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A Cognitive Conveyor for Digital Innovation - Definition and Conceptualization of the Digital Mindset

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Abstract. Notwithstanding the ubiquitous notion of the ‘digital mindset’ as a central way of thinking in digitalization, the literature lacks an unambiguous and integrative definition that allows further conceptualization of the phenomenon in a detailed manner. This paper defines and conceptualizes the digital mindset in a digital innovation context by an integration of different psychological perspectives and systematic analysis of digital innovation literature, cross-validated through an inductive expert survey (n=50). As a result, a coherent definition and conceptualization with 11 thinking patterns contribute to the research of the human side of digitalization and pave the way for future research avenues. Concluding our work, we highlight overlaps and draw parallels to related theoretical IS concepts and link our results to extant findings of IS research.

Keywords: digital mindset, digitalization, digital innovation, digital transformation.

1 Introduction

The human side of digitalization and digital innovation, especially the opaque but promising field of human thinking and behavior in this context, is crucial to discover, leverage, and successfully implement digital innovations [1]. A supportive part of this is the ‘mindset’, which enables and supports humans at solving tasks in a specific context through cognitive processes, filters, or beliefs [2–4]. The impact of digital technologies, their malleable, recombinatorial, and generative nature, alter these ways of thinking, resulting in a “shift in the personal identity of [innovation] actors” [5, 6]. Further, the digital mindset is commonly deemed to be a significant factor in the role of a Chief Digital Officer (CDO) [7] and an overall critical component for digitalization, in general, and digital innovation, in particular [1, 8, 9].

For example, employees sense innovative digital technologies like artificial intelligence, NFC or RFID chips, new digital services, or platforms not only as co-existing, but detect potentials to recombine them with other technologies, businesses or industry cases (e.g. combine smartphones with NFC for payment). They instantly realize innovation potentials of evolving technologies through experimentation, open-minded sense-making, and breaking down their own silos and expanding their horizons regarding new skills or technologies. It is not the nature of these employees to plan in conservative ways by precisely planning the specifications and requirements, but instead to iteratively try out prototypes, learn through trial-and-error, and integrate feedback.

What sets these individuals apart is a mental state, which we call the ‘digital mindset’. The digital mindset includes special ways of thinking, which have evolved through the special properties of digital technologies and accompanying digitalization phenomena. We therefore value the digital mindset as a fundamental individual factor for digitalization and its more specific instantiations of digital innovation and digital transformation. There are overlaps between these evolved concepts: Gregory et al. [10] for example state that “[...] digital innovation triggers a digital transformation [...]” [10 p.2]. That is, the creation of “new” things and the transformation of “old” things in digitalization are interrelated [10]. Through this interrelation, a digital mindset is taking in different weightings, depending on the perspective. Particularly, for digital innovation emphasis is mainly put on the creation and sensing of new things, whereas a digital mindset for digital transformation rather focuses on the transformation of “old” things, e.g., changes in “structures, roles and management (Tumbas et al. 2018), culture, competencies [...] and resistance to change (Vial 2019).” [10 p.2].

Overall, there is neither a general definition of the ‘digital mindset’ [11] nor conceptual clarity regarding mindsets in general, as its definitions stem from different psychological perspectives and from ambivalent uses and adaptations in the literature like the entrepreneurial mindset [12] or the agile mindset [13]. There are even first definitions of the digital mindset available [11, 14, 15] which, however, neglect a detailed conceptualization and take only a single psychological perspective into account. A clear definition and conceptualization sets the basis for theory development and serves as the starting point by describing the phenomenon [16]. Therefore, our work focuses on the general definition of a digital mindset and a specific conceptualization in a digital innovation context as we aim for a conceptualization of the construct that supports the initial phase of having new, innovative ideas in digitalization. We argue that, as digital innovation is the initiator for other instantiations of digitalization, also their supporting mindsets are interrelated and our conceptualization on the initiator therefore allows further conclusions for interrelated and following perspectives. With a detailed conceptualization of the digital mindset from a digital innovation perspective, future researchers will be able to create propositions, causal explanations, and finally explicit prescriptions to further develop the theory of the digital mindset [16 p.301].

Therefore, in this paper we address the following research questions:

RQ1: How can a digital mindset be defined from an integrative psychological perspective?

RQ2: How can a digital mindset be conceptualized in the context of digital innovation?

By answering these questions, we contribute to IS research regarding the human side of digitalization, investigating why certain people lead organizations to succeed at innovating digitally, while others fail. First, a clear definition with an integrative view on digitalization and the mindset concepts provides the basis for further, more consistent and aligned research on digital mindset and builds a framework for further specialized research on digital mindsets from an IS perspective. Second, a detailed conceptualization provides a foundation for a future operationalization which enables theoretically sound empirical research.

2 Method

To answer our research questions, a three-part methodology was conducted. First, in an unsystematic approach, literature of both constituting concepts, extant literature on “digitalization” and “mindset” was processed to build a definition for the digital mindset. Second, for a detailed conceptualization of the digital mindset from a digital innovation (DI) perspective, different definitions of DI were used as a starting point to extract important characteristics of DI. Additionally, we conducted a *systematic* literature review according to Webster and Watson [17] to enlarge and complement the identified concept list. We used this concept list to derive concept-centered thinking patterns. Third, an explorative expert survey following the guidelines of Schmidt [18] was conducted to validate the aggregated list of thinking patterns.

2.1 Systematic Literature Review

As the goal of the review is to cover all relevant concepts that constitute successful DI, the scope was first set to literature reviews analyzing the topics of DI in IS research in an integrative way, namely to summarize and aggregate identified relevant concepts. We define concepts as a set of requirements, phenomena, drivers, or characteristics that are part of or do support DI and utilized this interpretation as a keyword list to indicate important concepts within our scope (‘digital’ AND ‘innovation’ AND (‘requirements’ OR ‘phenomena’ OR ‘drivers’ OR ‘definition’ OR ‘characteristics’ OR ‘concepts’ OR ‘literature review’ OR ‘literature analysis’). Hence, to address our scope and identify articles with important concepts, we used Proquest and AIS databases, complemented by EbscoHost and Google Scholar, to cover the management and IS literature. We applied a three-step filtering process to our initial results (7929 articles): in the first step, after removing duplicates, articles were considered relevant if their titles or abstract included the topics of digital innovation (1378 articles left); in the second step, we reduced the stack to only those articles that did a literature review (42 articles left); lastly, an article was read completely ensuring that the article itself uses relevant concepts (16 articles left). To augment the findings from those literature reviews and include most recent research, we then did also include primary research like case studies or empirical findings that were not included in former literature reviews due to timeliness (publications later than 2019). Thus, we added 5 further articles.

We analyzed these 21 articles on characteristics, concepts, traits, phenomena, or components of digital innovation, leading to a list of 172 concepts. We filtered for duplicates and excluded items only mentioned in one article, resulting in a reduced list of 102 concepts. The next step of filtering included grouping items with partially same wording (e.g. internal collaboration and external collaboration) and formulating overarching generic concepts for the group (e.g. ‘collaboration’). The following list of 70 concepts were analyzed on similar items with different wording (e.g. ‘collaboration’ and ‘working together’). Finally, we developed a concept matrix [17]. Thus, we ended up with a joint list of 23 concepts for DI. Due to overlaps of the concepts, we partitioned the resulting list in bundles of similar or duplicate thinking patterns and reformulated the bundles to a more abstract thinking pattern. This process was repeated for the

higher-level thinking pattern, until no more abstractions could be made. The corresponding thinking patterns support the concepts of DI.

These concepts were then used to derive concept-centered thinking patterns (cf. Figure 1 for the overall process based on the example of a single thinking pattern)

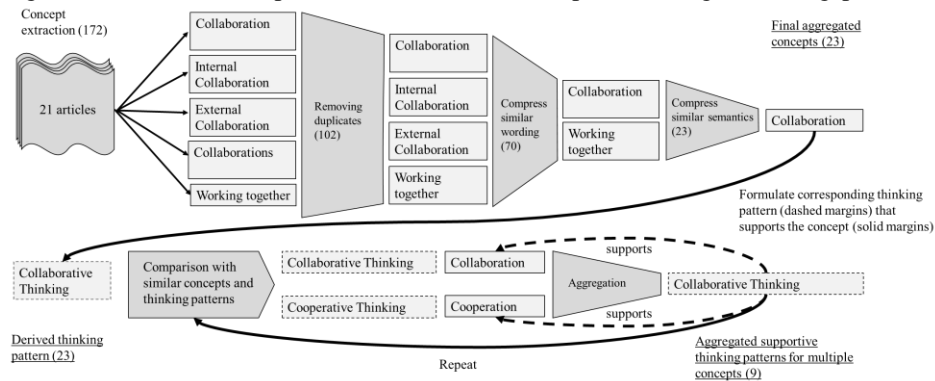


Figure 1: Method for deriving concept-supporting thinking patterns, exemplified for the “collaboration” thinking pattern

2.2 Explorative Expert Survey

As the literature so far has not yet provided a conceptualization of the digital mindset, we used an exploratory expert study in parallel to our literature-based inductive approach. This would allow us to both validate the so-far derived concept and also to potentially extend it without being bound by any restrictions or biases. As we aimed to gather expert suggestions, we followed the guidelines of Schmidt [18] for the collection phase of Delphi studies. We collected the data via an online survey tool from practitioners and researchers with a minimum of 3 years of experience in the digital innovation field. It was expected that these subject matter experts either possess the required ways of thinking themselves or, due to their scientific or practical experience, have sufficient knowledge about ways of thinking that support digital innovation. After careful research on LinkedIn and at German universities and companies, a total of 149 experts were contacted per mail, whereby 50 participated (33.5% response rate, 68% female, 32% male, 36% researchers, 64% practitioners).

To facilitate a shared understanding about ‘digital mindset’, we started with providing our definition to the participants. Subsequently, the experts were asked to propose up to five ways of thinking in plain text fields related to a digital mindset. Overall, they came up with 202 suggestions which, by removing duplicates, were reduced to 37 unique ways of thinking. We mapped those to the thinking patterns derived from the literature and found both lists to be very consistent, with two new patterns derived from the survey and nine patterns uniquely derived from the literature review. As we defined the digital mindset as exactly these patterns, we use the combined list as detailed components that constitute a digital mindset in the context of digital innovation.

3 Results

The following section provides the results of our work. First, a conceptualization of the general mindset concept is provided in section 3.1. Second, section 3.2 merges this conceptualization to the general definition of the ‘digital mindset’. Finally, section 3.3 shows the conceptualization and validation of the digital mindset in a digital innovation perspective.

3.1 Conceptualization of ‘Mindset’

Külpe [19] was the first to mention the concept of ‘mindset’. He conducted an experiment with showing single syllables with different characteristics like typography to his subjects. Subjects were instructed to remember characteristics of the syllables like the frequency of letters to be able to reproduce them. Afterwards, subjects had to report their observations regarding the *a priori* given instructions, but they were now also asked to report characteristics that they were not instructed to take notice of. Results showed that the given instructions had a significant impact on the accuracy of the reports. Watt [20] defined this effect of a specific task (instructions) that prepares the individual for a proper task completion as *mind-set*. As both Watt and Külpe are scholars from the cognitive research stream of psychology (CP), this first definition of the mindset concept originates from this stream, which has mainly remained unchanged since then. In his investigation of phases during task completion, Gollwitzer [21] defines mindsets as “phase-typical cognitive orientation that promotes task completion”. It describes how a person is evaluating possible methods and estimates action-outcome probabilities through relevant information for desirability and feasibility that are received through a heightened receptivity for a breadth of methods (cognitive tuning) [3].

Overall, the social and organizational psychology research stream (SOP) views mindsets from a different angle; they are conceptualized as filters that lay above the whole cognition of an individual and thus affect the totality of cognitive processes [4, 22, 23]. The research on the concept of a ‘global mindset’, referred to above, typifies its mindset conceptualization in this research stream [4, 22, 23]: Rhinesmith [23 p.63] defines the global mindset as a “[...] a filter through which we look at the world [...] and orientation to the world that allows you to see certain things that others do not see”.

According to Gupta and Guvindarajan [4], these cognitive filters, and thus the mindset concept, are formed by knowledge structures that are characterized through differentiation – the narrowness and width of knowledge – and integration, reflecting the capabilities of a person or organization to combine and integrate this knowledge. Interestingly, there are similarities and overlaps between the definitions of the different research streams, as for example the integration can be seen as cognitive processes and the context of the integration (e.g. globalization in case of the global mindset) as a specific task [22].

In addition to these two first perspectives of the mindset concept, the positive psychology (PP) research stream again adopts a completely different viewpoint and gains

distance from the purely cognitive processes [22]. Dweck [2] acknowledges that mindsets include cognition and cognitive processes but are mainly built on inherited beliefs and convictions.

Despite all three psychological mindset perspectives being based on different core assumptions, there are overlapping boundaries. A new conceptualization of a mindset focused on a specific topic therefore does not necessarily have to fit in (only) one perspective [22]. Accordingly, for our research, we consider the concept of mindset from all three different lenses and underlying definitions:

Method Lens – Mindset as cognitive processes: A Mindset is the sum of cognitive mechanisms and procedures to solve a task [3].

Filter Lens – Mindset as cognitive filters: A Mindset is formed out of cognitive filters that affect cognitive processes and are composed of specific knowledge structures [4].

Belief Lens – Mindset as convictions: A Mindset is constituted by core beliefs of humans about their identity [2].

3.2 Definition of a ‘Digital Mindset’

The literature (for example on the ‘global mindset’) proposes that the prefix of a specific mindset describes the generic task whose performance should be supported through the respective applied mindset [4, 23, 24]. Analogous to this, we can derive the meaning of ‘digital’ in a digital mindset. The word ‘digital’ derives from the Latin word *digitalis* (using the finger) or *digitus* (finger) and has the meaning of using digits and was used to describe the function of computers [25]. The associated noun ‘digitization’ describes “[...] converting an analog signal into [...] binary digits” [26 p.301]. Digitalization, its consequence, describes the “manifold sociotechnical phenomena and processes of adopting and using these technologies in broader contexts.” [26 p.301], “change[s] in a firm’s organizing logic by instilling new properties into product platforms” [27 p.130] or “ [the] process of transforming the structure, processes, people skills and culture of the entire organization so it can use digital technologies to create and offer products, services and experiences that customers, employees and partners find valuable.” [28 p.142]. Thus, the digital mindset describes coping with the consequences created through digitization, namely digitalization. To shed further light on the task of digitalization and to follow the guidelines for appropriate definitions according to Suddaby [29], an investigation of the concept – in particular of the formative subtasks – was pursued. According to Frenzel [30 p.8] “Digitalization can be defined as (1) the use and application of digital technologies in contexts of individuals, organizations, or society at large, as well as (2) the influences on individuals, organizations, or society at large, induced by this usage.” and includes the subconcepts of digital innovation and digital transformation [30].

Bican and Brem [31] describe the relationships of digital innovations, resulting from recombining different technologies and thereby leading to digital transformation affecting all business aspects. Despite sometimes unclear interdependencies and conjunctions, most scholars therefore name DI and transformation processes as the main tasks and components of digitalization [31–36].

For defining the digital mindset, we conclude that ‘digital’ describes digitalization as an overarching task environment in which the mindset is used and required.

Based on the previous sections, we can now derive a definition that includes a clear digital and integrative mindset perspective. Suddaby [29] proposes three key requirements that definitions should meet: (1) “[...] the definition should capture the essential properties and characteristics of the concept or phenomenon under consideration”, (2) “a good definition should avoid tautology or circularity”, and (3) “a good definition should be parsimonious”. Merging the underlying definitions of ‘mindset’ and ‘digital’, leads us to the following integrative definition:

A Digital Mindset describes thinking patterns, epitomized through cognitive processes, filters, and core convictions of humans constituted of cognitive mechanisms and knowledge structures that affect and foster the use and application of digital technologies and cope with their consequences in contexts of individuals, organizations, or society.

3.3 Conceptualization of the ‘Digital Mindset’

As outlined above, we focus, for our conceptualization, on the task of digital innovation, aligning with the argument of Bican and Brem [31] that it is the antecedent sub-task for companies and their employees in the age of digitalization to proactively gain competitive advantage and survive. The literature stand on digital innovation offers different definitions of digital innovation (DI) that hardly name a clear core concept, but show connotations between the process and arising impacts. Exemplarily, Chan et al. [37] mentions recombination and digital technologies as core concepts, but focuses only on *disruptive* digital innovations and only names recombination as enabling concept. The definition provided by Barrett et al. [38] contains different core concepts like the recombination and fluent boundaries but restricts itself to products and services. Svahn et al. [39] expand this view and highlight the use and recombination of digital resources and knowledge, as the core concept of digital innovation, which is supported by many other scholars [6, 40–42]. These recombinations lead to an increased generativity [43, 44] and product-agnosticism [43] and thus fluent boundaries of products and services. Further, DI comes along with new organizational forms such as decentralized controls, innovation networks [42, 45], the concept of innovation ecosystems [42], and platforms gaining importance [5, 6, 42]. A frequently mentioned important approach of DI, which is linked to generativity, and recombination, is the involvement of the customer and collaboration [6, 42]. For digital innovation, this means innovating through co-creation and open innovation [6, 40, 42, 46]. Next to that, DI and digital technologies as its enablers induce uncertainty and unpredictability [9, 47], resulting in the demand for experimenting [44, 45], taking risks [39], entrepreneurship [6, 42], agility [48, 49], and the ability to creatively improvise [50]. Table 2 in the Appendix shows the full list of the identified concepts.

Building on the prior assumptions, derived thinking patterns that are crucial for these concepts reflect supporting ways of thinking for digital innovation. Hence, we can derive that *recombinatorial thinking* is an essential thinking pattern for DI to support the

concept of recombination. While recombinatorial thinking in general is not a digitalization-specific phenomenon, it especially pertains to digital technologies and, through their modular architectures [43], their combination through different layers. Thus, (digital-technological) recombinatorial thinking appears as a mandatory thinking pattern for DI. The prerequisite to enable this modularity and the opportunity for user-created recombinatorial products or services is *generative thinking*, which supports the concept of generative products and services and unbinds the boundaries from the outset. Along with these comes the substitution of entrenched traditional ways of thinking through *disruptive thinking patterns*, which support at the same time envisioning potential out-of-the-box reconfigurations, combinations and ubiquitous generativity of digital technologies. Market convergences induce shifts from product to services in the form of platform services and a general platform orientation, which implies a *platform oriented thinking pattern*. Regarding this new orientation, a generic shift from isolated and conservative thinking to *digital oriented thinking pattern* is required. This includes the readiness and openness for new digital technologies that enables sensing new (business) opportunities to explore or exploit and therefore support entrepreneurial alertness and ambidexterity. In particular, this implies also thinking in generally *collaborative ways*. This does not only foster interdisciplinary action, but also leverages the concept of customer involvement during the development of products and services and acting in reciprocal company ecosystems. Several of these concepts like, e.g., customer involvement, open innovation, or interdisciplinary, and collaboration are connected to the organizational concept of agility and thus require *agile ways of thinking*. Furthermore, new collaborations, market disruptions, or newly recombined products and services require a *risk-affine thinking pattern* that enables, e.g., bold experimenting. In addition to that, not every development or innovation of a product, process, or service can be expected to be fully mature and needs to be prototyped and tested. This calls for a thinking pattern that focalizes the potential of failure as calculated scenarios of those experiments. These ways of thinking can be summarized in the *resilient thinking pattern*.

Together, these different thinking patterns form the essential supporting ways of thinking for DI. The 37 expert suggestions, collected through the Delphi survey asking for relevant ways of thinking related with a digital mindset, are covered almost completely by the derived 9 thinking patterns. An overview about the essential ways of thinking as part of a digital mindset mentioned by experts can be found in Table 1, which maps them to the thinking patterns derived from the literature. Only two suggested thinking patterns, namely *scaled thinking* and *data-driven thinking* were not covered by our literature-based thinking patterns. We derived the *exponential thinking pattern* out of scaled thinking, that includes on the one hand the awareness of scaling and the exponential character of digital technologies, but on the other hand does also cover the linked technological envisioning, i.e., the opportunity to imagine and plan with future digital developments. Next to that, the *data-driven thinking pattern* describes on the one hand thinking in algorithmic ways, and on the other hand taking the byproduct of digital technologies – data and its potential – continuously into account when making decisions. Both thinking patterns were added to our list of thinking patterns and built a unified conceptualization of supporting ways of thinking for DI. Table 3 in the Appendix provides detailed definitions of all eleven derived thinking patterns.

4 Discussion

Summarizing the findings of our work leads to the following contributions: Firstly, the developed definition of a digital mindset forms a *stage I* theory according to Gregor [16] by describing the phenomenon of a digital mindset. The developed definition clarifies that a digital mindset is constituted of cognitive processes, filters, and core convictions that support dedicated subtasks of digitalization. It clearly states the components of a digital mindset and resolves potential misinterpretations of this term as currently apparent in the literature. Elaborating a conceptualization for a specific perspective, namely digital innovation, also provides a blueprint for other conceptualizations and clarifies in a detailed manner which thinking patterns constitute a digital mindset.

Secondly, we conceptualized the digital mindset as consisting of 11 thinking patterns that support the task of digital innovation and therefore digitalization. However, some of the thinking patterns may have overlaps and may not be fully discriminant. In the following discussion, we draw parallels to other theoretical concepts in IS in order to aim to group our inductively developed thinking patterns. This will make the conceptualization more parsimonious and propose directions for operationalization. First, the *disruptive, risk-affine and resilient thinking patterns* describe mental efforts of trying innovative and out-of-the-box options. Their experimental nature can be linked to the concept of Personal Innovativeness with IT (PIIT) described as the “willingness of an individual to try out any new information technology” [51] stemming from IT adoption research. The thinking patterns hence can be seen as the cognitive processes, filters, and beliefs regarding PIIT. Second, the *digital and platform-oriented, agile, collaborative, exponential and data-driven thinking patterns* overlap with and relate to the concept of ‘digital literacy’, which describes the flexible and adaptive ability to explore, evaluate, analyze data and information, and – in general – act in new digital and collaborative environments [52]. Thus, our thinking patterns can be seen as the mental part of digital literacy, including the corresponding cognitive processes, filters and beliefs. Third and lastly, as digital innovation is powered by a “[...] system’s generative capacity to produce something new without input from the system’s originator” [39], the theoretical concept of generative capacity can also be applied on the human side as an antecedent and attribute to enable creative solutions and digital innovations by re-configuring and recombining [53]. *Generative and recombinatorial thinking* describe exactly these ways of thinking, building the cognitive processes, filters and beliefs of generative capacity.

Taking these proposed groupings of the developed thinking patterns into account (cf. Figure 2), we can significantly distinguish the developed conceptualization from former digital mindset definition attempts. On the one hand, we extend the work of Solberg et al. [14] by providing a definition and taking more than one psychological perspective into account. On the other hand, the thinking patterns of digital literacy cover and ex-

tend the previous conceptualization by Tour [15]. With our link to PIIT, our conceptualization also integrates the IT mindset [54], but also describes a broader concept with the mental aspects of digital literacy and generative capacity.

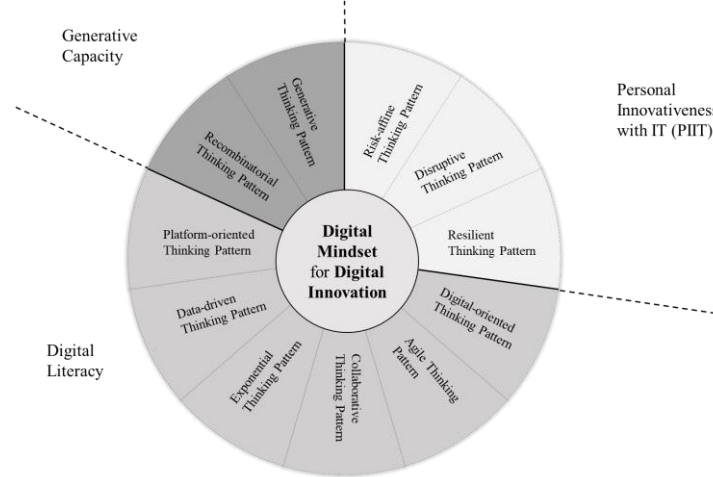


Figure 2: Dimensions and grouping of the digital mindset (own illustration)

Of course, our approach has some limitations. Although our analysis of the literature only considered literature reviews that include a comprehensive corpus of literature and even added additional recent empirical work, there is the possibility of having missed out other core aspects of DI. The developed thinking patterns are based only on studies considering ‘new’ or emphasized traits of DI. As a result, traits and therefore thinking patterns that remain unchanged may stay undetected. Following, the developed thinking patterns could lack completeness as well. To ensure completeness of a digital ‘innovation’ mindset, complementary additional research on analyzing the literature on a general ‘innovation mindset’ and their related thinking patterns might be useful. Further, our conceptualization lacks an empirical validation. An operationalization and broad empirical investigation should follow as next step to support the identified thinking patterns and their actual, differential importance for DI.

Nevertheless, our findings already provide fruitful and useful contributions to the academic world as well as for practitioners. For example, the latter can be supported by receiving a starting point for renovating their company culture. As digital mindsets can be viewed as the premise for successful digitalization, firms should consider these ways of thinking as highly relevant for the future. For academic research – as already stated above – the developed definition of a digital mindset provides the first unified conceptualization and thus resolves blurry articulations, ambiguities, and misinterpretations of the concepts. Beyond the field of IS research, the findings – as being the first mindset definition in a specified context that reconciles all psychological mindset perspectives – serve as a starting point for the development of mindset definitions and conceptualizations in different contexts. This is especially relevant for research on the human side of digitalization, as it can be used as basis for various empirical research.

5 Appendix

Table 2: Aspects of digital innovation identified from literature

	Use of digital Tech.	Unpredictability	Experimentation	Collaborative Innovat-	Distributed Innovating	Recombination	Creativity	Tolerance of Failure	Drive of Entrepreneurs	Flexibility	Customer integration	Continuous Learning	Improvisation	Digital Evolution Scan-	Interdisciplinary Teams	Taking Risks	Generativity	Platforms	Ambidexterity	Agility	Disruption	Ecosystems
[41]	X	X	X	X	X	X																
[6]				X	X	X	X	X	X	X					X						X	
[55]	X			X	X	X		X								X						
[56]	X		X			X					X							X	X	X		
[57]	X					X																
[50]	X					X	X					X	X	X	X	X	X			X		
[47]	X	X		X		X			X								X	X		X	X	
[48]	X			X							X						X	X		X	X	X
[44]		X	X			X	X	X	X	X	X			X	X		X		X	X	X	
[49]	X			X							X									X	X	
[9]	X					X							X	X								
[58]						X												X				
[59]						X																
[60]	X					X								X					X		X	
[1]	X													X								
[61]				X		X																X
[39]	X		X	X		X	X	X	X	X	X			X	X	X	X	X			X	X
[62]				X		X					X				X							
[43]	X					X	X										X	X				
[42]			X	X	X	X		X	X	X	X						X	X	X			X
[45]	X	X		X	X	X							X		X		X	X			X	X

Table 3: Definitions of the eleven developed thinking patterns, i.e., components of the conceptualized digital mindset

Thinking Pattern	Definition in a digital mindset context
Agile Thinking	Comprise thinking in principles of the agile manifesto, but also the willingness to learn, thinking in flexible, adaptable and uncertain ways that include the possibility of failure.
Exponential Thinking	Recognition and awareness of scalable and exponential characteristics of digital technologies. It includes technological predictions and visions.
Generative Thinking	Thinking that fosters procrastinated binding and solution exaptation typically for digital solutions by integrating abstraction and modularity during development.
Data-Driven Thinking	Turning away from reliance on gut feelings, recognizing potentials of data and constantly taking these into account in decision making or product development and thinking in computing ways of problem solving.
Combinatorial Thinking	Constantly integrating the recombinatorial characteristics of digital technologies in solution-finding to broaden the potential solution space by creatively combining independent digital technologies.
Disruptive Thinking	Constantly questioning of existing solutions and imagination of how digital technologies could induce alternative scenarios that include fundamental pivots e.g. in the first principle how problems are solved.
Collaborative Thinking	Describes the openness for communication, cooperation and collaboration to support problem-solving. It includes awareness about the own synergy effects and can pertain in inter- or intradisciplinary collaboration.
Risk-Affine Thinking	Comprises the readiness of individuals to take calculated risks regarding the digital technologies and business domain.
Platform-Oriented Thinking	Ways of thinking that apply the platform concept and its belonging phenomena like network effects on traditional tasks, products or businesses through the availability of digital technologies.
Digital-Oriented Thinking	A generic open-minded way of thinking, affinity and tuning towards the usage and application of digital technologies to sense exploit as well as exploration possibilities.
Resilient Thinking	Compromises ways thinking that include tolerance for failure, thinking of failure experiences as learnings and describe in general the cognitive ability to recover quickly from failures.

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