduced in quite some length in the Harvard Business Review, as a production concept promising maximum productive variety (Starr, 1965). Not much later, the principle soon became a key business planning and control element when structuring large administrative systems, including procedures for corporate planning of multi-national corporations such as IBM and Xerox (Morgan, 1971). In other words, product modularity, for quite a while, has been appreciated as an important architectural principle in both physical as well as digital artifacts. Modularity can be defined as "architecture that allows firms to develop common parts, subsystems, and modules from which a stream of derivate products can be efficiently developed and launched" (Marion et al., 2015, p.98). Below, figure 3 depicts key properties of digital artifacts, i.e. the key mechanisms involved.



**Figure 3.** The properties of digital artifacts.

Such architecture further permits the changing of a functional element of the product by changing the corresponding component without at the same time necessitating additional changes in other components (Bourreau et al., 2007, p.177). Firms, therefore, can rapidly and inexpensively respond to changing markets and consumer demands by launching new products derived from existing modular products. This design principle has led to the emergence of relatively stable platforms including complementary sets of modules (Srinivasan and Venkatraman, 2018). The

modular feature of a software-based platform enables external complementors and the platform owner to replace system components while preserving a stable core. (Hein et al., 2019). DTs have also introduced a layered modular architecture that extends the 'old' modular architecture of physical products by incorporating four loosely coupled layers of devices, networks, services, and contents created by digital technology. The layered design in DTs are embedded into physical products and allow for enhancing product functionality with software applications (Yoo et al., 2010, p.725). Borrowing from the modular architecture, von Briel et al. (2018b) have proposed that differences in digital venture ideas both change the identity of the digital artifact and have implications for ensuring the venture creation process (p.279). This in turn suggests that the composition of digital artifacts may thus explain why some digital ventures can scale rapidly while others cannot (p.291).

**Proposition 4.** The modularity of digital artifacts is associated with rapid adaptability.

So far, our conceptualization of digital entrepreneurship has only examined the roles of agency and artifacts. Next, we will look into the structural arrangements which are at play in digital entrepreneurship. Synthesizing basic constituents of entrepreneurship theory (agency and artifacts) with implications associated with the employment of DTs will show that the location of entrepreneurial agency changes and/or expands from primarily being relatively concentrated and fixed towards being increasingly distributed and fluid as a result of different structural arrangements following from the DTs involved.

### 3 Discussion and conclusion

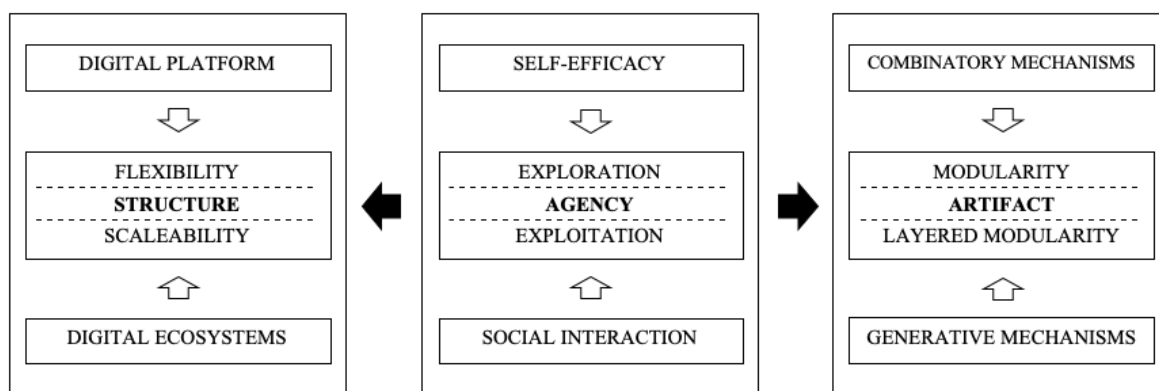
The diffusion and adoption of digital technologies have allowed firms to engage in various processes during which data, information, know-how, contacts and/or artifacts are exchanged while at the same time having given rise to new collaborative structures orchestrating the activities involved. Past locational advantages, modes of entrepreneurial agency, pace of change, and conceptualizations are being increasingly altered in the digital age. DTs have both reduced the liability of location (by making it possible to reach the world from anywhere) as well as allowed former physical locational advantages to turn into a liability (when firms stay clinched to previous locational advantages). Notwithstanding, making DTs a prerequisite for setting up a new business tends to increase the likelihood of intensified technological dynamics as well as to decrease the durability of organizational boundaries.

The development of DTs and the increasing growth of digital entrants suggest that a generally accepted individual attribute such as risk aversion cannot stand alone. Digital entrepreneurship highlights the presence of fundamental uncertainty. Uncertainty has assumed increasing importance. Consequently, it seems appropriate to re-acknowledge the distinction between risk and uncertainty. Where the former is quantifiable, the latter reflects the unknown and immeasurable (Saunders, 2016). De Groot and Thurik (2018) put it differently by saying that while the outcome in risk situations is unknown, the probability distribution of that outcome is known – in contrast to uncertainty, where both remain unknown.

We have reexamined the theory on digital technologies and the theory on entrepreneurship and identified critical bridging points that allow for conceptualizing digital entrepreneurship. The wider significance of applying a digital perspective on entrepreneurship goes beyond isolated discussions of how agency, structures and artifacts are affected by digital technologies. It necessitates a (re)appreciation of the effects of technology in general and of digital technology in particular. This in turn has important implications for the advancement of the theory in the field. The

paper contributes to entrepreneurship theory in more than one sense. First, the paper extends existing theory on entrepreneurship by situating entrepreneurship in the context of DTs. A deeper understanding of the far-reaching digital implications on entrepreneurship requires an integration of digital technology and entrepreneurship concepts.

Second, the digital entrepreneurship as examined here does not imply that the locus of human agency and related self-efficacy is no longer relevant for explaining digital entrepreneurship. Rather, it should be acknowledged that such agency and associated capability are still needed, that go well beyond being means-to-an-end (creating a new venture). Our analyses of digital technologies showed that DTs both affect previous conceptualization of artifacts while at the same time introducing a broader repertoire of structural arrangements during opportunity exploitation. Third, adding a digital outlook on entrepreneurship introduces new challenges that will have to be adequately dealt with and managed. The unstable nature of digital artifacts implies continuous modifications throughout their lifecycles. The digital agency involved requires skills and competences that can handle different configurations of processes and structures as well as potentially conflicting rationales and/or paradoxes associated with digital architecture. An integrated analytical framework for digital entrepreneurship is presented below in figure 4.



**Figure 4.** A proposed framework for digital entrepreneurship.

We conclude that when employing a digital perspective on entrepreneurship it is implied that entrepreneurship theory needs to link up with theory on digital technologies to allow for conceptualizing digital entrepreneurship and thus shed light on key similarities and differences. Such a 'marriage' involves an integration of core concepts from the theory on digital technologies and the theory on entrepreneurship. Our analyses show that digital entrepreneurship not only involves entrepreneurial agency and digital technologies, but also affects the previous conceptualization of artifacts and the modus operandi of entrepreneurial agency by applying a broader repertoire of architectural arrangements. This in turn implies that the employment of DTs has effects that go well beyond being means-to-an-end, pointing to a need for more attention toward and appreciation of DTs in the field of entrepreneurship.

#### 4 Limitations, implications and conclusion

Digital technologies have challenged how a business venture was previously conceived in terms of the nature of agency, artifacts and structural arrangements. Increasing porosity and fluidity, following from the adoption of DTs, have paved new ways of organizing business activities by relying less on individual arrangements and more on setups that involve different agents.

Our work also has a number of limitations, which in turn point towards some managerial

implications and future research needs. First, the framework is focused on the identification and specification of key constructs. Thus, in the case of agents, the framework does not address the role(s) of agents' skills and competences. In consequence, more research is needed on what this development implies in terms of the skills and competencies of the agents involved in digital ventures. This, in turn, calls for taking into account the contextual dimensions when developing entrepreneurial digital competences (Ngoason, 2018). Conceptualizing entrepreneurship through a digital lens invites for differentiating between born-digital-entrepreneurs and digitally adapting entrepreneurs who apply technologies as an add-on feature later on in the life cycle of the established firm.

Second, there are potential implications that the framework does not address. DTs have been much appreciated by entrepreneurial managers for their ability to promote flexibility enabled by modular structural arrangements. The modular design principle has led to the development of relatively stable platforms within which complementary set of modules are allowed to vary and evolve. Notwithstanding, this characteristic may also imply a potential 'lock-in effect'. More research is needed to evidence this and in order to guide future entrepreneurs on how much individual flexibility can be enjoyed without it becoming entirely at the expense of any stability in the commonly held platform and/or ecosystem, research is also needed to determine if a potential 'lock-in-effect' is possible.

Third, from a managerial point of view, more insight is needed regarding how digital ecosystem entrepreneurs cope with the challenges related to matching and/or adjusting individual entrepreneurial interests with collectively held ecosystem interests. How does reduced individual autonomy affect the wider scope of opportunity exploration and exploitation as well as the individual operation and strategic development of the participating firm? With regard to the variety of architectural arrangements identified in digital entrepreneurship, more research would be helpful to shed more light on the relationship between different configurations of infrastructure and applied business model design.

Another limitation relates to cross-country differences. The global reach of most digital companies implies that country-specific regulations may also pose significant risk (Kraus et al., 2019). Future research should identify such risks and ways to address them. Similarly, when born-digital-entrepreneurs base their new business on an existing innovation platform, the latitude for differentiation will be determined by the platform technology in question and its ability to keep pace with development. They also have to be capable of balancing both the independent (individual agent) mindset and the interdependent and potentially conflicting hub-based ecosystem mindset, which points towards the importance of cognitive capabilities (Nambisan and Baron, 2012) and limitations.

Last but not least, more research on how the concept of living lab may act as a potential innovation booster is needed. More specifically, it could be interesting in future research to test how more recent innovation approaches may affect digital entrepreneurship. One such example is the living lab approach, which has been referred to as a co-creating innovation approach allowing the involvement of various users in a real-life setting (Dell'Era and Landoni, 2014) and for experimenting with new technologies (van de Poel, 2017). Bringing a living lab approach into a digital entrepreneurship context (Dinh et al., 2018) could serve as a possible fertile test bed (Engels et al., 2019) for entrepreneurial agency and related structures. This, in turn, advances existing entrepreneurship theory by shedding more light on the significance of DTs in terms of impact on existing business models, opportunities and fast scalable growth.

Pushing the digital ecosystem theory a step further up from the micro to the meso and macro levels, the concept of living labs may further increase its potential. The living lab concept

embraces related concepts such as business incubation, open innovation, collaborative communities, cross-sectional collaboration and partnerships, entrepreneurial resource networks (Srinivasan and Venkatraman, 2018), user engagement and co-creation. According to the S3 Platform, living labs are referred to as user-centred, open innovation ecosystems rooted in a systematic user co-creation approach that integrates research and innovation processes in real life communities and settings<sup>1</sup>, thus representing a paradigm shift (Helsinki Manifesto)<sup>2</sup> and a new European R&D and Innovation System. The living lab approach has not been empirically tested in this context. In such tests, there is a need for examining the implications of the inherent ‘instability’ of living labs in terms of leaving and joining such labs and the consequences for its survivability. From a practical policy point of view, the living lab approach may be a policy tool, which can help bring previously separated sectors (private-public) together to create business model experimentation and associated horizontal knowledge spillover (Autio et al., 2017).

In answering the research question stated in the beginning of the paper we conclude that important bridging points exist that can allow for conceptualizing digital entrepreneurship. We have done so by identifying and discussing multi-disciplinary and generic constituents from the theory on entrepreneurship and on DTs into a multi-disciplinary framework highlighting the bridging role of DIs and DPs with DAs.

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## Biographies



**John P. Ulhøi.** John P. Ulhøi is Professor of OMT at School of Business and Social Sciences of Aarhus University. His research examines how (new) technology, innovation and environmental regulation affect organizations. He is presently Vice-President of The European Doctoral program Association in Management and Business Administration and Board Member of The Nordic Academy of Management. He is Editor-in-Chief for Scandinavian Journal of Management, and has other current or previous editorial positions on the boards of Business Strategy and the Environment, International Journal of Environmental Research and Public Health, Journal of Global Entrepreneurship Research, and European Journal of Operational Research. His work appears in Journal of Organizational Behavior; Journal of Business Venturing; Entrepreneurship, Theory and Practice; Business Strategy and the Environment; Journal of Cleaner Production, Corporate Social Responsibility and Environmental Management; Journal of Cleaner Production, Technovation; Technological Forecasting and Social Change, European Journal of Operational Research and Scandinavian Journal of Management, Frontiers in Robotics and AI.

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