The concept of mindfulness in information systems research: a multi-dimensional analysis

Abstract:

The concept of mindfulness has garnered increasing attention during the last decade. Initially proposed within the scope of Information Systems (IS) research as a means of creating a deeper knowledge foundation for decision making regarding information technology (IT) innovations, it soon became broadly applied throughout IS research. To gain a better understanding of the evolved diversity of this concept, this paper reviews and analyzes extant IS research by means of (a) the investigated IS themes, (b) the purpose of using the concept, (c) the level of application of the concept, and (d) the tendency to focus either on mindfulness, mindlessness, or both. By synthesizing research findings, we derive a high-level IS mindfulness theory. We then propose future research opportunities, such as the explanation of the relationships between different levels of mindfulness, applying mindfulness to bridge the different phases of the software development process, and identification of guidelines for designing information systems that facilitate mindfulness. As the first review on the application of mindfulness in IS research, we contribute to the overall understanding of mindfulness and address the four abovementioned dimensions from which mindfulness emerges in order to demonstrate that mindfulness provides a meaningful platform for generating knowledge.

Keywords: individual mindfulness; organizational mindfulness; mindful organizing; literature review

Introduction

In times of increasingly turbulent environments characterized by ongoing change, complexity, and uncertainty, mindfulness is inexorably gaining importance as a means of supporting individuals' performance in the workplace (Dane, 2010) and supporting organizations in the endeavor to achieve reliability (Ray *et al*, 2011). Individual mindfulness is a psychological construct representing a state of alertness and dynamic awareness (Langer, 1989a; Langer, 1989b). Taken to the organizational level by organization and management science, it has been defined as an organization's cognitive processes of revealing and redirecting new events and their erroneous consequences (Weick *et al*, 1999; Weick & Sutcliffe, 2001). As a decision-maker characteristic, mindfulness allows managers to resist bandwagon pressure and to instead implement alternative solutions, thereby avoiding disadvantageous outcomes for the organization (Fiol & O'Connor, 2003). Mindfulness also forms the basis for reinforcement learning and thus for the long-term survival of an organization through identifying appropriate actions and learning from interpreting the related outcomes (Levinthal & Rerup, 2006).

In the early 2000s, Swanson & Ramiller (2004) and Fichman (2004) laid the foundations for the importance of mindfulness as a promising paradigm to study phenomena in Information Systems (IS) research. Accordingly, a mindful organization fosters its effectiveness in innovating with information technology (IT) by means of considering its facts and specifics while judging whether, when, and how to innovate (Swanson & Ramiller, 2004). In the following years, the increasing permeation of IT offered various opportunities to further leverage the advantages of mindfulness not least in IS research. Within the context of designing, managing, and using complex and imperfect IT (which is today ubiquitous), mindfulness amplifies individuals' and organizations' efforts in achieving reliability and performant work outcomes (Butler & Gray, 2006). In turn, IT can be used exemplarily to promote mindfulness by providing enriched action repertoires for organizations and supporting collaboration or alternative courses of action (Valorinta, 2009).

Interestingly, despite the concept's importance and permeation through different areas and levels of analysis in IS research during the past decade, it has not yet been subject to a structured review or meta-analysis. Consequently, insights resulting from IS research on mindfulness are fragmented into a heterogeneous field of divergent studies. To address this shortcoming in the literature, we conducted a structured literature review on mindfulness in IS research. Our goals were to *consolidate the existing body of knowledge* regarding the application of the mindfulness concept in IS research, *demonstrate its importance* as a concept for investigating IS phenomena,

and to *stimulate and guide the use of the concept in future research*. To accomplish these goals, we categorized a sample of 64 papers concerned with mindfulness relevant to IS research using an analysis schema comprising (a) the IS theme investigated ("what"), (b) the purpose of application ("how"), (c) the level of applying the mindfulness concept ("where"), and (d) the application of the antonym mindfulness versus less mindfulness or mindlessness ("which"). In so doing, we follow (Kaganer & Vaast, 2010) in treating mindfulness as a behavior that can be described as being more or less mindful. That is, our understanding of mindfulness, and thus the presentation of our findings, also comprises mindlessness as the negative extreme pole at the opposite pole of being very mindful.

In essence, our review adds value to IS research in that it synthesizes the fragmented application of the mindfulness concept to IS phenomena by revealing that: first, mindfulness has reached a wide distribution through IS themes such as IS development (ISD) (e.g., collectively mindful agile teams in the field of ISD (Vidgen & Wang, 2009)), IT management (e.g., the effects of mindfulness in making radio frequency identification (RFID) adoption decisions (Goswami *et al*, 2008)), IT use and outcomes (e.g., the impact of mindfulness on perceived usefulness and intention to use an online wiki (Sun & Fang, 2010)), and IT innovations (e.g., mindfulness and bandwagon effects on IS innovation assimilation in turbulent environments (Wolf *et al*, 2012)). Second, we identified three ways in which mindfulness in IS research has fundamentally been applied: as a prerequisite representing an input factor for actions or IT artifacts, as an accelerator either mediating or moderating the effect of the input variable on the outcome, or as a result of a specific action or application of an IS artifact. Third, while a significant part of the literature focuses on the organizational level (e.g., Valorinta, 2009; Wong *et al*, 2009), other studies concentrate on the group level (e.g., Matook & Kautz, 2008; Teo *et al*, 2011; McAvoy *et al*, 2013) or individual level (e.g., Goswami *et al*, 2009; Lee, 2009; Sun & Fang, 2010). Finally, we address research focusing on the bipolarity of the mindfulness concept, i.e., on IS research that juxtaposes mindfulness with mindlessness in terms of a continuum (Fiol & O'Connor, 2003), as interrelation (Levinthal & Rerup, 2006), or as dialectics (Carlo *et al*, 2012), in contrast to other studies that elaborate only on one of the two poles of mindfulness when investigating IS phenomena and artifacts.

In the following sections, we will first discuss the theoretical background of mindfulness before we present the research methodology we applied as well as the results of the review. Based on our review, we subsequently derive a high-level metatheory of IS mindfulness addressing some of the gaps identified. We then use the review results to discuss research questions as well as methodological issues observed in extant research and provide recommendations for guiding

future studies that apply the mindfulness concept to IS phenomena. Subsequently, the paper elaborates on the limitations of our study and consequential avenues for further research in this field before concluding with a summary of the results.

Theoretical background

Individual mindfulness

The psychological construct of mindfulness has been conceptualized on an individual level by Ellen J. Langer (Langer, 1989a; Langer, 1989b) who defines it as a cognitive process of alertness and dynamic awareness. Accordingly, a mindful individual reacts to events in his or her environment, actively questions existing categories and interpretations, and creates new ones which in turn invokes an increased state of involvement and wakefulness (Langer & Imber, 1980; Langer & Moldoveanu, 2000). Essentially, mindfulness is constituted by the following psychological states: *(1) openness to novelty; (2) alertness to distinction; (3) sensitivity to different contexts; (4) implicit, if not explicit, awareness of multiple perspectives; and (5) orientation in the present* (Langer, 1997, p. 23). Mindlessness, in contrast, is characterized by a state of reduced attention in which an individual becomes entrapped in old categories and distinctions drawn in the past (Langer, 1989a; Burpee & Langer, 2005). The behavior of a mindless individual is rigid and rule governed (Langer, 1989a), as if being "on automatic pilot" (Langer, 1997, p. 4). Thus, being in a mindless state, relying on existing routines, and operating from a single perspective, eventually results in diminished human performance (Langer, 1989a; Langer, 1997).

Existing research has described mindfulness in different ways, which must be taken into consideration in order to ensure a clearer understanding in our subsequent analysis. In particular, mindfulness has been conceived as a state (Langer, 1989b; Brown & Ryan, 2003), as a trait (Sternberg, 2000; Kohls *et al*, 2009; Dane, 2010), as a cognitive ability, and as a cognitive style (Sternberg, 2000). The definition proposed by Langer characterized mindfulness as "a state of alertness and lively awareness" (Langer, 1989a, p. 138). Since some people can attain this mindful state more easily than others, Dane (2010) suggested that mindfulness ought to be interpreted as *a trait* instead. As a personality trait, mindfulness is a static tendency similar to other traits such as extraversion or neuroticism (Sternberg, 2000). The predisposition of trait mindfulness to span mindfulness across contexts, in turn, has a positive impact on state mindfulness (Sun & Fang, 2010). When understood as a *cognitive ability*, mindfulness manifests itself as cognitive skill or capacity similar to intelligence or memory which varies among humans (Sternberg, 2000). Finally,

as a *cognitive style*, mindfulness refers to the preferred approach of employing one's cognitive ability (Sternberg, 2000).

It is also worth noting that in accordance with social cognition theory (Fiske & Taylor, 2013), the cognitive processes (i.e., internal mental processes, unobservable) of mindfulness provide the basis for mindful behavior (i.e., external physical processes, observable). That is, similarly to the cognitive development in organizational learning (Fiol & Lyles, 1985), mindfulness encompasses the necessary understanding of causal relationships and overall rules and norms (Feldman & Pentland, 2003). These cognitive processes, in turn, entail behaviors that reflect specific actions. However, since behavior could also result, for instance, from mimicry, it is important to emphasize the cognitive microfoundations of mindfulness.

Eastern philosophies of mindfulness form the basis for other mindfulness approaches, such as the widely known mindfulness-based stress reduction (MBSR) technique (Kabat-Zinn, 1982) that was introduced into mental health treatment in the 1980s. However, in order to guide the expectations of the readers of this analysis, Eastern-based approaches must be differentiated from mindfulness as addressed by the Western scientific perspective (Langer, 1989b), since the Eastern tradition of mindfulness is rarely integrated into IS research. In short, having its roots in Buddhism, the Eastern idea of mindfulness comprises the observation of environmental as well as internal experiences, e.g., thoughts and emotions, without judging them as good or bad or true or false, in order to develop mindfulness skills (Baer, 2003). In contrast, Langer's concept of mindfulness (1989b), based on the Western scientific tradition, concentrates on external factors like information categorization in order to solve active and goal-oriented cognitive tasks.

Organizational mindfulness and mindful organizing

Drawing on high-reliability organizations (HRO), such as nuclear power plants or aircraft carriers, Weick *et al* (1999) transferred Langer's mindfulness concept to the organizational level. Due to the high criticality of errors, learning by trial and error is intolerable in HROs (Weick *et al*, 1999). Therefore, instead of relying on highly standardized routines, Weick *et al* (1999) argued that high reliability results from stability in cognitive processes of revealing and redirecting new events and their erroneous consequences. Thus, organizational mindfulness (OM) can be characterized as "a combination of ongoing scrutiny of existing expectations, continuous refinement and differentiation of expectations based on newer experiences, willingness and capability to invent new expectations that make sense of unprecedented events" (Weick & Sutcliffe, 2001, p. 42). In contrast, organizational mindlessness encompasses ignorance of failures

and simplifying and normalizing events, which eventually leads to unreliable outcomes (Weick *et al*, 1999).

The state of mindfulness is manifested by five cognitive processes (Weick *et al*, 1999; Weick & Sutcliffe, 2001; Weick & Sutcliffe, 2006). Organizations exhibiting a *preoccupation with failure* are constantly concerned about failures although they seldom arise. Thus, mindful organizations will, instead of focusing on successes, encourage and reward reported failures in order to learn about their system by analyzing near misses as additional data points for learning (Weick *et al*, 1999). In the context of *reluctance to simplify interpretations*, mindful organizations take into account that simplifications comprise the tendency of overlooking threats and potential unexpected consequences. Thus, to stay reliable, they limit assumptions, increase sensing capabilities of their employees, select new employees with non-typical prior experience, frequently facilitate job rotation, and encourage skepticism (Weick *et al*, 1999). *Sensitivity to operations* and likewise 'situational awareness' encompass "the integrated big picture of operations in the moment" and to "act thinkingly" (Weick *et al*, 1999, p. 43). Particularly, situational awareness refers to the cognition and comprehension of the present situation and its projection to the future (Weick *et al*, 1999). Organizations' *commitment to resilience* is embedded in their capability to anticipate and resiliently absorb an occurring event but nevertheless endure its operations (Weick *et al*, 1999). For this purpose, they rely on experts which pool their knowledge in self-organized, informal networks, support improvisation (Bourrier, 1996, p. 106; Weick *et al*, 1999, p. 47), and create future knowledge while concurrently improving existing knowledge (Weick *et al*, 1999; Fiol & O'Connor, 2003). Loosening hierarchical constraints to handle new problems with a wider range of capabilities and by individuals with the highest expertise is described as *underspecification of structures/deference to expertise*. Accordingly, the hierarchical rank is subordinated to expertise and experience to "allow decision making to migrate along with problems" (Weick *et al*, 1999, p. 49) in mindful organizations.

Recently, research has empirically validated mindfulness across hierarchical levels (Ray *et al*, 2011) and reconciled extant literature on OM (Vogus & Sutcliffe, 2012). As a result, Vogus & Sutcliffe (2012) argued for establishing mindful organizing (MO) as an additional dimension since multi-hierarchical analysis is inevitable for an organizational phenomenon such as mindfulness. In brief, MO can be regarded as a bottom-up process driven by the employees to improve operational outcomes. In contrast, OM is specified as a top-down process initiated by the top management to create and maintain an institutional culture for thinking and acting mindfully (Vogus & Sutcliffe, 2012). While the concept of mindfulness within the organization is very much the same, the process to achieve that cognitive state differs from an OM or MO perspective.

Regarding the organizational level, the Eastern approach toward mindfulness defined in the section above may help to overcome the constraints of Western mindfulness. That is, while Western mindfulness concentrates on the content of the mind, such as past experiences, known routines, or established concepts, Eastern awareness is concerned with avoiding such existing thought constructs, instead focusing attention on the mental processes themselves (Weick & Putnam, 2006). Consequently, enriching Western mindfulness by including attentional processes of Eastern mindfulness can facilitate insights not necessarily tied directly to concepts (Weick & Putnam, 2006; Weick & Sutcliffe, 2006). Furthermore, mindfulness meditation could eventually lead to benefits for the organization, such as increased awareness and better decision making (Weick & Putnam, 2006).

Research methodology

In order to systematically identify relevant literature about mindfulness in IS research, we followed the guiding recommendations of Webster & Watson (2002). In so doing, we decided against using databases like ABI/Inform (ProQuest) or ScienceDirect (Elsevier). Because tentative searches within these databases had resulted in a vast number of non-IS mindfulness papers with limited value for the literature review, the rationale behind our approach was to limit the sample to mindfulness papers with IS focus and to key non-IS literature. Consequently, to focus the review on IS and key non-IS outlets only, we organized our search process along a ranking of Management Information System (MIS) journals provided by the Association for Information Systems (AIS) (AIS, 2015), which consolidates the rankings of various authors into one comprehensive ranking. We also supplemented this ranking with proceedings from the three most important IS conferences (European Conference on Information Systems (ECIS), Hawaii International Conference on System Sciences (HICSS), and International Conference on Information Systems (ICIS)).

The identification of literature comprised the steps depicted in Figure 1, which we accomplished during the second half of 2014. To ensure that we also captured papers published during this period, we repeated the process in January 2015. First, we screened the tables of content of the outlets listed in the rankings either manually or by using automatic, in-text search engines (when available) for the search terms “mindfulness,” “mindlessness,” “mindful,” or “mindless.” We did not limit the search to any specific time period in order to allow the inclusion of articles published even earlier than the papers providing the basis for mindfulness in IS research, e.g., Fichman (2004), Swanson & Ramiller (2004). Second, to reduce the quantity of the sample to a manageable size, we scanned the paragraphs containing the search terms in the identified papers.

In so doing, we were able to exclude papers that only mentioned the search terms within their references or as an expression without referring to the underlying concepts, e.g., "*organizations should be mindful of...*" We then used the frequency of the search terms as an indicator for the relevance of a paper for our literature review. Accordingly, papers mentioning one or more of the search terms more than three times while also citing the defining papers (e.g., Langer, 1989b; Weick & Sutcliffe, 2001) were considered relevant and thus selected for the subsequent in-depth reading for our analysis schema. Additionally, we reviewed these papers' bibliographies (backward search) to ensure that our literature review also covered relevant articles not identified in the first step (Webster & Watson, 2002). Overall, this screening reduced the more than 1800 papers initially identified to 64 papers integrating mindfulness into the focus of their study – seven of these papers were referenced frequently by the other 57 papers. The analysis of another set of 64 papers that referred to the search terms less than three times was deferred to the last step of our literature analysis strategy and included reading the abstract, introduction, and conclusion, as well as the paragraphs containing the search terms. These papers were not subject to the analysis schema but were used, where appropriate, for substantiating recommendations or questions for future research.

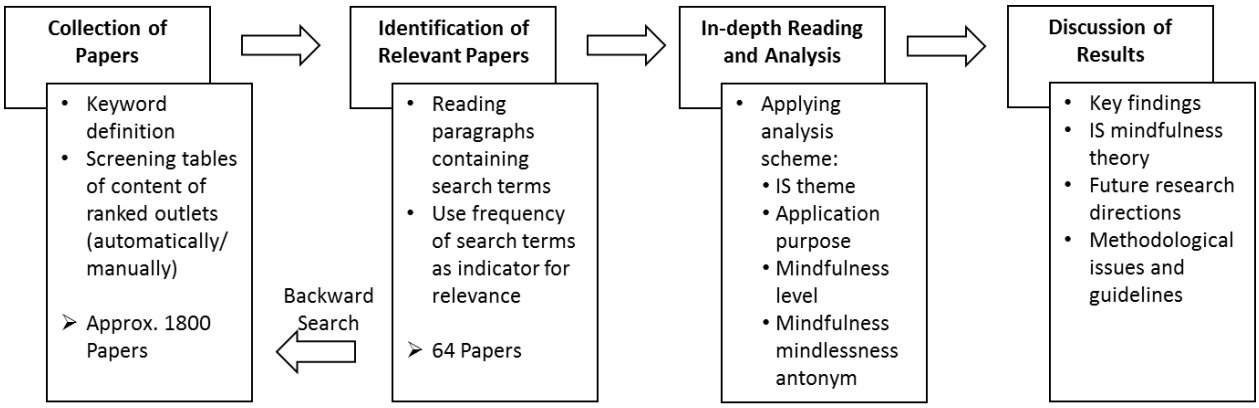

Figure 1: *Step-by-step literature analysis strategy.*

As a result of the in-depth reading, we coded the papers and compared and discussed our deviating results when necessary to determine the following dimensions with regard to the mindfulness concept: (1) general IS theme investigated ("what"), (2) purpose of application ("how"), (3) level of mindfulness ("where"), and (4) emphasis on mindfulness, mindlessness or both ("which").

The following sections discuss the contents of the papers along these dimensions and their associated categories using a concept-centric approach (Webster & Watson, 2002; Rowe, 2014).

Consequently, every paper can be assigned to each of the four dimensions resulting in an overlap of the dimensions for each paper, as can be inferred from the supplement Table A1. Overall, the literature review was guided by the examples of the Roberts *et al* (2012) review on absorptive capacity in IS research and Leidner & Kayworth's (2006) review on culture in IS research.

Year of publication and research methods

Before addressing the results of the content analysis of the literature review, we conducted a scientometric analysis focusing on the year of publication and the research method applied. As can be inferred from Table 1, the number of publications increased over the years, reaching its peak in 2009. After a decline in publications, especially in 2010 and 2013, the number of research articles dealing with the mindfulness concept gained new momentum in 2014 with nine articles.

	Methodology									
Year	**Action research**	**Archival research**	**Conceptual**	**Case study research**	**Ethnography**	**Field experiment**	**Field study**	**Grounded theory**	**Lab experiment**	**Total**
Before 2004			2	1		2				**5**
2004			2	1						**3**
2005									1	**1**
2006			4	1						**5**
2007			1		1					**2**
2008				3			1			**4**
2009	1		2	5			2	1	1	**12**
2010		1		1			1		1	**4**
2011			1	2			3	2		**8**
2012			2	3					2	**7**
2013			1	1		1	1			**4**
2014		1	1	3			3		1	**9**
Total	**1**	**2**	**16**	**21**	**1**	**3**	**11**	**3**	**6**	**64**

Table 1: *Publication year and research methodologies*

Concerning the categorization of the research methodologies applied in the 64 research articles subject to our literature review, we followed the classification schemas of Vessey *et al* (2002) and Palvia *et al* (2003). Table 1 depicts the distribution of research methodologies applied across 10+ years with the majority of research articles being either of conceptual nature (16 papers) or inferring the results from case study research (21 papers). In contrast, only approximately one third of the papers contained in our review used quantitative research methodologies, such as field

studies (eleven papers) or lab experiments (six papers), for gaining insights into the mindfulness concept. Other research methods, such as action research (one paper), archival research (two papers), ethnography (one paper), field experiment (three papers), or grounded theory (three papers), have only rarely been applied in existing research.

Thematic analysis

The thematic analysis for determining "what" has been investigated in extant IS research with regard to the mindfulness concept used has revealed essentially four themes following the categorization of Leidner & Kayworth (2006): *IT innovation, IT management, IT use and outcomes*, and *IS development*. As a fifth theme we included *other*, which subsumes papers that could not be assigned to one of the four themes and encompasses papers on meditation mindfulness (two papers), research approaches (two papers), papers originating from organization science (four papers), and papers on "computers are social actors" (CASA) (five papers). According to the CASA paradigm, people mindlessly interact with computers. As a result, they attribute subconscious behavior to the computer as if it were a social actor and thereby apply social rules such as politeness (Nass & Moon, 2000; Lee, 2010).

More specifically, research on *IT innovation* (11 of 64 papers) use mindfulness for the identification of facilitators or inhibitors regarding the adoption and diffusion of novel IT-based processes or products (Fichman, 2004) like RFID (Teo *et al*, 2011) or grid computing (Wolf *et al*, 2012). Papers assigned to the *IT management* category (13 of 64 papers) concern themselves with aspects of organizational decision making regarding effectively managing IT resources (e.g., IT personnel or IT governance) (Leidner & Kayworth, 2006). For example studies investigate decision-maker mindfulness on adoption decisions (Goswami *et al*, 2008; Goswami *et al*, 2009) or dealing with social media in terms of policies (Culnan *et al*, 2010; Kaganer & Vaast, 2010). In all, 17 of 64 papers address questions relating mindfulness to *IT use and outcomes*. The IT systems used within these studies cover a wide range of artifacts including three-dimensional software that supports architects (Carlo *et al*, 2004; Carlo *et al*, 2012), ERP systems (Valorinta, 2009; Nwankpa & Roumani, 2014), virtualized desktops (Dernbecher, 2014; Dernbecher *et al*, 2014), and an online wiki system (Sun & Fang, 2010; Sun, 2011). At the same time, manifold outcomes are addressed, such as user satisfaction (Sun, 2011), IT reinvention (Carter *et al*, 2011; Nevo & Nevo, 2012), and reliability (e.g., Van de Walle & Turoff, 2008; Simha & Kishore, 2011). Ten papers deal with questions on the interplay of mindfulness and *IS development*. Of those, six papers explicitly link

mindfulness to agile development methods as theoretical underpinnings since both concepts have been identified as sharing similar characteristics (Butler & Gray, 2006).

Table 2 provides an overview of the sources contributing to the different themes, as well as the dependent variable in the case of empirical studies, or the causal effect for qualitative research. Since the investigated IS themes are interrelated with the purpose of applying the mindfulness concept, we will combine the detailed discussion of the themes, dependent variables, and effects with elaboration of the question of "how" the mindfulness concept has been used in IS research in the subsequent section.

Theme	Dependent variable / effect	Source
IT innovation	Performance	Wolf *et al* (2009), Wolf *et al* (2012), Fichman & Melville (2014),
	Research avenues	Fichman (2004)
	Successful IT innovation management	Swanson & Ramiller (2004), Mu & Butler (2009), Ramiller & Swanson (2009), Zheng *et al* (2009), Teo *et al* (2011), Leung *et al* (2014)
	Technology rejection	Lee *et al* (2012)
IT management	Corporate social media policies	Kaganer & Vaast (2010)
	Decision	Fiol & O'Connor (2003), Goswami *et al* (2008)
	Managing institutional pressure	Wong *et al* (2009)
	Mindfulness	Muhren *et al* (2007), Goswami *et al* (2009), Muhren *et al* (2007); De Hertogh & Viaene (2012)
	Organizational readiness	Sammon & Adam (2007)
	Performance	Culnan *et al* (2010), Khan *et al* (2013)
	Reliability	Pu & Kishore (2006), Van Den Eede *et al* (2006), Van Den Eede *et al* (2006); Merminod *et al* (2008)
IT use and outcomes	IS usage / intention to use / user satisfaction	Timmerman (2002), Sun & Fang (2010), Sun (2013), Nwankpa & Roumani (2014)
	IT reinvention	Carter *et al* (2011), Nevo & Nevo (2012)
	Mindfulness	Valorinta (2009)
	Performance	Yoo & Kanawattanachai (2001), Wolf *et al* (2011), Ie *et al* (2012), Dernbecher (2014), Dernbecher *et al* (2014)
	Reliability	Carlo *et al* (2004), Butler & Gray (2006), Van de Walle & Turoff (2008), Simha & Kishore (2011), Carlo *et al* (2012)
IS development	Agile software development practices	Vidgen & Wang (2009), McAvoy *et al* (2013)
	Inefficiency	McAvoy & Butler (2009), Sammon *et al* (2012)
	Mindfulness	Surendra (2009), Nagle *et al* (2011)
	Reliability	Sammon *et al* (2014)
	Successful ISD/ASD project	Crowston & Kammerer (1998), Matook & Kautz (2008), Beck *et al* (2011)
Other	CASA: – Anthropomorphism – Mindfulness	 Lee (2010), Kim & Sundar (2012), Liang *et al* (2013) Lee (2005), Lee (2009),

	Meditation – mindfulness	Chittaro & Vianello (2014), Vidyarthi & Riecke (2014)
	Organization science: – Organizational learning – Performance – Quality of organizational attention	 Levinthal & Rerup (2006) Weick & Roberts (1993), Salvato (2009) Weick & Sutcliffe (2006)
	Research approach: – Improved case study research – Successful IT innovation	 Keutel *et al* (2014) Leung *et al* (2013)

Table 2: *IS themes and dependent variables / causal effects investigated using mindfulness*

Purpose of application

Three ways of using mindfulness in IS research

In addition to the "what" that has been examined, we further analyze "how" mindfulness has been applied, in order to further improve our understanding of the use of mindfulness in IS research. The three categories used for this dimension are (1) mindfulness as a prerequisite, (2) mindfulness as an accelerator, and (3) mindfulness as an implication. Figure 2 summarizes the three different application purposes of mindfulness in IS research.

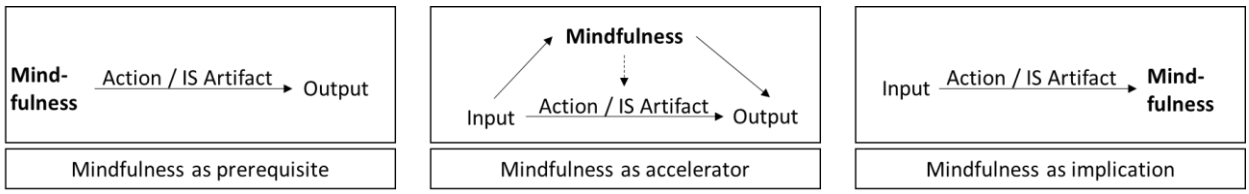

Figure 2: *Three ways of using mindfulness in IS research*

When used as a *prerequisite* and hence in terms of an exogenous variable (left box in Figure 2), the existence of mindfulness constitutes a necessary requirement for further actions and outcomes. For instance, when mindfulness is observable as a team capability within an IS development project, the team members will demonstrate agile behavior (McAvoy *et al*, 2013). Furthermore, mindfulness as an *accelerator* (box in the middle in Figure 2) amplifies the effect between the input and the output variable in the sense of either being a moderator (solid line) or a mediator (dashed line). Regarding IS *use and outcomes* exemplarily, mindfulness positively moderates the relationship between initial beliefs about a system and the intention to use it (Sun, 2011) and increases the influence of top management support on IS performance (Khan *et al*, 2013). Finally, mindfulness can be categorized as *implication*, and thus as an endogenous variable

(right box in Figure 2), as in cases when the ubiquity of IT triggers cognitive and behavioral practices and thereby increases and also decreases mindfulness (Valorinta, 2009). Table 3 depicts the distribution of mindfulness in IS research across purposes of application and IS themes, which will be discussed in more detail below.

	Theme					
Mindfulness used as…	**IT innovation**	**IT management**	**IT use and outcomes**	**IS development**	**Other**	**Total**
...prerequisite	6	4	3	2	7	**22**
…accelerator	5	6	13	6	2	**32**
...implication	–	3	1	2	4	**10**
Total	**11**	**13**	**17**	**10**	**13**	**64**

Table 3: *Mindfulness application purposes and IS themes*

Mindfulness as a prerequisite

A large set of papers (22 of 64 papers) applied mindfulness as a prerequisite for various areas of investigation. Of those, seven papers apply mindfulness as a prerequisite for heterogonous topics categorized as *other* – such as research guidelines for conducting case study research (Keutel *et al*, 2014) or design research (Leung *et al*, 2013), to advance knowledge regarding the CASA paradigm (Lee, 2010; Kim & Sundar, 2012; Liang *et al*, 2013), or topics such as new product development (Salvato, 2009), dealing with institutional pressure (Wong *et al*, 2009), and mindful and less-mindful learning processes (Levinthal & Rerup, 2006).

With regard to mindfulness as a prerequisite in the context of *IT innovations* (six papers), Fichman & Melville (2014) use a lack of mindfulness as a rationale for the misalignment between organizations' degree of leadership in innovating with IT and their resource profile. Consequently, mindless organizations are less likely to make the best use of their resources when adopting IT innovations, which in turn leads to unsatisfactory returns and decreased performance. Moreover, the prevalence of mindfulness served as an adequate explanation for successful IT implementations through the mindful consideration of requirements of internal and external stakeholders (Teo *et al*, 2011) or by mindfully aligning the supply chain strategy with the implemented RFID technology (Leung *et al*, 2014), but likewise also for the abandonment of an IT innovation as a mindful response to its limitations (Lee *et al*, 2012). In addition to assessing the degree of mindfulness (Mu & Butler, 2009), applying a suitable instrument to evaluate the existence of mindful implementation strategies, for example through an organizational readiness

self-assessment (Zheng *et al*, 2009), as well as the degree of mindfulness, might therefore be an effective means of increasing the success of IS implementations.

Drawing on *IT management* (four papers) and the related decision-making process, one paper originating from management science and thus not necessarily having an IS focus utilizes the concept to explain decision making in the face of bandwagons (Fiol & O'Connor, 2003). More specifically, mindfulness was found to promote decision-makers' evaluation of the state of preparedness as a first step before deciding on the implementation of an IS, thereby mitigating the risk of project failure (Sammon & Adam, 2007). Mindfulness also supports making discriminating adoption decisions due to extended environmental scanning and information processing in terms of an exogenous variable and allows decision makers to see beyond the adoption project to evaluate the real options of IT (Goswami *et al*, 2008).

Another three papers use mindfulness as prerequisite in the context of *IT use and outcomes.* Regarding mindfulness in technology acceptance, Sun & Fang (2010) proved that mindfulness negatively influences uncertainty while it has a positive effect on perceived usefulness and the intention to use. In a post-adoption stage, mindfulness will impact the IT reinvention since a mindful user will notice a changing, ambiguous, or uncertain situation, validate the adequacy between IT and task, and take appropriate measures in case of emerging misfits (Nevo & Nevo, 2012). Instead of rejecting it, he or she will likely then mindfully reinvent either the IT itself or its use, by departing from its original purpose (Nevo & Nevo, 2012). In emergency situations like tsunamis or hurricanes, the mindful use of a decision support system fosters the capacity to discover and manage unexpected events through mindful anticipation and containment, thereby improving reliability (Van de Walle & Turoff, 2008).

Researchers have also shown interest in mindfulness as prerequisite for *IS development* (two papers). While Vidgen & Wang (2009) suggest collective mindfulness as one capability of agile teams, which in turn is enabled by self-management and team discipline, McAvoy *et al* (2013) deploy mindfulness to investigate the presence of the underlying prerequisites for ISD agility. In particular, by examining the actions and perceptions (behaviors) of software development team members, they state that mindfulness promotes these prerequisites (labeled as "being agile") in case of insufficient agile practices ("doing agile").

Mindfulness as an accelerator

The role of mindfulness as an accelerator has enjoyed the majority of scholarly attention (32 of 64 papers) either on a general level, such as organizational performance (Weick & Roberts, 1993) or organizational attention (Weick & Sutcliffe, 2006), or when dealing with IS.

Thirteen papers in this category deal with *IT use and outcomes*. More specifically, most studies focus on *performative* aspects, for instance Ie *et al* (2012), who question whether media multitasking can be improved by increasing mindful flexibility through encouraging the state of mindfulness. They conclude that younger individuals and those who have a dispositional tendency to be more mindful perform better. In a similar vein, Dernbecher *et al* (2014) find a positive influence of mindfulness on the job performance of users of a virtualized, cloud-based desktop solution. More specifically, in a comparative study between more and less mindful users, Dernbecher (2014) demonstrates a stronger impact on job performance among less mindful users. In a virtual team setting, Yoo & Kanawattanachai (2001) suggest that transactive memory systems (TMS) interrelating with the collective mind are important parameters for explaining team performance. In brief, while TMS provides the platform to share and retrieve information, it is appropriated through mindfulness. Further, an accelerating effect of mindfulness leading to increases in business process performance has been found regarding the effects of information overload (Wolf *et al*, 2011).

Butler & Gray (2006) theorize that individuals and organizations achieve *reliability* when creating, managing, and using complex and imperfect systems based on appropriate cognition such as mindfulness-based approaches. According to Simha & Kishore (2011), IT amplifies the effects between social capital and mindfulness, which in turn enhances risk mitigation efforts. Similarly, Carlo *et al* (2004) show that organizations enact mechanisms which are also observable within HROs in order to mitigate risks in complex environments and that IT systems serve as facilitators for the five cognitive processes of the collective mind. In a follow-up publication, the authors conclude that enacting contradictory technologies-in-practice will produce both mindful and mindless behaviors (Carlo *et al*, 2012).

Another focal point in this category is mindfulness and its relation to *IS Usage, Intention to Use or User Satisfaction, and IT reinvention*, respectively. From a theoretical perspective, it has been demonstrated that mindfulness can moderate the relationship between theoretical constructs (e.g., media richness, social influence) and media use (Timmerman, 2002). This is consistent with Sun's (2011) longitudinal study in which he conceptualizes mindfulness as moderator. In so doing, he substantiates that the impact of the decisions made mindfully at the adoption stage are deferred

to the post-adoption stage where they emerge in terms of post-adoption disconfirmation, user satisfaction, and modified beliefs. In contrast, when users are limited by subconscious behaviors and mindlessly applied IT routines, IT cannot be used to its fullest potential. Management therefore must maintain mindfulness in order to achieve an adequate degree of user-driven innovation in the postadoptive stage (Carter *et al*, 2011). Specifically, mindfulness can be increased by creating an environment which drives trust among IS users regarding the competence, reliability, honesty, care, and openness of the leadership team. On the other hand, if users feel empowered to try out new thoughts and ideas without being punished for failures, more frequent use and experimentation with ERP systems occur (Nwankpa & Roumani, 2014).

Concerning *IT innovations* (five papers), Swanson & Ramiller (2004) elaborate on the question "whether, when, and how to innovate with information technology" (Swanson & Ramiller, 2004, p. 553). They propose that organizations will be innovating with IT by mindfully attending to their facts and specifics. In so doing, they are expected to demonstrate mindfulness in all four phases of innovating with IT: comprehension, adoption, implementation, and assimilation. In this context, mindfulness supported by routines can push the organization toward active and ongoing self-assessment required for innovating with IT. Drawing primarily on Fiol & O'Connor (2003) and an earlier version of Swanson & Ramiller (2004), Fichman (2004) invokes mindfulness as new opportunity for conducting IT innovation research. Essentially, he argues that by integrating mindfulness into research on IT innovation, the "black box" of decision making can be opened. As such, mindfulness explains how expanded scanning and information processing of managers contribute to discriminating decisions made in order to successfully resist bandwagons. Based on this rationale, Wolf *et al* (2012) demonstrate that organizations benefit from mindfulness when dealing with bandwagon phenomena in turbulent environments. In particular, mindfulness eventually leads to increases in business process performance regarding grid assimilation in the face of institutional pressure (Wolf *et al*, 2009).

Using mindfulness as an accelerator for *IT management* (six papers) has been shown to be an adequate basis for reliable risk management in offshoring projects or incident management processes, since it enacts the capability to reveal and manage unforeseen events (Pu & Kishore, 2006; Van Den Eede *et al*, 2006). According to Merminod *et al* (2008), reliability in new product co-development processes can be increased by individual and collective mindfulness, which in turn are supported by the monitoring and communication functionalities provided by a product lifecycle management system. In their study, Culnan *et al* (2010) argue for mindful adoption as part of the implementation strategy in order to generate business value from social media. Adopting a social media platform consistent with the culture, clients, and business strategy of the

organization, or developing qualitative and quantitative metrics for assessing the impact of the application, are some of the constituting elements of the mindful adoption strategy. However, through projecting only familiar aspects on new, unknown phenomena, mindlessness might hamper preparedness regarding changes in IT (Kaganer & Vaast, 2010). Finally, mindfulness was found to moderate the influence of top management support on IS performance (Khan *et al*, 2013).

Throughout the *IS development* process (six papers), especially regarding the initial requirements elicitation phase, it has been demonstrated that mindless behavior can result in inefficiencies (McAvoy & Butler, 2009; Sammon *et al*, 2012). Thus, in order to increase efficiency through mindfulness, organizations should promote "interactive routines" which challenge the efficiency of existing routines within the ISD process, thereby supporting its ongoing improvement (Sammon *et al*, 2012; Sammon *et al*, 2014). Another possibility would be to pay particular attention to socio-psychological factors (e.g., the Abilene-Paradox (Harvey, 1974)) that can inhibit mindful decision making (McAvoy & Butler, 2009). For the subsequent requirements analysis phase, the collective mind was found to serve as a useful alternative to coordination mechanisms within the prevalent group processes, since it contributes to the individuals' sensemaking regarding their work and the work of the group (Crowston & Kammerer, 1998). Shifting from the group to the global level, management practices in global multivendor ISDs like "expertise-driven reorganization of intervendor power relations" were mapped onto the cognitive processes underlying mindfulness (Beck *et al*, 2011). The authors advocate that management practices should not only focus on the client organization but should span all involved parties in terms of "interorganizational" mindfulness. Since mindfulness and agile development methods share similar characteristics (Butler & Gray, 2006), Matook & Kautz (2008) connect the guiding values and principles provided by the Agile Manifesto to the key determinants of individual and collective mindfulness. By extending the understanding of agile ISD practices through the mindfulness lens, they demonstrate how mindful behavior can be a useful means of ensuring successful results in ISD projects.

Mindfulness as an implication

Compared to the two preceding categories, research on mindfulness resulting from different factors is limited (ten of 64 papers). With regard to *IT management* (three papers), examples for IT facilitating mindfulness in decision making can be found where decision support systems substantiate mindfulness when facing the challenges posed by social media (De Hertogh & Viaene, 2012). Taking a different approach by drawing on decision-maker mindfulness in IT

innovation adoption, Goswami *et al* (2009) investigate factors that determine mindfulness, such as individual personality traits like openness to experience and conscientiousness, or an informed culture prevailing in an organization. Of these traits, conscientiousness was found to be positively moderated by innovation radicalness. With regard to incident management processes, Muhren *et al* (2007) found that organizations can learn from HROs that utilize this capability by dealing with high-complexity situations and tight-coupling to increase mindfulness.

The enabling or amplifying influence of IT on mindfulness has also been investigated in light of the reliability aspects of *IT use and outcomes*. In his study on organizational mechanisms and characteristics in the context of use and development of IT, Valorinta (2009) points out that IT-intensive organizations and HROs share similar characteristics, since small errors can have serious consequences in both kinds of organizations. Consequently, both base their safeguards on high levels of mindfulness. Against this backdrop, Valorinta (2009) investigates the IT impact on cognitive and behavioral dimensions and finds that heightened attention and an enriched action repertoire enable mindfulness, whereas cognitive inertia and challenged enactment have an inhibiting effect.

Another approach to promote mindfulness has been identified not directly related to an IT artifact, but with regard to agile *IS development* techniques (two papers) (e.g., eXtreme programming, pair programming) (Surendra, 2009). In a global ISD organization, mindfulness was found to be improved by agile practices but only within its globally dispersed locations (Nagle *et al*, 2011). Thus, introducing "shared understanding" as an additional component of mindfulness could potentially help overcome the obstacle of making mindful decisions across dispersed locations (Nagle *et al*, 2011).

The *other s*tudies (four papers) that address mindfulness as a technique to reduce stress proved that special mobile applications support thought-distancing meditation techniques (Chittaro & Vianello, 2014) and that technologies increase well-being by fostering meditation mindfulness (Vidyarthi & Riecke, 2014). CASA studies, investigating how informational social influence exerted by a computer prompts or inhibits mindfulness, reveal that enduring dispositional differences like rationality are of high importance when dealing with placebic vs. real information. Moreover, interactive computer programs which flatter their users temporarily elicit mindfulness among individuals categorized as low rational (Lee, 2005; Lee, 2009).

Level of mindfulness

Delineating the levels of mindfulness

Mindfulness can be traced back to individual and organizational mindfulness as original forms in the literature. However, in the course of evolving research in IS, this distinction became blurred due to emerging new concepts like mindfulness in technology acceptance (Sun & Fang, 2010; Sun, 2011) or mindful organizing (Dernbecher *et al*, 2014). Therefore, to precisely capture the different nuances of mindfulness, we differentiate organizational, group, and individual levels following the categorization of Roberts *et al* (2012). As a result we will contribute to the question of "where" the mindfulness concept has been applied in IS research thus far. Table 4 summarizes the categorization of this dimension. More specifically, the three levels where the mindfulness concept has been applied are presented. "Multiple levels" indicates that an unambiguous assignment to one of the three levels of the mindfulness concept was not possible, which will be discussed in the section on methodological issues and recommendations below. Moreover, Table 4 outlines the hierarchical levels of observation from which the data used for analysis were collected.

	Hierarchical level of observation									
Mindfulness level	**Multiple**	**CxOs**	**CxOs & managers**	**Managers**	**Managers & employees**	**Employees**	**Project members**	**Students & other**	**n/a**	**Total**
Organizational level	3	1	2	2	1		8		7	**24**
Group level	1	1		1	1		5	1	1	**11**
Individual level	2		2	2	1	3		9	3	**22**
Multiple levels	2				1		1		3	**7**
Total	**8**	**2**	**4**	**5**	**4**	**3**	**14**	**10**	**14**	**64**

Table 4: *Level of mindfulness and hierarchical level of observation*

Organizational level

The *organizational level* represents the highest level of mindfulness in IS research. Building primarily on its five constituting cognitive processes (Weick *et al*, 1999; Weick & Sutcliffe, 2001), OM is defined as a characteristic of an organization (Vogus & Sutcliffe, 2012). Further, interorganizational mindfulness reflects the interplay of organizations involved in relationships and networks of multiple organizations (Beck *et al*, 2011). As a result, we found 24

of 64 papers that addressed an organization (17 papers), a group of organizations (six papers), or both (one paper) as a focal level of their analyses.

With regard to the hierarchical level of observation, the studies interested in the mindfulness concept at the organizational level derive their research results from data gathered at different levels. More precisely, they refer to the organization(s) as unit(s) of analysis in an overarching manner without going into further details regarding the hierarchy level of observation (Swanson & Ramiller, 2004; Levinthal & Rerup, 2006; Pu & Kishore, 2006; Ramiller & Swanson, 2009; Culnan *et al*, 2010; Fichman & Melville, 2014; Leung *et al*, 2014), or they generalize to the organizational level based on responses from C-level managers (e.g., CEO, CIO, etc.) (Wolf *et al*, 2012), middle managers (Wolf *et al*, 2009; Kaganer & Vaast, 2010), or of a mixture of both (Simha & Kishore, 2011; Teo *et al*, 2011). Furthermore, while some researchers gain data from managers and employees in their studies (Muhren *et al*, 2007) others ground their findings on information gathered from various hierarchy levels of observation (Van de Walle & Turoff, 2008; Mu & Butler, 2009; Leung *et al*, 2013) or among project team members (Wong *et al*, 2009; Zheng *et al*, 2009; Beck *et al*, 2011; Nagle *et al*, 2011; Lee *et al*, 2012; Sammon *et al*, 2012; McAvoy *et al*, 2013; Sammon *et al*, 2014).

Group level

Mindfulness is not reducible only to the bipolarity of individual and organizational mindfulness but rather can also emerge within a group as a result of individuals heedfully interrelating their activities (Weick & Roberts, 1993). Therefore, we include the *group level* of mindfulness, also denoted as collective mind or collective mindfulness, as an intermediate level of analysis in our review. This delimitation is especially relevant for the IS discipline, where research can refer to groups of users or project teams. Thus, focusing the analysis solely on OM or on underlying individual levels would carry the risk of overlooking group-specific manifestations of mindfulness.

When looking at the studies categorized as "group level" papers (11 of 64 papers), we found all papers sharing a group as the unit of analysis (e.g., team, project, department etc.), even when the group included members from different organizations (Carlo *et al*, 2004; Carlo *et al*, 2012). Similar to studies on OM, researchers gained knowledge by collecting data from various levels, such as the C-level (Khan *et al*, 2013), general management (De Hertogh & Viaene, 2012), manager and employees (Van Den Eede *et al*, 2006), students (Yoo & Kanawattanachai, 2001), across different hierarchical levels (Surendra, 2009), or from a generic point of view, not focusing

on any specific level (Weick & Roberts, 1993). Also, team members served as a source for data analyzed in these studies (Crowston & Kammerer, 1998; Carlo *et al*, 2004; McAvoy & Butler, 2009; Vidgen & Wang, 2009; Carlo *et al*, 2012).

Individual level

Finally, the *individual level* of mindfulness encompasses 22 papers dealing with different types of mindfulness referring to the individual as the subject of analysis: *individual mindfulness* (eight papers) as defined by Langer (1989b) including emerging concepts such as *IT mindfulness* (Carter *et al*, 2011); *mindfulness in technology acceptance* (Sun & Fang, 2010); *mindful organizing* (three papers) as a job-related specific form of individual mindfulness exhibited by employees (Vogus & Sutcliffe, 2012); *managerial mindfulness* (four papers) representing the mindfulness of decision making managers as a special subgroup of employees*; mindfulness meditation* (Kabat-Zinn, 1994) (two papers) which has its roots in the Eastern tradition of mindfulness; and *CASA mindlessness* (five papers).

Overall, the papers derive their evidence from data collected from employees (Timmerman, 2002; Sun & Fang, 2010; Wolf *et al*, 2011; Dernbecher, 2014; Dernbecher *et al*, 2014; Nwankpa & Roumani, 2014) with managers as a special subgroup (Fiol & O'Connor, 2003; Sammon & Adam, 2007; Goswami *et al*, 2008; Goswami *et al*, 2009), students (Lee, 2005; Lee, 2009; Lee, 2010; Sun & Fang, 2010; Ie *et al*, 2012; Kim & Sundar, 2012; Liang *et al*, 2013; Chittaro & Vianello, 2014), randomly chosen individuals (Vidyarthi & Riecke, 2014), or in a general conceptual manner (Carter *et al*, 2011; Nevo & Nevo, 2012; Keutel *et al*, 2014).

In particular, *IT mindfulness* reflects an individual's propensity to actively pursue new ways of using and getting involved with IT (Carter *et al*, 2011). As such, it has been described as comprising the four dimensions proposed by Langer (1997): alertness to distinction, openness to novelty, orientation in the present, and awareness of multiple perspectives (Carter *et al*, 2011). Interestingly, the dimension "openness to novelty" can be interpreted as curiosity, which in turn overlaps in part with the concept of cognitive absorption. Likewise, personal innovativeness with IT has been found to correspond with this dimension in terms of experimentation. However, both concepts are conceptually distinct from this dimension. Consistent with this definition, it was hypothesized that IT mindfulness would be negatively influenced by computer self-efficacy (Carter *et al*, 2011). Regarding *mindfulness in technology acceptance* the four aforementioned dimensions have been advanced to the specific context as active information searching/processing, creation of new categories, awareness of individual needs, and openness to alternatives (Sun &

Fang, 2010). These processes improve an individual's likelihood of accepting a technology. Similarly, with focus on IT use, it has been claimed that mindfulness manifests when considering novel solution alternatives, highly context-specific use of IT, strong conformity between business requirements, and used IT capabilities (Wolf *et al*, 2011).

Mindful organizing deviates from the aforementioned concepts of individual mindfulness since it emerges as a bottom-up process complementary to organizational mindfulness driven by individual employees, and thus focuses on the individual in an organizational context. So far, minimal research has been conducted either explicitly (Dernbecher, 2014; Dernbecher *et al*, 2014) or implicitly (Nwankpa & Roumani, 2014) that addresses mindfulness among employees as a phenomenon distinct from mindfulness on the organizational level. However, this is not too surprising given the fact that while scholars in the past had already touched on the idea of mindful organizing (Weick & Sutcliffe, 2001; Butler & Gray, 2006; Weick & Sutcliffe, 2006) it has only been recently defined in detail and delineated from OM (Ray *et al*, 2011; Vogus & Sutcliffe, 2012).

Despite its important role in decision making, e.g., regarding bandwagons (Fiol & O'Connor, 2003; Swanson & Ramiller, 2004), *managerial mindfulness* as a specific form of mindfulness among employees has yet attracted few scholarly discussions. In brief, managerial mindfulness has been defined as an individual cognitive property of decision makers, i.e., a trait (Goswami *et al*, 2008; Goswami *et al*, 2009), but also as an attentive and heedful state of mind (Fiol & O'Connor, 2003). Moreover, whereas Fiol & O'Connor (2003) list four of the cognitive processes constituting mindfulness as the underpinnings of decision-maker mindfulness, Goswami *et al* (2009) subsume these as facets of conscientiousness and add "openness to experience" as a characteristic of individual mindfulness as well as the "informed culture" of the organization as a determinant for managerial mindfulness. As a consequence, mindful managers tend to exhibit a higher degree of scanning and engage in interpretations more relevant to the context when making decisions on IT innovations and only decide to join a bandwagon in case they expect advantages for their specific circumstances (Fiol & O'Connor, 2003; Goswami *et al*, 2009).

Mindfulness–mindlessness antonym

The fourth dimension of our literature analysis is concerned with mindfulness and its antonym mindlessness, characterized by, for example, management science as a continuum (Fiol & O'Connor, 2003), whereas organization science discusses their interrelation (Levinthal & Rerup, 2006). In the latter case, mindfulness and mindlessness are not seen as distinct categories but rather as complementary categories for which the effectiveness of one requires the existence of the other.

As an example, Levinthal & Rerup (2006) draw on established repertoires of action (i.e., less-mindful behavior) as a necessary foundation for flexibly responding to unknown situations by recombining them in novel ways (i.e., mindful behavior). Similarly, the dimension "mindfulness–mindlessness antonym" questions whether IS research considers mindfulness and mindfulness separately or as the combination of both, and if so in which way (i.e., as continuum, (interrelated) complements, dualism, duality, dialectics).

Numerous papers (25 of 64 papers) focus on mindfulness only, supporting the claim that a more nuanced understanding of the interrelation between mindfulness and mindlessness can easily be overlooked when concentrating on one focal perspective (Levinthal & Rerup, 2006). Another group of papers (19 of 64 papers) juxtapose mindfulness with mindlessness to define the concept, however, throughout the study the authors concentrate predominantly on mindfulness (see Table 5, left side, Mindfulness/Mindlessness column). In contrast, only five papers put strong or exclusive emphasis on mindlessness.

Thus far, mindfulness and mindlessness have been interpreted in 15 of 64 papers on the one hand either as (interrelating) complements (Swanson & Ramiller, 2004; Levinthal & Rerup, 2006; Lee *et al*, 2012), as dialectics (Carlo *et al*, 2012), and as a dual concept (McAvoy & Butler, 2009), or on the other hand as a continuum (Kaganer & Vaast, 2010) and as opposite to each other (e.g., Fiol & O'Connor, 2003; Wolf *et al*, 2009; Leung *et al*, 2014). More specifically, Swanson & Ramiller (2004) posit that within an organization, mindfulness and mindlessness are mutually suppressing while within an institutional environment mindfulness and mindlessness are interacting complements. As a consequence, an organization will exhibit a rather high degree of mindlessness at the beginning of its engagement with an innovative IT and become rather mindful with the advancement of the IT. Regarding the larger institutional environment, mindfulness and mindlessness will shift over time among organizations and across the innovation itself, thereby reflecting patterns of the innovation or the organizational characteristics (Swanson & Ramiller, 2004). In another example, Lee *et al* (2012) use mindfulness to analyze a small firm's behavior within the different innovation processes, and apply the three conditions of mindlessness proposed by Swanson & Ramiller (2004) (i.e., attention deferral, contextual insensitivity, and institutional preemption) to demonstrate the lack of mindlessness perceived within their case study. As a result, they did not find mindless innovating to be a strategic choice for small firms. In a similar vein, Leung *et al* (2014) build a framework of mindful and mindless effects within the different phases of the innovation process. Assigning the RFID adoption in different cases either to mindfulness or mindlessness, they found a misalignment between supply chain strategy and RFID complexity as one explanation for unsatisfactory benefits resulting from a mindless implementation. In addition,

other studies separate organizations (Wolf *et al*, 2012) or users (Dernbecher, 2014) into more mindful and rather less mindful groups to compare them with each another. Unlike these studies which oppose both concepts, Carlo *et al* (2012) introduce the term "collective minding" which encompasses dialectics of simultaneous mindful and mindless behavior resulting from the confrontation with contradictions within the five dimensions of mindfulness.

When adding the level of mindfulness to the analysis of the emphasis on the mindfulness–mindlessness antonym as depicted in Table 5, the results indicate that most of the papers using only mindfulness or mindlessness refer to the individual level of analysis (18 papers, left side of the table). The papers making use of both categories of the antonym mostly relate to the group or organizational level (11 papers, right side of the table). This observation can be justified, on the one hand, by the capacity of mindfulness or mindlessness on an individual level as a personal characteristic which can move only in one direction of the antonym. On the other hand, as for example evidenced by the conceptualization as dialectics in Carlo *et al* (2012), it is more likely that in larger units of analysis both sides of the antonym occur. Here, mindfulness and mindlessness "form a bipolar tension within a whole, in which IT can simultaneously and paradoxically support both acting mindfully and acting mindlessly" (Carlo *et al*, 2012, p. 1083).

	Mindfulness–mindlessness antonym									
Mindfulness level	**Focus on one category (mindfulness or mindlessness)**				**Focus on both categories (mindfulness and mindlessness)**					**Total**
	Mindfulness only	**Mindlessness only**	**Mindfulness/ mindlessness**	**Mindfulness/ mindlessness**	**Complements (interaction)**	**Dialectics**	**Dual concept**	**Continuum**	**Opposite**	
Organizational level	10		5	1	3			1	4	**24**
Group level	5		3			1	1		1	**11**
Individual level	7	1	7	3					4	**22**
Multiple levels	3		4							**7**
Total	**25**	**1**	**19**	**4**	**3**	**1**	**1**	**1**	**9**	**64**

Table 5: *Level of mindfulness and focus of the mindfulness–mindlessness antonym*

Following the example of Gupta *et al* (2006) regarding their differentiation of exploration and exploitation, it is however interesting to note that the majority of the papers dealing with both sides of the concept (right side of Table 5) define the two categories of the antonym as two sides of a continuum or as opposite from each other and thus mutually exclusive (ten papers). In contrast, we found only five papers treating them as orthogonal, i.e., coexisting, in terms of interrelating complements, dialectics, or a dual concept.

Discussion

Summary of key findings

As can be concluded from the diversity and quantity of analyzed papers dealing with mindfulness, extant IS research has demonstrated considerable interest in the mindfulness concept on various IS themes ("what"): IT innovation, IT use and outcomes, IT management, IS development, as well as other, smaller themes (CASA, meditation, research approach organization science). Interestingly, the mindfulness concept has been applied in a versatile manner ("how") across these themes either as a prerequisite for an action or as influencing an IS artifact and leading to a specific outcome; as an accelerator where it either mediates or moderates the causal relations between input and outcome; or as a result exemplarily either emerging from certain actions or being facilitated, supported, or enhanced by IT. Across the themes and application purposes we found that mindfulness, on the one hand, was used for investigating partly similar dependent variables and causal effects, such as increasing performance, ensuring reliability, or successfully

managing IT innovations. On the other hand, heterogeneous outcomes, such as corporate social media policies, managing institutional pressure, or technology rejection, were objects of investigation. Our review also shows that mindfulness has been conceptualized on different levels of analysis ("where"): individual, group, or organizational levels address distinct types of mindfulness, such as organizational mindfulness or individual mindfulness, which in turn encompasses specific forms, like managerial mindfulness or mindful organizing. In order to draw conclusions on the varying levels investigated, the papers subject to our analysis collect data on heterogeneous levels of observations ranging from C-level managers to managers or regular employees, as well as project members in distinct roles, to students. The majority of the reviewed papers place strong emphasis on the mindful side of the mindfulness concept within their research while the mindless side is hardly covered ("which"). Consequently, the research focus is mostly one-directional. However, there is also a smaller set of studies juxtaposing mindfulness with mindlessness, conceptualizing the antonym as orthogonal in terms of (interrelating) complements, as dialectics, and as a dual concept, or alternatively as a continuum and opposite from each other.

In addition to these basic observations drawn from extant literature, the interpretation of our analysis led to the following findings:

1) Despite the rich portfolio of *themes* investigated by extant IS literature, research gaps remain, especially with regard to the effects of mindfulness over time, and particularly regarding subsequent phases of an innovation or software development process.
2) For each of the three *purposes of applying the mindfulness concept* (see Figure 2) the relationship between the IT artifact and the mindfulness concept has been interpreted as one-directional with mindfulness either as an independent or dependent variable or as a moderator. A reciprocal relationship between mindfulness shaping IT and at the same time being reshaped by IT has not yet been considered.
3) Similarly, the IS literature has – with few exceptions – treated the *levels of analysis* of mindfulness phenomena in an IS-context as clearly delimited from each other and has primarily focused on one level at a time. The results of our analysis therefore suggest that an integrated approach linking the levels needs to be explored.
4) To date, the existing IS literature has made heterogeneous use of the mindfulness–mindlessness antonym across the levels of analysis with the wide majority focusing on the mindful side. Thus, looking at one side of the bipolar concept only potentially entails the risk of not comprehensively investigating phenomena from both possible perspectives, e.g., that IT can simultaneously support acting mindfully and acting mindlessly (Carlo et al, 2012). Moreover,

to date, a comprehensive and comparative analysis between mindfulness and mindlessness as a continuum (i.e., mutually exclusive) or as orthogonality (i.e., coexisting) providing insights on the appropriate use of the mindfulness–mindlessness antonym is missing.

5) In our review, we found that only few of the papers applying the mindfulness concept go beyond the definitions of mindfulness borrowed from psychology and organization science on an individual and organizational level (see also "Theoretical background" section above) to conceptualize and operationalize mindfulness as an IS-specific construct (e.g., Matook & Kautz, 2008; Valorinta, 2009; Beck *et al*, 2011; Carlo *et al*, 2012). Although the IS mindfulness research stream is already in a mature state, a comprehensive IS mindfulness theory has not yet been developed.

Toward an IS mindfulness theory

To address some of the key findings summarized above, the following section aims at providing a high-level metatheory on mindfulness in IS research. In addition to the results of the literature review, the metatheory was inspired by Giddens' (1984) structuration theory. Here, human actions build on social structure, while at the same time these actions produce and reproduce social structure. Concerning the mindfulness concept, the section above on the "Purpose of application" of the literature review identified three unidirectional ways of using mindfulness in IS research (i.e., as a prerequisite, as an accelerator, or as an implication). However, instead of interpreting mindfulness and its interplay with IT as one of these three mutually exclusive relationships, we suggest a duality between IT and mindfulness similar to Giddens' (1984) "duality of structure." As such, mindfulness is neither an endogenous nor exogenous variable, but rather reciprocally interacts with IT.

As depicted in Figure 3, mindfulness shapes the IT artifact, whereas the IT artifact is capable of facilitating mindfulness. More precisely, for example when designing or developing an IT artifact (i.e., action), human agents draw on mindfulness (i.e., structure). The resulting IT artifact in turn has internalized mindful characteristics which enable it to facilitate mindfulness when being implemented or adopted. An example would be a mindfully developed online banking system supporting its users in mindfully carrying out their banking transactions. However, mindfulness does not necessarily lead to performant and reliable IT, rather mindfulness can create "bad" IT which fosters mindlessness (see also Butler & Gray, 2006). For instance, an ERP software which was mindfully developed might entail mindless utilization when the user only mindlessly relies on the implemented workflow instead of mindfully using the software.

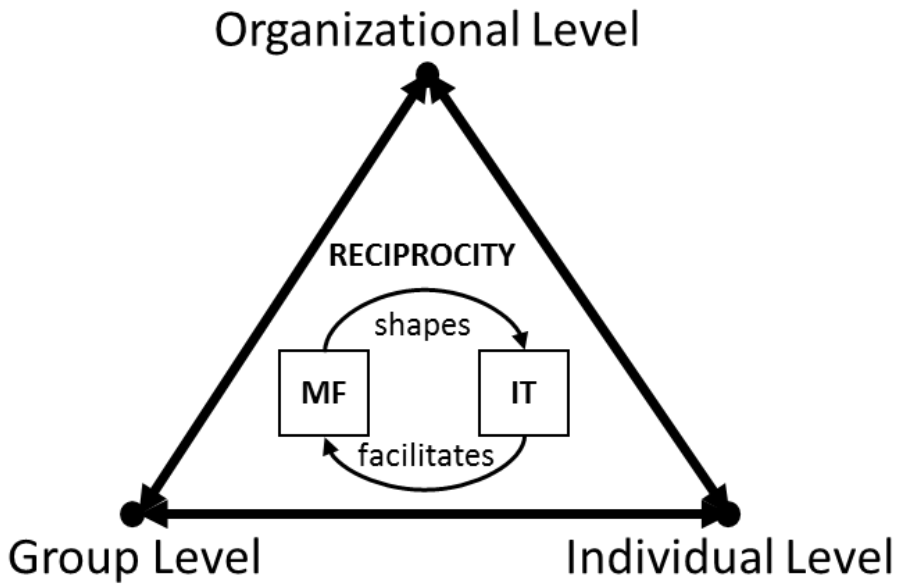

Figure 3: *IS mindfulness theory*

Since the choice of applying mindfulness, mindlessness, or both in IS research strongly depends on the level of analysis and the research context, no universal statement can be made here regarding the interpretation of the mindfulness concept as a continuum or as orthogonality. Instead, we refer to Levinthal & Rerup's (2006) warning that a one-dimensional investigation may fall short in noticing the interaction between mindfulness and mindlessness. However, there might be still cases in which it is legitimate to focus on one side or the other side of the mindfulness–mindlessness antonym. Similarly, the assumptions underlying the conceptualization of the mindfulness concept either as a continuum or as orthogonality have to be made specific to each research context.

Furthermore, similarly to the mindfulness phenomena identified in our literature review, the duality of mindfulness and IT can be observed on individual, group, or organizational level. Moreover, transmission processes between the three levels are possible, where spillover effects link the influential effects of mindfulness or mindlessness top-down or bottom-up. An example of a spillover effect between the individual level and group level would be a business analyst who mindlessly defines the requirements regarding a new system, which in turn challenges the mindfulness of the development team when they are motivated to question the appropriateness of the requirements. Another spillover effect can be found between the individual and the organizational level. To give one example, an IT decision maker on the individual level might

mindfully decide to implement a new, organization-wide software, thereby influencing the mindfulness-facilitating effect of the software throughout the organization. Finally, a spillover effect can be found between the group and organizational level. For instance, the results of an organization-wide mindfulness training initiative rolled out in order to increase an organization's performance may trigger mindful dynamics in a group of IS developers due to team synergies.

Closely related to the spillover effects of mindfulness from one level to another level of analysis is the emergence of mindfulness between levels. Thus, Figure 3 also allows a second multilevel perspective in which group mindfulness emerges from individual mindfulness and organizational mindfulness emerges from group mindfulness or from individual mindfulness. As an example for emergence, the mindfulness of a project manager can lead to an environment of mindfully thinking and acting for the project team members, thereby evoking the mindfulness of the individuals in that environment eventually leading to mindfulness in the project team and thus on group level.

In sum, this duality view regarding the interplay between mindfulness and IT allows for an integrative perspective in future IS research. The following section points out research issues on mindfulness in IS research identified in our literature review.

Research issues on mindfulness in IS research

As our review shows, much research exists on mindfulness in the different categories within the four analyzed dimensions; however, large gaps arise in the attempt to integrate the distinct perspectives. Therefore, we used the results of the review to develop an initial set of research questions summarized in Table 6. Although the proposed research questions are not intended to be definitive, this section aims at providing guidance to IS research on how to close these research gaps.

Dimension	Research question
IS themes	**RQ1a:** How can the innovation process across all phases be linked to the mindfulness concept? **RQ1b:** How can the mindfulness concept be employed to link the different phases of the ISD process involving different ISD methodologies and tool support? **RQ1c:** How can experimental treatments and the consideration of distal effects be applied to investigate the evolving effects of mindfulness on IS adoption and use?
Application purpose	**RQ2a:** Which design requirements and guidelines are effective for mindfully designing and developing information systems that in turn support mindfulness? **RQ2b:** How do distinctive input factors, such as organizational culture or costs of mindfulness, influence mindfulness and which other outcomes can result from mindfulness, such as organizational commitment or intrinsic work motivation involving IS themes on different levels?
Level of mindfulness	**RQ3a:** What are the constituting factors for group mindfulness involving information systems? **RQ3b:** How does mindfulness on the group level emerge from the individual level and how does it emerge from the group or individual level to the organizational level and how can the emergence of mindfulness across the different levels be measured consistently? **RQ3c:** How does mindfulness evolve from interorganizational interrelations?
Mindfulness–mindlessness antonym	**RQ4a:** What are the assumptions for interpreting the IS mindfulness concept as a continuum or as orthogonality? **RQ4b:** In an IS context, is it advisable to achieve balance between mindfulness and mindlessness on the group or organizational level? If so, what are adequate balancing mechanisms? **RQ4c:** How does mindfulness on one level interact with mindlessness on a higher or lower level of analysis?

Table 6: *IS mindfulness research questions*

Research issues on IS themes

Since the IS themes identified in our review offer a multitude of future research questions, we will provide only examples for pursuing research regarding different IS themes. For instance, regarding *IT innovation* processes (Swanson & Ramiller, 2004), we found that research on the comprehension phase was particularly underrepresented (Kaganer & Vaast, 2010), while adoption (Goswami *et al*, 2008; Goswami *et al*, 2009), implementation (Sammon & Adam, 2007; Teo *et al*, 2011), and assimilation (Mu & Butler, 2009; Wolf *et al*, 2012) are all often considered. Further, some papers reflect multiple (Fichman & Melville, 2014) or all phases of the innovation process in their research (Ramiller & Swanson, 2009; Lee *et al*, 2012; Leung *et al*, 2014). Research should thus address Swanson and Ramiller's (2004) call for studying early comprehension of IT innovations in particular, as well as the need to link the processes with each other and analyze the variation across the innovation stages (Fichman, 2004) involving the mindfulness concept. For example, this could be done by investigating the influence of the IS community on the lifecycle of

IT innovations (emergence, development, and fate) (Swanson & Ramiller, 2004) or through the development of a "grand theory" (Lee *et al*, 2012), e.g., covering consequences of mindful and mindless innovations.

Although Butler & Gray (2006) propose challenging avenues for further research on *IS development*, we discovered that almost all studies fail to embrace them. Furthermore, extant research has either explicitly focused on capturing requirements only or on the ISD process in general. Consequently, further research is also needed in order to bridge the mindfulness concept with the application of ISD methodologies and tool support, while at the same time linking the different phases of the ISD process.

Concerning *IT use and outcomes*, we found two papers particularly thought-provoking since they, either separately or combined, provide interesting opportunities for future research regarding the evolving effects of mindfulness on IS adoption and use. First, the idea of exposing users to experimental treatments conceptualized to induce mindfulness (Ie *et al*, 2012) and subsequently comparing these users to a control group without treatment appears promising for gaining further insights. Second, following Sun (2011), we suggest that taking distal effects of mindfulness between the adoption and post-adoption stage into account could be one possible approach for elaborating on internal, cognitive contexts of adaptive system usage behavior (Sun, 2012).

Research issues on the purpose of application

IT as an enabler for mindfulness has not yet been sufficiently investigated (Van de Walle & Turoff, 2008); among other issues, we still do not know which conditions, triggers, and attributes are required from an IS to prompt mindfulness (Sun, 2011), how ISs should be fundamentally designed to aid users in producing reliable outcomes, nor is there a detailed account of how routinized, mindless use can be avoided (Butler & Gray, 2006). At the same time, the interplay with mindful ISD processes leading to such a mindfulness-supporting IS in terms of the proposed duality between mindfulness and IT requires further analysis. Consequently, an important future research topic would be the mindful specification of design requirements and the derivation of guidelines to assist system analysts engaged in mindfully designing systems that support mindfulness. However, IS researchers have contributed to the study of IS design for supporting situation awareness (Sonnenwald *et al*, 2004) and distributed cognition (Boland Jr *et al*, 1994), which might serve as fruitful starting points for further contributions in the attempt to open the "black box" in which IT is treated as passive element (Carlo *et al*, 2012).

Focusing on the unidirectional application of mindfulness as identified in our literature review as either a prerequisite, accelerator, or implication in an IT context invokes questions for input factors which can influence or interact with mindfulness, such as organizational culture (Valorinta, 2009), the organizational environment (Muhren *et al*, 2007), costs of mindfulness (Hales *et al*, 2012), and intensifying mindfulness by means of Eastern mindfulness techniques (Weick & Putnam, 2006). In contrast, other outcomes, such as organizational commitment (Mowday *et al*, 1979) or intrinsic work motivation (Gagné & Deci, 2005), could be also considered in future research.

Research issues on the level of mindfulness

The level of mindfulness raises several future research issues. The first issue concerns the *organizational level* where, despite the knowledge already generated, a clear definition of group mindfulness delimiting the concept from individual and organizational mindfulness is missing. Instead, in most cases the application of organizational mindfulness to a group of people (e.g., team, project, or department) served as proxy for group mindfulness. Accordingly, the question of whether and to what extent group mindfulness differs from the other two concepts requires IS research to devote more attention to the constituting factors for group mindfulness. Furthermore, other researchers called for investigation of communication genres (McChesney & Gallagher, 2004) or trust (Yoo & Kanawattanachai, 2001) regarding their association to project success, organizational processes constituting group mindfulness (Barreto & D'Eredita, 2004), or the causal chain from group mindfulness to group action to group tacit knowledge (Erden et al, 2008).

As a third issue, we identified the scarcity of *interorganizational mindfulness* (nine of 64 papers) which we describe as mindfulness observable within a network of organizations (Beck *et al*, 2011). In particular, the question is how mindfulness evolves from interorganizational interrelations. To give one example, researchers could use existing research as a starting point for determining further constituting elements, such as contextual foundations (Beck *et al*, 2011), or varying sets of stakeholders, such as customers (Teo *et al*, 2011). Other topics worth investigating could be the impact of the organizational culture or of change processes within and between organizations or the influence of the interplay between more and less IT-intense organizations (Valorinta, 2009) on interorganizational mindfulness.

Finally, the consideration that mindfulness as organizational property cannot simply be aggregated from the minds of its employees (Weick & Roberts, 1993; Swanson & Ramiller, 2004) requires further attention in an IS context for bridging the mindfulness concept across all three

levels. The question could thus be how mindfulness emerges from an individual level to a group level and how it emerges from group or individual levels to an organizational level involving IS themes. An integrative view across the levels in terms of a multilevel theory on the emergence of mindfulness would then also require a consistent way of collecting data on the appropriate level(s) of observation (Kozlowski & Klein, 2000). For instance, the elaboration on this question could reflect on the consideration that while mindful organizing has been described as being facilitated by a corresponding environment (Vogus & Sutcliffe, 2012), mindful behavior of employees could emerge, for example, externally through new employees, or it could be intrinsically grounded in individual mindfulness.

Research issues on the mindfulness–mindlessness antonym

Overall, research on the question of whether the mindfulness–mindlessness antonym should be treated in IS research as dualism or as a continuum is relatively scarce. So far, this question has primarily been discussed in organization science (Levinthal & Rerup, 2006; Weick & Sutcliffe, 2006). Here, Weick & Sutcliffe (2006) emphasize the importance of the question of how the two processes are conceptualized, as a continuum or as orthogonal, since it has a fundamental impact on whether the two processes can operate simultaneously or sequentially. To answer this question, competition for the required resources needs to be taken into account. While using the same resources implies mutual exclusivity and thus the sequential ordering of the processes, the usage of divergent resources allows the processes to run simultaneously. For IS research, Carlo *et al* (2012) addresses this discussion on the group level and comes to the conclusion that it is a process of becoming which unfolds in light of the dialectics of mindfulness and mindlessness. However, drawing parallels to the analysis by Gupta *et al* (2006) regarding the differentiation of exploration and exploitation, and referring to the results of our literature review, the discussion for interpreting the IS mindfulness concept as a continuum or as orthogonality should be extended to the other levels as well. For this purpose, a thorough analysis of the underlying assumptions is required concerning the availability of resources as discussed by Weick & Sutcliffe (2006) or Gupta *et al* (2006) among other issues.

In conceptualizing mindfulness as dualism, the question emerges of whether an optimal balance between mindfulness and mindlessness exists, for example, to increase the reliability or performance of an IS. One argument indicating that the balance between mindfulness and mindlessness is desirable can be found in Butler & Gray (2006). According to the authors, it might also be worth promoting mindlessness when the rewards of being mindless outweigh the risks.

The question concerning adequate mechanisms that help achieve balance is closely related to this idea. An example for this would be the mechanisms discussed by Gupta *et al* (2006) for balancing exploration and exploitation: ambidexterity or punctuated equilibrium. While the former comprises the concurrent existence of both, the latter anticipates switching between the two concepts at varying intervals. As in the example of Butler & Gray (2006), mindlessness could be pursued for the comprehension phase of IT innovations when an organization prefers to take the role of a follower, while mindfulness during the subsequent implementation phase may prove to be a reasonable strategy to get the most out of the innovation.

Thus far, the mindfulness concept has not been analyzed in light of the multiplicity of levels on which mindfulness or mindlessness can occur – especially regarding the emergence of mindfulness on one level and mindlessness on a higher or lower level of analysis (or vice versa) or regarding the interrelation between the levels. An example of this issue would be leaders of an organization who mindlessly jump on the bandwagon of an IS innovation, while on the group level, developers mindfully push the implementation of that innovation in order to achieve a high adoption rate.

Methodological issues and recommendations

In addition to the research issues we observed various methodological issues in the course of our literature review. Consequently, this section discusses these issues and provides recommendations for conducting future research. Thus far, existing research has – with few exceptions regarding institutional theory (e.g., Goswami *et al*, 2008; Wolf *et al*, 2012) – refrained from combining mindfulness with other theories prevalent in the IS discipline. Yet, considering different purposes of application, it is unclear which of these theories are appropriate for research on mindfulness involving the variety of IS themes and levels of analysis. The diversity of theories either being developed within the IS discipline or borrowed from other disciplines is therefore a valuable source for coupling the mindfulness concept with other established theories in order to substantiate future research. For instance, media selection theory (Timmerman, 2002) could be utilized to examine the mindful adoption of IS, social capital theory could be studied regarding underlying mechanisms of mindful behavior and could also be combined with transaction cost theory or agency theory (Simha & Kishore, 2011), or mindfulness could be interpreted as a microfoundation of IT-related dynamic capabilities (Gärtner, 2011).

As a result, we recommend that IS research endeavors to extend the mindfulness concept by combining it with existing theories from the IS discipline as well as from other related disciplines.

Generally, we observed three issues during our efforts to code the papers identified in our literature search into one of the three categories of the "purpose of application" ("how") dimension. More precisely, reading a paper did not always result immediately in an unambiguous coding. This is basically attributable to the reluctance of authors to provide guidance on the purpose of the application of mindfulness in their studies. However, in order to entirely comprehend the findings of a study, it is essential for the reader to capture the aim of a paper including the underlying concepts and the assumptions made by the authors. Moreover, through envisioning and formulating the underlying concepts, the authors gain additional confidence in the context and interrelations of their study. This also helps readers and authors alike to embed the study into extant research, to position it within the IS community, and associate it with related topics.

Another issue we perceived was that, with few exceptions, researchers considered mindfulness as a preexisting phenomenon. Technically, this is not incorrect, since "[…] the processes of mind […] are presumed to be inherent in all organizations. What may vary across organizations is the felt need to develop these processes to more advanced levels" (Weick & Roberts, 1993, p. 358). However, without providing the rationale for presuming why mindfulness is inherent or without measuring the level of existing mindfulness, researchers leave it to the readers to make their own assumptions or miss the opportunity to compare research results. Exemplarily, researchers could apply measures to evaluate the level of existing mindfulness as has been shown by Nagle *et al* (2011), who first quantitatively assessed the degree of mindfulness by applying the mindfulness instrument of Mu & Butler (2009) before proceeding with their qualitative analysis. Similarly, authors could ascertain whether they conceive mindfulness as a trait, state, or cognitive style (Sternberg, 2000).

The third general observation we made is related to the application of the five cognitive processes constituting OM (preoccupation with failure, reluctance to simplify interpretations, sensitivity to operations, commitment to resilience, underspecification of structures) within existing research. More specifically, we discovered that approximately half of the papers took these five processes into account only for definitional purposes or not at all. As a result, these studies potentially risk neglecting more nuanced results which could have been achieved by means of the five processes. Moreover, transporting these processes to specific research settings could result in more advanced research. For example, Valorinta (2009) mirrored the processes adapted

to IT-intense organizations, Beck *et al* (2011) mapped them against global ISD management practices, and Carlo *et al* (2012) renamed the processes to reflect the poles comprised by what they defined as collective minding. Other authors in turn, add new processes like situated curiosity (Lee *et al*, 2012), sense-making (Van Den Eede *et al*, 2006), or shared understanding (Nagle *et al*, 2011). Finally, extant research has called for efforts in developing new measures (Fichman, 2004; Swanson & Ramiller, 2004; Khan *et al*, 2013) or advancing existing measures for a more differentiated view regarding the distinct hierarchical levels (Dernbecher *et al*, 2014).

Thus, regarding the "purpose of application" we recommend that IS research (a) provides a transparent justification for why mindfulness was chosen for a study, (b) clearly states how it is used in the course of the study (i.e., as duality between mindfulness of IT or unidirectionally as a prerequisite, accelerator, or implication), (c) exemplifies the rationale for presuming mindfulness to be inherent and for determining the degree of mindfulness (e.g., high, medium, low), (d) heedfully integrates the five cognitive mindfulness processes in the course of its studies unless a rationale for not doing so can be provided.

In the course of analysis of the "level of mindfulness" dimension, we found seven papers which could not be assigned unambiguously to one of the three levels of organizational, group, or individual since they concurrently concentrated on individual and collective mindfulness (Fichman, 2004; Butler & Gray, 2006; Weick & Sutcliffe, 2006; Matook & Kautz, 2008; Merminod *et al*, 2008) or individual and organizational mindfulness (Salvato, 2009; Valorinta, 2009). While this ambiguity is understandable for comprehensive papers (e.g., Weick & Roberts, 1993; Fichman, 2004; Butler & Gray, 2006), generally, it bears the risk of confusing the reader or losing the traceability of results. However, these papers could provide a starting point for elaborating on a transition between the levels and contributing to the guiding principle that mindfulness on a higher level is not reducible to nor constituted by mindfulness at a lower, individual level (Weick & Roberts, 1993). For this purpose, a multilevel approach should be chosen. With such a multilevel approach, the initial and most important step is for researchers to state and describe the constructs and the levels of analysis constituting the multilevel theory (Kozlowski & Klein, 2000). Another important issue involves choosing to measure the constructs of the multilevel theory (i.e., the level of observation). That is, individual constructs of the theory can be assessed with data collected from an individual; constructs representing a unit, such as a group (e.g., team, department) or an organization, should be measured with data appropriate for that unit (see Kozlowski & Klein (2000) for details). So far, existing research has observed the data for multiple levels (see also Table 4) across all levels within an organization (Merminod *et*

al, 2008; Salvato, 2009), among project managers in different roles (Matook & Kautz, 2008), and among different managers and employees in IS functions (e.g., management positions in the supply-chain organization, top or middle-level managers) (Valorinta, 2009).

Interestingly, while some studies concerned with the group level of analysis draw on observations made among team members, other papers also use team members to generalize at the organizational level. Thus, while one stream of research aligns level of analysis and level of observation, the other mixes both by drawing from the group level of observation to the organizational level of analysis. Again, mindfulness in a collective context, such as an organization or group, emerges not only from individually mindful employees (Butler & Gray, 2006). Hence, we challenge whether it is sufficient to generalize from a subset of employees (e.g., project team) to the organizational level of mindfulness. Instead, in order to gain a comprehensive view on mindfulness as an organizational phenomenon, it might be necessary to complement the team member approach with insights contributed by C-level managers, who are most likely competent enough to reflect on mindfulness throughout the organization (Kozlowski & Klein, 2000).

Consequently, concerning the "level of mindfulness" we recommend that IS research (a) provides justifiable reasons why which level of mindfulness is applied for achieving which purpose of research and (b) clearly states the level of analysis addressed as well as (c) the level of observation and if appropriate the rationale for generalizing from the level of observation to the level of analysis.

Our analysis of the "mindfulness–mindlessness antonym" dimension revealed that less than one quarter of the papers conducted their research in the light of both concepts. In so doing, they were able to gain knowledge to an extent that would not have been possible by looking only at one side of the concept, e.g., that IT can simultaneously support acting mindfully and acting mindlessly (Carlo *et al*, 2012). Nevertheless, applying both concepts is not feasible for all research contexts. Exemplarily, on an individual level, where either mindfulness or mindlessness can be adopted, it can be sufficient to analyze one side only.

For this reason, concerning the "mindfulness–mindlessness antonym" we recommend that IS research (a) consciously evaluates the applicability of one or both sides of the antonym to the respective research context, (b) in case both sides are addressed, clearly defines its interpretation either as orthogonal or as a continuum and discloses the underlying assumptions.

Limitations of the study and future research directions

Beyond these aspects, we acknowledge a number of limitations of our study in which we see a potential for further research in this field. First, the search terms used in the process of collecting the research articles for this literature review were restricted to the terms mindfulness, mindful, mindlessness, mindless. However, there might be concepts which are closely related to the mindfulness concept that are worth analyzing to create a more complete image of these phenomena in IS research. Thus, to build on our study, synonyms or related concepts, such as sensemaking, vigilance, alertness, wariness, diligence, watchfulness, heedfulness, or conscientiousness, might be addressed in future research. Second, the view of our study is restricted by a general observation and ignores variations which could emerge due to differences across industries or countries in which the studies were conducted. Hence, an extension of our study could compare insights generated on mindfulness between different industries and between not only the cultures associated with the countries of analysis, but also those associated with the countries of origin of the researchers. Third, this study has disregarded an in-depth view on the broad spectrum of IS artifacts underlying the analyzed papers. In the future it might therefore be interesting to see how mindfulness is defined depending on the IS artifact or whether variations are observable over time regarding the changing nature of the IS artifacts. Finally, since the aim of our study was to provide an overview on the use of mindfulness in IS research over the past ten years (and beyond), we did not focus on philosophical assumptions (i.e., positivist vs. interpretive) in detail. Thus, mindfulness in IS research could be also analyzed within the context of underlying assumptions in order to identify further research gaps or inconsistencies.

Conclusion

For this study we were interested in the different ways in which mindfulness was applied in IS research. To gain a more thorough understanding, we used an analysis schema covering four dimensions to code a sample of 64 papers. Every paper was assigned to a category within each of the four dimensions representing the investigated IS theme, the purpose of application, the level to which the concept was applied, and the use of either one or both sides of the mindfulness–mindlessness antonym. After synthesizing research findings from various perspectives, we demonstrated that IS research has generated substantial knowledge across various IS themes and hierarchical levels regarding mindfulness applied as a prerequisite, accelerator, or implication. However, our study also revealed that knowledge regarding mindfulness is very fragmented and

divided by numerous research approaches. We believe this literature review on mindfulness in IS research will further improve research outcomes because it provides a clear schema for categorizing novel studies and relating them to extant research. By applying our categorization, researchers will be able to conduct studies and represent their findings to readers in a more comprehensible way. In order to support this endeavor, we derived a metatheory, defined research questions on mindfulness, and offered methodological recommendations to guide future IS research.

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