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The impact of workplace information literacy on organizational innovation: An empirical study

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ABSTRACT

The present study investigates the relationship between CEO's information literacy and innovation in small and medium-sized enterprises (SMEs). Even if information literacy's business value has been recognized in recent literature, its impact on organizational innovation, a critical and strongly information intensive process, has never been studied before. Structural equation modeling based analysis of data collected from 184 company CEOs in Finland revealed that CEOs' information literacy has a positive impact on the development of exploratory and exploitative innovations in SMEs. Additionally, opportunity recognition mediates the relationship between information literacy and innovation. Overall, the influence of information literacy is slightly stronger on exploitation than exploration. Nevertheless, the mutual positive effect suggests that information literacy enhances innovation ambidexterity in organizations. Based on these findings, we discuss theoretical and practical implications as well as future research opportunities in workplace information literacy research.

1. Introduction

Organizations exist because of innovation. It ensures their long-term survival by contributing to sustained growth and development of competitive advantage. Continuous innovation is propelled by novel strategies and timely decisions derived from environmental scanning and astute analysis of information (Tang, 2016). Although information renders numerous types of benefits for organizations, its ever-increasing volume, complexity and diversity have emerged as some of the greatest challenges to innovation development (Damanpour, 2017; Dean & Webb, 2011). Consequently, individuals' capacity, particularly in upper echelons, to engage with complex information and utilize it to inform market analysis, decision making and strategy implementation has become increasingly important for successful organizational innovation (Deltor, 2010; García-Morales, Jiménez-Barrionuevo, & Gutiérrez-Gutiérrez, 2012; Zhu, Wang, & He, 2016).

Information literacy has been identified in the recent literature as a key capability in helping organizations to effectively leverage information to create business value (Forster, 2017b; Inskip, 2014). Previous research in the educational, and more recently in the workplace context, proposes that information literacy helps in critical information analysis and balanced decision making paving the way for knowledge creation, learning and innovation (Cheuk, 2008; Forster, 2017a; Lloyd, 2010; Zhang, Majid, & Foo, 2010). While theorizing points to a potentially positive relationship between information literacy and innovation (Cheuk, 2017), clear empirical evidence is still lacking. Particularly, how information literacy of organizational leadership contributes to different types of innovation and whether it spurs innovation ambidexterity at the organizational level lacks substantiation.

This study seeks to address this important research gap by examining the impact of CEOs' information literacy on exploratory and exploitative innovation in SMEs. Moreover, it explores how this relationship is established through opportunity recognition that acts as a mediator. By addressing this specific gap, the present study makes a major contribution to information literacy research by exploring the role of information literacy in one of the most crucial activities — innovation — in an economically important part of the industrial sector, that is the SMEs (see e.g. Hope, 2018). SME refers to an organization that has less than 250 employees and an annual turnover below 50 million euros (European Commission, 2003). This study also responds to recent calls to investigate the organization-level impact of information literacy (Cheuk, 2017; Goldstein & Whitworth, 2017) in different organizational contexts (Middleton, Hall, Muir, & Raeside, 2018). Concrete evidence of the value of information literacy for organizations in general, and for innovation in particular, is seriously lacking

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(Goldstein & Whitworth, 2017). In turn, this is a plausible reason why information literacy has not received serious attention among business professionals and management researchers so far (Cheuk, 2017). By providing this lacking evidence, the present study enhances the understanding of the impact of information literacy on organizational innovation and simultaneously contributes to the interdisciplinary approach to information literacy research.

In what follows, we present literature review and hypotheses. Then, we explain our research method and present findings using data obtained from 184 SME CEOs through a survey distributed in Finland. We conclude with discussion of the results, suggestions for future research and practical implications of this study.

2. Literature review

This section presents the research model by tracing back to theory on information literacy and innovation. First part of this section reviews research on information literacy in workplace context. Next, a brief overview of organizational innovation, exploitative and explorative innovations, as well as the role of CEOs in the development of innovation is presented. Subsequent discussion outlines the contingency of innovation on opportunity recognition, which is also influenced by information literacy and acts as a mediator in the relationship between information literacy and innovation. This section ends with the presentation of hypotheses built upon the discussion on the links among information literacy, exploratory innovation, exploitative innovation and opportunity recognition.

2.1. Information literacy in the workplace

Information literacy refers to a combination of knowledge, learning and the ability to operate with information, or the knowledge of when and what kind of work-related information is needed, with abilities such as finding, evaluating and using that information ethically to learn at work (CILIP, 2018; Virkus et al., 2016). It promotes critical thinking and competence in making balanced judgements in performance of work (Hall, Cruickhsank, & Ryan, 2016).

With the aim of addressing the major goal of information literacy instruction, to enhance an individual's capability to perform effectively in the working world, many researchers have recently started to explore in more detail the phenomenon of information literacy in the workplace context (e.g. Gilbert, 2017; Goldstein & Whitworth, 2017; Lloyd, 2007). Seminal work of Bruce (1999) investigates information literacy in the university as a workplace. Building on interviews with researchers, IT professionals and counselors, she presents an outline of the 'faces' of information literacy and underlines information literacy as a key characteristic of a learning organization. In their study of a law firm, Gasteen and O'Sullivan (2000) identify information literacy as a central aspect in the knowledge creation process. It helps employees to identify and seek relevant legal information and make sense of it. Lloyd's investigation of information literacy experiences of firefighters and ambulance workers sees it similarly, i.e. as a key factor in knowledge work when new recruits learn their duties, navigate through a complex information landscape and develop social connections at work (Lloyd, 2007, 2009). Adopting a relational and evaluative approach, Sommerville and Bruce (2017) conceptualize information literacy as a driver of informed learning i.e. learning to use information to learn at a workplace. The approach perceives information literacy as a key component, which enables collaborative information use in an informed (socio-technical) system. Further, Sayyad-Abdi, Patridge, and Bruce (2016) studied the work of web professionals and identified their information literacy experiences — staying informed, building a successful website, solving a problem or participating in a community of practice. In another study, Cleverley, Burnett, and Muir (2017) note that many organizations tend to have a poor understanding of their employees' level of information literacy and, consequently, both organizations and employees 'may not "know" that they "don't know"' (Cleverley et al., 2017, p. 93) – which can be problematic especially in situations when gathering new information is crucial. Finally, however, as Toledano and Farrill (2010) suggests, the current approaches to how information literacy is conceptualized in the organizational context may not necessarily cover all relevant aspects of information behaviour. Earlier studies have emphasized information seeking and the degree of sharing, whereas other interactions have received less attention both in organizational and general information literacy research (e.g. Huvila, 2011).

As a whole, previous research has significantly enhanced the understanding of workplace information literacy. Nevertheless, we find many studies exploring the emergence and experiences of information literacy in the workplace, whereas its impact, although mentioned (e.g. Lawal, Stilwell, Kuhn, & Underwood, 2013), remains a matter of secondary concern. The study by Goldstein and Whitworth (2017) is a partial exception in this regard. They propose a tool to understand the information literacy value for organizations in terms of work efficiency, profitability, customer service, staff motivation and legal compliance. However, their aim is to provide a generic map for identifying potential areas of inquiry, which may accrue benefits due to employees' information literacy, rather than to present a focused empirical analysis of the effects of information literacy.

2.2. Organizational innovation

Innovation is defined as an "idea, practice, or material artifact perceived to be new by the relevant unit of adoption" (Limaj & Bernroider, 2019; p.1). Innovation, though much desired, is difficult to achieve. According to Jansen, Van Den Bosch, and Volberda (2006), innovation can be categorized in terms of proximity and cognitive distance to current work practices, products, customers and markets. The greater the distance from the status quo, the more radical the innovation is. Following this rationale, organizational management literature categorizes innovation into two major categories known as explorative and exploitative innovation (Gupta, Shalley, & Smith, 2006; Lavie, Stettner, & Tushman, 2010; Osiyevskyy & Dewald, 2015).

Exploratory innovation refers to radical innovations that clearly depart from existing practices, systems and markets (Morgan & Berthon, 2008). Such innovations often reflect major changes in the organizational environment and fulfill the emerging needs of customers (Jansen et al., 2006). Common examples of exploratory innovations are new supply chain channels, new lines of products and entrance into new markets and industries. Exploitative innovation, on the other hand, is incremental and value additive by nature (Lee, Park, & Kang, 2018). It aims to bring efficiency into existing practices and improvements in products, and hence does not reflect major deviation from the established business of an organization and current state of affairs (Mueller, Rosenbusch, & Bausch, 2013). Exploitative innovation enriches current organizational knowledge and "reinforces existing skills, processes, and structures" (Jansen et al., 2006, p.1662).

The concurrent development of both types of innovations in organizations is known as ambidexterity (Lavie et al., 2010, Helfat & Peteraf, 2009). Initially, March (1991) conceptualized a trade-off between exploration and exploitation and hence specialization in either exploration or exploitation was encouraged. Nevertheless, later research showed that an imbalance of exploratory and exploitative innovation creates an opportunity cost that reduces organizational success potential in the long run (e.g. Miller, Zhao, & Calantone, 2006; Limaj & Bernroider, 2019). Moreover, organizations, which focus mainly on exploration, face the danger of pursuing the unknown – high uncertainty, long waiting periods and failures (Gupta et al., 2006; Sørensen & Stuart, 2000). Similarly, organizations that invest efforts in exploration only end up instigating inertia and a culture of "adaptation to things already known" (Lavie et al., 2010, p.116;. As a whole, a balance is required to ensure competitive advantage, which comes with

continuous adoption of newly created knowledge associated with exploration, and stability, emanating from the continuous refinement of current knowledge and achieved through exploitation (Cao, Gedajlovic, & Zhang, 2009; Gupta et al., 2006; Reilly & Tushman, 2013). Nevertheless, striking such a strategic balance in innovations requires a holistic understanding of the internal and industrial dynamics of an organization, and refinement of innovation policies and mechanisms, putting the organizational leadership at the core of innovation development.

According to the Upper Echelons theory, based on the notion of bounded rationality (Gerstner, König, Enders, & Hambrick, 2013), "organizational outcomes – both strategies and effectiveness – are… reflections of the values and cognitive bases of powerful actors, that is top executives in the organization" (Hambrick & Mason, 1984;). Therefore, the CEO, as the top executive and leader, has the strongest influence on organizational innovation directly through positive decisions and behaviour, and indirectly through utilization of personal networks and attention to specific strategies and practices (Jung, Wu, & Chow, 2008; Musteen, Datta, & Butts, 2014). The CEO's role in innovation is even more significant in SMEs (Cao et al., 2009). Due to small-scale operations, constrained financial resources and limited work force, SMEs often lack slack resources and administrative mechanisms needed to create and maintain autonomous innovation mechanisms (Cao et al., 2009). Consequently, the CEOs act as lynchpins in their organizations, as individuals who influence all decisions pertaining to organizational innovation at all levels (Karami, Analoui, & Korak Kakabadse, 2006; Lubatkin, Simsek, Ling, & Veiga, 2006). Previous research has empirically identified a number of factors, including the CEO's personality (Gerstner et al., 2013; Marcati, Guido, & Peluso, 2008), social network (Musteen et al., 2014), leadership style (Jung et al., 2008), risk taking and confidence level (Wong, Lee, & Chang, 2017) as determinants of successful innovation in SMEs.

2.2.1. Opportunity recognition

An innovation is a realized opportunity (Grégoire, Barr, & Shepherd, 2010; Park, 2005). Based on a study of 30 organizations, Desouza et al. (2009) present an innovation process that traces back to opportunity recognition as the first step. Opportunity recognition is "characterized by being alert to potential business opportunities, actively searching for them, and gathering information about new ideas on products or services" (Kuckertz, Kollmann, Krell, & Stöckmann, 2017, p.92). One of the most critical aspects of a CEO's job is to keep an eye on industry dynamics and recognize emerging business opportunities or, at the very least, to pay attention to such opportunities brought up by organizational employees. As accidental innovations are rare, development of innovative products, services and practices requires calculated efforts, attention and investments (Ozgen & Baron, 2007).

SMEs constantly need to recognize new growth opportunities and potential markets to expand and ensure long-term survival, particularly in competition with large organizations (Guo, Tang, Su, & Katz, 2017; Rehm, Goel, & Junglas, 2016). Opportunities arise continuously in dynamic and changing business environments. Environmental changes create disequilibrium and variance that can be exploited for the advantage of the SME through timely reaction, such as strategic reorientation and development of products (George, Parida, Lahti, & Wincent, 2016). According to Casson (2005), opportunities can be of any nature, ranging from political to regulatory, social and technical. As opportunity recognition is the first step toward innovation (Hansen, Lumpkin, & Hills, 2011), it is not surprising that CEOs' opportunity recognition capabilities are known to influence SME innovation and development of competitive advantage (Park, 2005). Overall, multiple studies have established the significance of CEOs' personal characteristics and behaviors in opportunity recognition and achievement of innovation (George et al., 2016).

3. Hypotheses

3.1. Information literacy and exploratory innovation

Exploratory innovations are commonly associated with experimentation, uncertain conditions, and audacious actions and practices (Flynn & Chatman, 2001; Limaj & Bernroider, 2019). As the greater reward often involves greater risk, CEOs have to develop untraditional and exceptional strategies to gain an upper hand in the competitive market. Nevertheless, development and execution of radical and risky strategies and practices require a good understanding of market information as well as strong confidence in one's own competence (Mueller et al., 2013; Wong et al., 2017). Musteen et al. (2014) show that SMEs' exploratory innovations in terms of new business ventures in overseas markets are strongly influenced by the market awareness of their CEOs, that is a result of their exposure to diverse information. Similarly, Faleye, Kovacs, and Venkateswaran (2014, p.1201) show that the CEO's competence in accessing relevant information in industry networks supports the development of highly innovative patents "by helping to evaluate and exploit innovative ideas" and by making the right resource allocation decisions. Given the importance of CEOs' information processing capability and market awareness identified in previous organizational innovation research, and in the existence of evidence that information literacy helps in environmental scanning and effective information analysis (Gilbert, 2017; Goldstein & Whitworth, 2017), it seems evident that CEOs' information literacy should have an impact on the organization's exploratory innovation.

We can also presume a positive relationship between information literacy and exploratory innovation from a self-efficacy perspective. Wong et al. (2017) note that CEOs' confidence and self-efficacy influence the development of exploratory innovations. Self-confidence enhances their potential to undertake exceptional decisions, such as adoption of untested technologies or the development of products for new markets. Information literacy, which has been linked to self-efficacy, i.e. the more information literate, the higher the self-efficacy and confidence in task accomplishments and goal achievement (De Meulemeester, Buysse, & Peleman, 2018; Kurbanoglu, Akkoyunlu, & Umay, 2006), can improve CEOs' confidence by allowing them to make sense of complex information situations (Gerstner et al., 2013). Consequently, they are likely to make bold decisions based on their evaluation of incoming information streams in ambiguous and uncertain market conditions, which, as suggested by previous research, is greatly needed for achieving exploratory innovations. Overall, based on the reviewed research and above arguments, we suggest a positive relationship between information literacy and exploratory innovations in organizations.

H1. CEOs' information literacy positively influences exploratory innovations in SMEs.

3.2. Information literacy and exploitative innovation

As exploitative innovations involve refinement of institutionalized knowledge, CEOs' understanding of the organizational internal knowledge system, common practices and their strengths and weaknesses is critical to their success (Jung et al., 2008). Without CEOs' "heightened organizational awareness", the process of incremental innovation by tuning current practices using options the firm has already mastered, will never excel (Tripsas & Gavetti, 2000, Yadav, Prabhu & Chandy, 2007, p.87). Nevertheless, the development of such an awareness is dependent not only on the use of formal information objects, such as written and verbal reports, manuals and company documents, but also on informal information, for instance, opinions, ideas and considerations available within the organization's internal social network. For example, an informal discussion within an organization's internal social network on the potential difficulties in product error detection can

direct the CEO's attention to the improvement of quality control procedures. Cao et al. (2010), show that SME CEOs with capabilities to procure information from organizations formal and informal sources, develop a better understanding of the distribution and utilization of available resources as well as the potential areas of improvement. This underlines the importance of CEOs information acquisition, evaluation and synthesis capabilities to constructively contribute to and support exploitative innovations. As such, most of the exploitative innovations take place at the lower level of hierarchy (Mueller et al., 2013) and the role of the CEO in such innovations is basically that of a facilitator and mentor. Nevertheless, such a role can be assumed only when the CEOs themselves have a realistic understanding of the internal realities and external industry dynamics pertaining to their organizations. As Yadav et al. (2007, p. 85) note, CEOs can "provide the direction only when they can themselves grasp the information in the right way". As a conclusion, we propose that CEOs' information literacy, which encompasses wide-ranging individual and collaboration-based information proficiencies, will allow the development of appropriate improvement mechanisms leading to continuous exploitative innovation in SMEs.

H2. CEOs' information literacy positively influences exploitative innovations in SMEs.

3.3. Information literacy and opportunity recognition

Opportunities arise from changes in technologies, market competition, policies, industries, market trends and experiences of failure and success in the past (George et al., 2016). Therefore, the recognition of opportunities is a highly information intensive process (Gaglio & Katz, 2001; Ozgen & Baron, 2007). Sarasvarthy et al. (1998) and Busenitz (1996) note that CEOs discover opportunities differently depending on their varying capabilities to obtain relevant information. Furthermore, the nature of handling information by executives at SMEs is different from their colleagues in large organizations (Hulbert, Gilmore, & Carson, 2015). Since SME CEOs are not supported by dedicated functions responsible for conducting internal and external environmental scanning (Cao et al., 2009), they often end up exposing themselves to an overflow of unfiltered or raw information (Kaish & Gilad, 1991). However, the CEOs not only have to deal with a surplus of information, but also with contradictory signals emanating from unprocessed information when attempting to identify potential innovation opportunities (Hulbert et al., 2015). Dean and Webb (2011) suggest that CEOs' high level of competence in handling information is critical in interpreting and assessing information and its implications and dealing with information overload, i.e. typical components of the opportunity recognition process. In this light, it is posited that an SME CEO's information literacy is crucial in the process of recognizing opportunities, as it is known to help to draw insights from large amounts of information in a timely as well as constructive manner. Therefore, we suggest a direct positive relationship between information literacy and opportunity recognition.

H3. CEOs' information literacy positively influences opportunity recognition in SMEs.

At the same time, however, opportunity recognition capability is needed to identify what information has potential. However, even if the discovery of new opportunities can partly depend on asymmetries of information, the genuinely new innovations are not related to what is known by someone but not by the others (Sarasvathy, Simon, & Lave, 2003). They are opportunities overlooked by everyone. Correspondingly, there is suggestion that opportunity recognition is not necessarily linked to previously acquired knowledge (Ardichvili & Cardozo, 2000), and in the same vein, it has been found that instead of being opposite to each other, executives' systematic and informed (i.e. information literate) acquisition of information and alertness to opportunities are complementary to each other (Foss, Lyngsie, & Zahra, 2013; Tang & Khan, 2016; Murphy, 2011). The earlier research has established the role of opportunity recognition as a precursor of exploration (Hansen et al., 2011). Similarly, the trajectory of radically new innovations (Gina & Rice, 2001) from discovery (i.e. opportunity recognition) to incubation (i.e. exploration of the opportunity) and acceleration (O'Connor & DeMartino, 2006) suggest of a similar course of influence from opportunity recognition to exploratory innovation. Based on the pairwise relationship of opportunity recognition with information literacy and exploratory innovation, we suggest the following hypothesis.

H3a. Opportunity recognition mediates the relationship between CEOs' information literacy and exploratory innovations in SMEs.

Opportunities tend to have a temporal aspect and emerge at a given point in time because of "a confluence of conditions which did not exist previously but is now present" (Baron, 2004, p.2). If not actualized, the door of opportunity will close and deprive the organization from developing a potential innovation. This is especially crucial in incremental exploitation of the available resources, including technologies and information available within the organization (Hansen et al., 2011; Park, 2005). This element of urgency in opportunity-innovation relationship plays an important role in the accelerating development of incremental innovations. Incremental innovations require less financial investment and involve low risk (Jansen et al., 2006; Shin & Lee, 2013). Consequently, CEOs tend to act upon incremental innovation related opportunities more swiftly. Moreover, detailed planning regarding small innovations takes place at lower levels of management (Mueller et al., 2013) which means once recognized CEOs find it easy to approve opportunities leading to incremental innovations. Therefore, previous research suggests a positive relationship between opportunity recognition and exploitative innovation (Choi, Lévesque, & Shepherd, 2008). Based on the relationship of opportunity recognition with information literacy and exploitative innovation, we suggest that opportunity recognition will mediate the impact of information literary on exploitative innovations.

H3b. Opportunity recognition mediates the relationship between CEOs' information literacy and exploitative innovations in SMEs.

4. Methodology

The data for this research was collected by surveying CEOs of knowledge intensive SME's in Finland. The target population was identified through a widely known commercial database Orbis. It contains comprehensive information on Finnish organizations in terms of their size, industry, revenue and company's contact details. We sampled the contact details of 4000 CEOs from a wide range of industries. After removing duplicates, the sample was reduced to 2800 potential respondents. Furthermore, around 30 percent of the e-mails containing survey invitations were bounced back which indicated no-reply email addresses. Consequently, final sample of this study was limited to 1960 potential respondents.

The data was collected with an electronic questionnaire. An invitation letter containing the link to the survey was distributed via e-mail during May–September 2018. Over this period, two reminders were sent to potential respondents. Overall, 184 complete responses were received. It represents a net return ratio of 9 percent. CEOs are difficult to access for research (Baruch & Holtom, 2008). Due to extensive company responsibilities and intense demands on time, the response rate of upper echelons in organizations usually tend to be low. Nevertheless, a sample as large as ours is considered feasible for reliable statistical analysis. Moreover, as Cook, Heath, and Thompson (2000) suggest, the response rate is less critical if reasonable representativeness has been achieved. The sample demographics presented in Table 1 indicates a diverse cross-section of population that can be considered as reasonably representative when compared to available Finnish

Table 1
Demographic profile of respondents.

Items	%	Items	%
Age		*Industry*	
18–29	0.5	Advertising & Marketing	4.4
30–39	6.6	Construction, Machinery, and Homes	6.7
40–49	26.2	Education	3.9
50–59	41.5	Entertainment & Leisure	3.3
60 & above	25.1	Finance & Financial Services	10.6
Education		Government	1.7
No education	0.5	Healthcare & Pharmaceuticals	3.3
Primary education (elementary)	2.2	Manufacturing	5.6
Secondary education (high school)	14.3	Nonprofit	1.1
Tertiary education (college or university)	83	Telecommunications, Technology, Internet & Electronics	15.6
Gender		Real Estate	7.2
Male	80	Retail & Consumer Durables	3.9
Female	20	Transportation & Delivery	3.3
		Utilities, Energy, and Extraction	3.3
		Other	26.1

company data.

In cross-sectional surveys, common method variance can influence the results of electronic surveys (Klarner, Sarstedt, Hoeck, & Ringle, 2013). Therefore, Harman's single factor test was used to examine the common method bias (Podsakoff & Organ, 1986). The first factor, extracted using principal axis factoring, without rotation, accounted for 20 percent of the overall variance. The small size of the accounted variance shows that common method variance is not likely to influence survey results (Klarner et al., 2013; Podsakoff & Organ, 1986).

The wave analysis (Van der Stede, Young, & Chen, 2006) was conducted to assess whether respondents are likely to be different from non-respondents (non-response bias) (Limaj & Bernroider, 2019). The early and late response split technique, which treats late respondents as proxy of non-respondents, was used to divide the dataset into two groups (Limaj & Bernroider, 2019; Wallace & Sheetz, 2014). No significant differences were found between two groups in terms of age ($\chi 2$, $p = 0.23$), gender ($\chi 2$, $p = 0.87$), education ($\chi 2$, $p = 0.63$), industry ($\chi 2$, $p = 0.45$) and company size ($\chi 2$, $p = 0.50$). The results suggest that non-response bias is not likely be a concern in this study.

In our dataset, the number of missing values did not exceed the critical level of five percent of the total values (Hair, Hult, Ringle, & Sarstedt, 2016). The mean imputation method was deployed as this technique has been found to be appropriate to handle a low number of missing values in a dataset (Hair et al., 2016).

4.1. Measurement instrument

All constructs in this study were measured using multiple items on a five-point Likert scale. The existing validated scales were used to measure opportunity recognition (Kuckertz et al., 2017) and innovation (Jansen et al., 2006; Jansen, Vera, & Crossan, 2009).

4.1.1. Information literacy scale development

An appropriate scale for measuring information literacy at workplace was not available. Following the systematic approach, a new workplace information literacy scale was developed which consisted of four main steps including selecting and creating scale items, establishing content validity, conducting a pilot study and testing the scale with confirmatory study. This stepwise scale development approach has been adopted in many previous studies (Dwivedi, Choudrie, & Brinkman, 2006; Miron-Spektor, Ingram, Keller, Smith, & Lewis, 2018; Moore & Benbasat, 1991).

First, we reviewed information literacy literature to identify different aspects of information literacy as well as previous scales used to measure information literacy. There are many information literacy scales developed specifically for the educational context (Radcliff, Salem, O'Connor, & Gedeon, 2007; Serap Kurbanoglu, Akkoyunlu, & Umay, 2006). Though not directly applicable to workplace context, these scales provide a huge inventory of items that with some modifications can be used to capture fundamental information literacy aspects of information literacy. Therefore, wherever possible, we selected and modified the survey items from the previous scales to measure information acquisition, evaluation and use which are known as three core dimensions of information literacy (Bruce, 1999; Cheuk, 2008; De Meulemeester et al., 2018; Gilbert, 2017).

As information environment of workplace is more complex and dynamic than educational context, recent qualitative work suggests that workplace information literacy is a broad phenomenon, which in addition to core information activities, also encompass a good understanding of workplace information environment (Hicks, 2017), ethical and moral concerns (Forster, 2017c) as well as tendency to learn and develop from information (Sommerville & Bruce, 2017). Based on recent theoretical and qualitative work, we identified three more constructs — learning from information experience, awareness of information environment and information ethics, — and created new items for their measurement. Final information literacy scale comprised of six dimensions: information acquisition, information evaluation, information use, awareness of information environment, learning from information experience and information ethics. Overall, the new multidimensional construct of information literacy reflects the recent theorising of workplace information literacy as a holistic endeavour, which covers a broader spectrum of activities than mere information acquisition (Huvila, 2011; Toledano & Farrill, 2010), and as whole, can be characterised as an intertwined practice rather a simple set of unrelated and basic information literacy skills (Lloyd, 2007).

The next step in the scale development process was to assess the content validity of the new information literacy scale. The items selected for information literacy scale were assessed by two experts with extensive knowledge of information literacy research as well as scale development. In total 20 items with highest approval from the panel experts were selected for the final information literacy scale. Deductive content development approach adopted in this study also ensures the content validity of the scale (Miron-Spektor et al., 2018).

Thirdly, we piloted our information literacy scale with a small group of 12 information professionals and academics to eradicate discrepancies in survey language and format as well as to ensure that information literacy scale is of appropriate complexity.

Finally, we conducted a confirmatory study to validate our scale. We tested the impact of information literacy on coping with organizational small-scale changes. Information literacy reduces uncertainty and distress associated with continuous environmental changes by helping to secure access and appropriately interpret information emanating from formal and informal sources (Forster, 2017a). Our sample consisted of 30 alumni of the home university of one of the authors. Partial Least Square Structural Equation Modelling (PLS-SEM) based analysis confirmed that the new scale meets all the requirements of scale reliability and validity (convergent and discriminant). These requirements are discussed in greater detail in the Section 4.2.1. Moreover, as expected information literacy was found to have positive impact on coping with organizational changes ($\beta = 0.52$, $p < 0.01$). Our confirmatory study sample was small, nevertheless, high values of reliability and validity noted in the main study further confirm that information literacy scale is reliable, valid and performs consistently well.

Information literacy is operationalized as a second order hierarchal construct due to its multidimensional nature. Hierarchal modeling reduces "the level of collinearity among indicators" (Limaj & Bernroider, 2019, p.6) and enhances theoretical parsimony (Hair et al., 2016). Moreover, it reduces model complexity and allows for exploration of complex models encompassing multilevel analysis (Huvila & Ahmad, 2018). In line with the suggestion of Lohmöller (2013) and Becker,

Klein, and Wetzels (2012)), repeated indicator approach is used to measure information literacy, which means indicators that measure six dimensions of information literacy, together, form the construct of information literacy. This approach has been found useful in hierarchical modeling as it provides better estimates and reliable higher order constructs (Becker et al., 2012).

4.1.2. Control variables

We introduced the CEOs' industry experience and company tenure as control variables. With the increase in the number of years spent in the industry and organization, the CEOs' task knowledge and experience increase. Consequently, a lengthy tenure and continued industry exposure help to devise strategic decisions and improve organizational innovation potential (Rodenbach & Brettel, 2012). Barker and Mueller (2002) have noted that CEOs' experience magnifies the effects of their personal characteristics on innovation and hence require to be controlled. Therefore, CEO industry experience and company tenure are introduced as controlled variables in this study.

4.2. Findings

We used partial least square structural equation modeling (PLS-SEM) to test our hypotheses (Hair et al., 2016). PLS-SEM is a multivariate technique, which is largely used to test exploratory relationships. It provides more statistical power compared to its co-variance-based counterparts, particularly for testing models with medium to high complexity (Hair et al., 2016). The guidelines given by Wetzels (2009) and Hair et al. (2016) for evaluating and reporting results were followed. SmartPLS 3.0 was used to compute the path model (Ringle, Wende, & Becker, 2015). The path weighting scheme was used for parameter estimation. Assessment of the measurement model was conducted before the evaluation of structural model.

4.2.1. Measurement model

Testing the measurement model includes assessment of the construct reliability and validity. We tested for the internal consistency reliability, indicator reliability, discriminant validity and convergent validity. The internal consistency reliability was assessed using composite reliability.

As shown in Table 2, the composite reliability values of all the constructs are above the threshold value of 0.70. Furthermore, we found sufficient proof of indicator reliability, which represents "variation in an item explained by the construct", as the indicators' loadings of all constructs in this study are above the recommended value of 0.60 (Hair, Ringle, & Sarstedt, 2011 p. 115). Convergent validity, i.e. the degree to which indicators of the same construct are correlated, was examined using average variance extracted (AVE), which shows all of our constructs have an acceptable AVE value of 0.50 or higher.

Discriminant validity was tested using the Fornell and Larcker criterion and the cross-loading evaluation. A shown in Table 3, the square root of AVE of each construct is higher than its correlation with other constructs, which fulfils the Fornell and Larcker criterion (Wong, 2013). Moreover, the cross-loading evaluation confirms that all indicators load on their respective constructs higher than their cross-loadings on other constructs. It further adds to the discriminant validity of the measured constructs. Overall, the results summarized in Tables 2 and 3 provide sufficient evidence of reliability and validity of the measurement scales used in this study.

This study operationalizes information literacy as a second-order reflective construct, which consists of six first-order reflective constructs. The "degree of explained variance of a hierarchical construct is reflected in its components" (Akter, Ambra, & Ray, 2011 p.110), which, in this case, is information acquisition (38 %), information evaluation (40 %), information environment awareness (50 %), information use (57 %), learning from information experiences (63 %) and information ethics (27 %; see Table 4). The AVE and composite reliability values of information literacy are 0.63 and 0.83, respectively, which are above the threshold values.

Table 2
Measurement statistics of first-order constructs.

	Mean	Standard deviation	Indicator loading	Composite reliability	AVE
Exploratory innovation	3.50	0.80		0.84	0.63
Item 1	3.88	1.00	0.79		
Item 2	3.40	0.96	0.81		
Item 3	3.42	1.0	0.89		
Item 4	3.50	0.88	0.84		
Exploitative innovation	3.70	0.60		0.90	0.70
Item 1	3.56	0.88	0.85		
Item 2	3.85	0.81	0.80		
Item 3	3.86	0.80	0.73		
Awareness of information environment	4.10	0.60		0.89	0.67
Item 1	4.13	0.80	0.84		
Item 2	4.04	0.81	0.90		
Item 3	4.22	0.71	0.77		
Item 4	4.18	0.66	0.76		
Information ethics	3.91	0.60		0.80	0.57
Item 1	3.71	0.84	0.73		
Item 2	3.95	0.82	0.81		
Item 3	4.08	0.70	0.72		
Information acquisition	3.90	0.50		0.89	0.80
Item 1	4.04	0.67	0.88		
Item 2	3.94	0.68	0.91		
Item 3	3.54	0.82	0.60		
Information evaluation	3.60	0.60		0.83	0.62
Item 1	3.62	0.73	0.72		
Item 2	3.67	0.77	0.82		
Item 3	3.76	0.74	0.82		
Information use	3.90	0.50		0.82	0.60
Item 1	4.07	0.67	0.74		
Item 2	3.70	0.67	0.75		
Item 3	3.87	0.74	0.83		
Learning from information experience	3.80	0.40		0.78	0.50
Item 1	3.80	0.70	0.60		
Item 2	3.85	0.72	0.72		
Item 3	3.93	0.68	0.71		
Item 4	3.84	0.78	0.70		
Opportunity recognition	3.60	0.60		0.88	0.59
Item 1	3.92	0.81	0.77		
Item 2	3.61	0.89	0.87		
Item 3	3.34	0.98	0.81		
Item 4	3.62	0.76	0.77		

4.2.2. Structural model

Once the construct reliability and validity were established, we tested for Hypotheses 1–5. First, we analysed the direct effect of information literacy on exploratory innovation, exploitative innovation and opportunity recognition. Then we conducted a mediation analysis to assess the indirect effects of information literacy on innovation via opportunity recognition. To test mediation, we followed both the general guidelines by Baron and Kenney (1986) and PLS specific mediation suggestions by Hair et al. (2016). We employed the PLS algorithm with the path weighting scheme and 5000 maximum iterations.

The results in Fig. 1 show information literacy has a positive effect on exploratory innovation ($\beta = 0.28$, $p < 0.01$), exploitative innovation ($\beta = 0.37$, $p < 0.01$) and opportunity recognition ($\beta = 0.37$, $p < 0.01$). Hypotheses 1, 2 and 3 have been empirically substantiated. The model also proposed that opportunity recognition would act as a mediator between information literacy and innovation. To asses mediation, we checked the significance of indirect effect (a*b) using the bootstrapping procedure (Hair et al., 2016; Nitzl, Roldan, & Cepeda, 2016). The indirect effect is the product of two paths from information

Table 3
Intercorrelations of the latent variables for the first-order constructs.

	1	2	3	4	5	6	7	8	9
Exploratory innovation	**0.80**								
Exploitative innovation	0.61	**0.84**							
Awareness of information environment	0.42	0.27	**0.82**						
Information Ethics	0.26	0.24	0.34	**0.75**					
Information Acquisition	0.18	0.15	0.28	0.22	**0.90**				
Information Evaluation	0.34	0.23	0.29	0.23	0.38	**0.79**			
Information use	0.33	0.46	0.35	0.25	0.32	0.37	**0.77**		
Learning from information experience	0.40	0.42	0.38	0.29	0.33	0.37	0.64	**0.68**	
Opportunity recognition	0.49	0.60	0.23	0.11	0.12	0.17	0.40	0.36	**0.77**

literacy to opportunity recognition (path a) and from opportunity recognition to the target construct, innovation (path b). The indirect effects of information literacy on exploratory (i.e., 0.18, $p < 0.01$) and exploitative innovation (i.e., 0.13, $p < 0.01$) via opportunity recognition are both significant, which confirms hypotheses H3a and H3b. Nevertheless, it is a partial mediation as the direct relationship between information literacy and innovation is still significant. As it is not full mediation, it is recommended to calculate the Variance Accounted For (VAF) values to assess the strength of the mediation. The VAF values range from 0 % to 100 %. Higher values indicate stronger mediation. The VAF levels of partial mediations in the relationship of information literacy and exploratory and exploitative innovations are 52 % and 49 %, respectively. It further confirms the mediation and also shows that around half of the effect of information literacy on innovation is through opportunity recognition.

5. Discussion

Based on the premise that SME CEOs' information handling capabilities are important for organizational innovation, we built and tested a research model suggesting that the information literacy of CEOs enables innovation and ambidexterity by empowering them to handle complex and large volumes of information emanating from the organization's internal and external environment, and that this effect is mediated by opportunity recognition. The model demonstrates the critical influence of information literacy in shaping a company's ambidextrous innovation. Survey data from 184 SME CEOs provided support for all the relationships proposed in the model.

In line with our assumption, it was found that CEOs' information literacy positively influences both exploratory and exploitative innovations in SMEs. The impact of information literacy is stronger on exploitation than exploration. This result is in line with the finding of Enkel, Heil, Hengstler, and Wirth (2017) who observed a stronger impact of individuals' capability to find knowledge on exploitation than exploration. This difference is potentially due to the inherently different nature of the two types of organizational innovations (Gupta et al., 2006). Information handling capabilities are extremely useful in finding and evaluating things that are already known, or at least available for access. It helps to identify opportunities for improvement and hence spurs exploitative innovations. In the case of exploratory innovation, relevant information, which can indicate a radical innovation process, is relatively less and in some cases does not even exist (Lavie et al., 2010). Therefore, exploration, in addition to systematic planning, is also thought to be a matter of creativity, risk taking and some serendipity (Kollmann & Stöckmann, 2014; Lavie et al., 2010). Although information capabilities help to conceive novel ideas and devise implementation processes thereof, the success of highly exploratory innovations is influenced by many external environmental conditions beyond control (Mueller et al., 2013). This explains the stronger effect of information literacy on exploitative than exploratory innovation.

Nevertheless, the small difference in the impact shows that information literacy promotes ambidexterity in SMEs. Information literacy through enhancement of information skills and experiences allows the effective assessment of complex information and, consequently, can help in making timely shifts between alternative modes of innovations. This is in alignment with the views of Cao et al. (2009), and Levinthal and March (1993) who postulate that congruent development of exploitative and explorative innovations is contingent upon management's informed decision-making.

The strong positive impact of CEOs' information literacy on exploratory and exploitative innovation noted further suggest that it compares to, for instance, leadership style (Nusair, Ababneh, & Kyung Bae, 2012; Somech, 2006), vision (Caridi-Zahavi, Carmeli, & Arazy, 2016) and personality (Gerstner et al., 2013) as an antecedent of innovation. Nevertheless, unlike other factors, which have differential effects (e.g. transformational leadership behaviour promotes exploration and transactional supports exploitation, see Jansen et al., 2009), information literacy appears to have a holistic effect; it supports both exploration and exploitation. The finding is in line with observations in information literacy research that emphasizes the similarly holistic nature and impact of information literacy as a practice (cf. e.g. Lloyd, 2007).

As far as our contingency argument is concerned, we found that CEOs' opportunity recognition is influenced by their information literacy capabilities. Moreover, it reinforces the effect of CEOs' information literacy on innovation as a mediator. The finding are logical as novel products or services evolve from the realization of options and alternatives noticed through pattern recognition (Tang, 2010), making sense of change signals (Vaghely & Julien, 2010) and procurement of diverse information through peripheral sources (Tang, 2010). The partial and complementary mediation shown in the results suggest that the relationship between information literacy and innovation is complex and enforced by more than one mediating factor. Nevertheless, as the results show, opportunity recognition accounts for 50 percent of total mediation, which means that our model represents a good level of theoretical sophistication. This partial mediation can also be explained by the fact that, even though perceived novel and promising, some opportunities end up being abandoned or postponed due to their

Table 4
Second-order information literacy construct and its association with first-order components.

Information acquisition	Information evaluation	Information environment awareness	Information use	Learning from information experiences	Information ethics
$R^2 = 0.38$	$R^2 = 0.40$	$R^2 = 0.50$	$R^2 = 0.57$	$R^2 = 0.63$	$R^2 = 0.27$
$\beta = 0.62$	$\beta = 0.63$	$\beta = 0.71$	$\beta = 0.76$	$\beta = 0.79$	$\beta = 0.52$
$p < 0.01$	$p < 0.01$	$p < 0.01$	$p < 0.01$	$p < 0.01$	$p < 0.01$

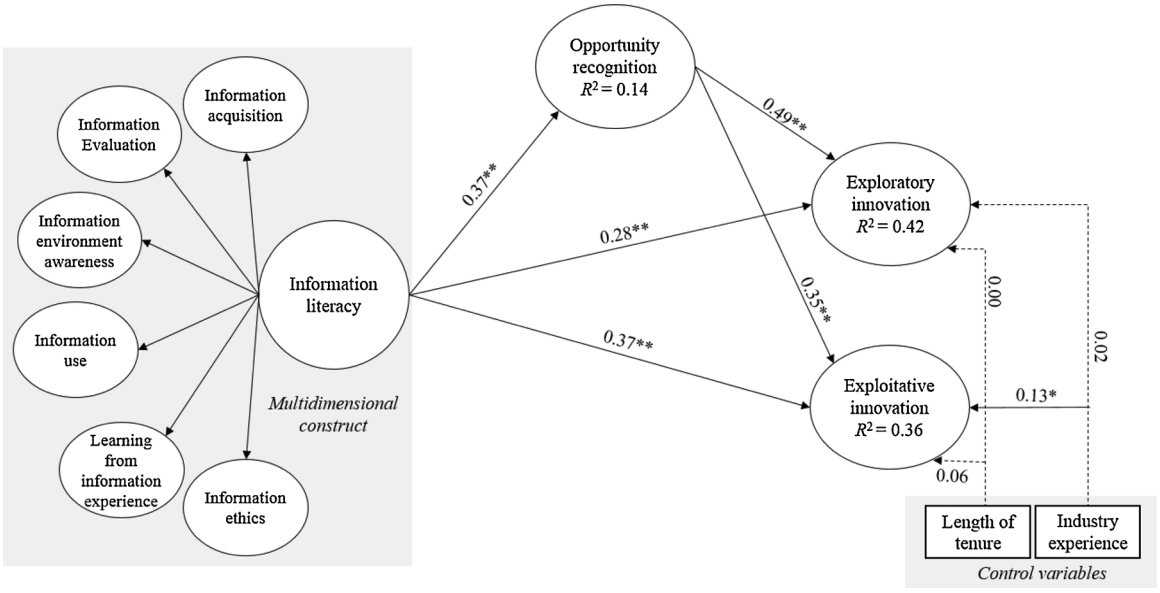

Fig. 1. PLS analysis results. Notes: *p < 0.05 (two-sided test), **p < 0.01 (two-sided test). Dashed line indicates non-significant path relation.

incompatibility with organizational knowledge and skills (Choi et al., 2008; Haynie, Shepherd, & McMullen, 2009). From this perspective, the positive influence of information literacy on both opportunity recognition and innovation implicitly suggests that information literacy not only helps to identify but also analyse, filter and implement the right opportunities in action.

Other than the mediation aspect of opportunity recognition, its direct positive relation with information literacy extends the connection of the findings to entrepreneurship research (Westhead, Ucbasaran, & Wright, 2009). In addition to triggering innovations in already established firms, "opportunities are at the core of market imperfections" and provide the potential to generate economic returns through entrepreneurial activity (George et al., 2016). As information literacy is composed of many information practices and capabilities, its impact on opportunity recognition adds support to previous entrepreneurship models that put information sourcing and evaluation at the core of new business creation (e.g. Murphy, 2011; Westhead et al., 2009).

5.1. Theoretical contributions

Prior studies have mainly focussed on individual-level impact of information literacy. In the educational context, prime focus is on the development of students' critical thinking and performance (Foo, Majid, & Chang, 2017; Stewart & Basic, 2014). Similarly, information literacy in a workplace context is seen in relation to the accomplishment of individual-level tasks (e.g. Cheuk, 2008; Forster, 2017b; Lloyd, 2010). This study analyses the macro-level impact and shows how the effect of information literacy of individuals, particularly those with decision-making power, radiates through the organization generating organizational level implications. By suggesting transitive nature of information literacy impact, this study makes an important contribution to existing workplace information literacy literature and opens up the opportunities for exploring its different types of organizational as well as team level impacts. Overall it enhances our understanding of macro level implications of workplace information literacy, which is seriously lacking in previous research.

Furthermore, the present study directs our attention to the information capabilities of organizational management. The extant literature has focused particularly on employees at lower level of hierarchy and suggests that higher echelons play a vital role in the development of employees' information literacy (Ahmad & Widén, 2018; Somerville, Howard, & Mirijamdotter, 2009; Virkus & Mandre, 2015). This study is the first to investigate the information literacy of upper echelons and its implications. In addition to showing that information literacy is needed at all levels of organizations, the present study postulate that information literacy of upper echelons should not be taken for granted. If the leaders themselves are not information literate, they cannot contribute effectively to the development of organizational innovation. Most importantly, the potential of highly literate individuals working at the lower level cannot be realized fully. It is conceivable that a poorly information literate leader is incapable of fostering an environment supportive of creativity and learning, which in earlier research (e.g. Ahmad & Widén, 2018; Virkus & Mandre, 2015) has been identified as key premises in the development and realization of information literacy in an organization. In other words, benefits of information literacy of employees are tied to the information capabilities of upper echelons. This realization is clearly missing in the previous research on workplace information literacy.

This study also enhances theoretical enrichment of information literacy field by connecting it to business management through interdisciplinary dialogue. Theoretical and empirical containment of information literacy concept to education has limited the intellectual structure of information literacy as a concept. By studying the relationship of information literacy and organization innovation the present study advances much needed cross proliferation of ideas and interdisciplinary dialogue between information literacy and business management.

This study also contributes to organizational innovation research. Although the relationship between leadership and innovation is widely recognized, the underlying mechanisms that explain this relationship have not been properly established (Jansen et al., 2006; Kraft & Bausch, 2016). From this perspective, our study, which focuses on CEOs' information literacy as a critical contributing factor to innovation and ambidexterity, advances our understanding of organizational innovation from the Upper Echelons Theory perspective (Damanpour & Schneider, 2006; Jansen et al., 2006; Mueller et al., 2013).

From a methodological viewpoint, a central contribution of our study relates to the development of a new scale to assess information literacy in a workplace context. Most of the information literacy scales are developed for educational context. This study provides a new and to best of our knowledge first scale on workplace information literacy. The new scale which builds on recent conceptual and qualitative research on workplace information literacy represents a multidimensional nature of workplace information literacy. Future research investigating

workplace information literacy stands to benefit from this scale. Particularly studies that aim to analyse the antecedents and consequences of workplace information literacy can utilize this measure to test the relationship between information literacy and other critical organizational factors that are known to be information and collaboration intensive, such as social capital and absorptive capacity.

5.2. Implications for practice

By highlighting the importance of information literacy in innovation, our study suggests to SME top executives and founders of small businesses that a company aiming to spur its innovation ambidexterity needs to assess and invest on their information handling capabilities. For example, SME executives should critically evaluate their awareness of the organizational information landscape while making major strategic decisions and developing organizational knowledge creation and management strategies. At lower hierarchical level, information literacy should be considered an important part of employees' knowledge and professional skills. SMEs should invest in information literacy programmes to develop such information literacy capabilities that align with organization specific information work and needs. In this regard information professionals can play an important role. A continuous development of new information technologies, recognition of innovative ways of information use and spread of misinformation underline the need to conduct information literacy training programmes at least twice a year.

Our results also suggest that information literacy has transitive effects. This has implications for the selection of middle-level managers in organizations. The teams that perform knowledge intensive and innovation related activities, such as new product development, should be headed by managers with strong information capabilities. Moreover, succession plans should ensure that information literacy is emphasized among other key competences of new recruits particularly those employed on managerial levels.

As continuous innovation is integral to organizational survival, educators should consider ways of enhancing workplace information literacy. This should be acknowledged already in the education of the future workforce. Information literacy training is part of many educational programmes, to support students in their studies, being able to effectively find, evaluate and use information in completing assignments and reports. However, any specific information skills apply differently in workplace context. This study underlines the importance of introducing practice-oriented information literacy programmes which in addition to enhancing academic information literacy skills also support the development of information skills important for students' future working life.

Finally, this study has potential policy-level implications. The information literacy approach helps managers to focus on aspects supporting effective information handling and thus workplace learning and collaborative knowledge creation. Information literacy becomes even more important in today's companies undergoing digital transformation. Technology makes it possible to radically change industries, economies, and organisational processes. Still, we are not taking full advantage of technological innovations although important work is being done. For example, the European Commission is developing policies on digital transformation, focusing big data and digital platforms, digital skills, cities and regions, and ICT standardization. OECD (2017) has made a thorough report on the key issues for digital transformation, focusing technology, infrastructure, standards and legislation, and digital skills, as one of the focus areas in succeeding with digital transformation. From these documents, we can see that digital transformation is about enabling technology and infrastructure and less on the user perspective, although digital skills are acknowledged. An additional limitation is that they focus on ICT skills, which is too narrow a scope while digitalization entails much more than the ability to use technology, e.g. PISA results have not increased in parallel with the use of computers in classrooms which underlines that digital transformation is a far more complex matter than availability of technology. Our results emphasize the importance of acknowledging a broader understanding of information handling skills and suggests making major investments by governments on the development of information literacy. To support businesses to actively include information literacy competency in the required skills set among employees, managers included, and to be able to include courses focusing information literacy and the complexity of information skills in their training programmes, we recommend governments to include guidelines on information literacy for lifelong learning where institutional commitments and action plans support the personnel development. Through an active approach to include information literacy in national policies, it is possible to encourage companies to take the necessary steps to work with the information literacy agenda which is often avoided because of its complexity. We strongly recommend governments and organisations to extend the narrow digital skills approach to include the multifaceted approach to information and knowledge that the information literacy approach entail.

5.3. Limitations and future research directions

This study has limitations that should be taken into account. First, our study was conducted with SMEs, which represent a specific type of organization. As noted earlier, SME CEOs can be expected to be more involved in organizational operations as compared to their counterparts in large organizations. Therefore, generalization of findings to large organizations where lower-level management is likely to play a more central role in innovations, particularly in the development of exploitative innovations, (Mueller et al., 2013) is debatable. We suggest that further research should test the proposed model in large organizations and include hierarchy as a moderator. It would help to shed light on whether and to what extent information literacy at various managerial levels contribute to different types of innovations. Second, as shown in our results, opportunity recognition is a partial and complementary mediator, which explains around 50 percent of indirect relationship between information literacy and innovation. There are probably other mediators, identifying such factors presents an opportunity to further explain the effect of information literacy on innovation and extend the model proposed in this study. Third, even though we followed the suggestions of Bandura (2006) in the development of scale, self-judgment of information literacy, a desired and valuable capability, may have some element of response bias in form of over estimation. Fourth, our study is cross-sectional, which makes it susceptible to recall bias (Theorell & Hasselhorn, 2005). Also, as innovation is an evolving process encompassing different trajectories over time, our collection of data at a specific time period may introduce some bias in responses. Moreover, people are known to remember success stories more than the failures. As a whole, it is apparent that future research should adopt a longitudinal research design to enhance the validity of the findings.

6. Conclusion

This study makes an important contribution to workplace information literacy research by explicitly examining the impact of information literacy in the workplace context. Prior studies on information literacy have developed and refined conceptualizations of workplace information literacy (Forster, 2017b; Lloyd, 2011). This study enriches earlier theoretical work by demonstrating the impact of information literacy on opportunity recognition and organizational innovation. It provides empirical evidence that workplace information literacy has concrete benefits and that it is integral to organizational learning and innovation (Goldstein & Whitworth, 2017). To develop a holistic understanding of the implications of workplace information literacy, we will further explore its connection with other

organizational factors such as social capital, organizational change and leadership behaviour. This study has extended contribution to workplace information literacy research by investigating the information literacy of CEOs who represent an important and hard-to-reach segment of the workforce in a new setting of SME. Finally, from the perspective of business practice, this study provides practical evidence that underlines the importance of developing the awareness of information skills and competencies in organizations at all levels and among decision makers. Information literacy skills will be an increasingly important part of future work competencies, and therefore it should be present in educational programmes to a larger extent.

CRediT authorship contribution statement

Farhan Ahmad: Conceptualization, Methodology, Formal analysis, Investigation, Writing - original draft, Writing - review & editing, Visualization. **Gunilla Widén:** Conceptualization, Writing - original draft, Writing - review & editing, Supervision, Funding acquisition. **Isto Huvila:** Conceptualization, Writing - original draft, Writing - review & editing, Supervision.

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Appendix A

Information literacy

1. Information acquisition

1 I can easily get my hands-on right information when needed.
2 When looking for information I can easily identify the right information sources (e.g. company employees, intranet, online sources and clients).
3 I often get involved in discussion with colleagues to get information.

1. Information evaluation

1 I can spot inaccuracy, errors, etc. in information acquired from different sources.
2 I can determine the reliability of the information.
3 I can identify points of agreement and disagreement among information sources.

1. Information use

1 I am good at putting information into action (problem solving, informed decisions etc.).
2 I am good at using information for positive changes in work practices.
3 I am good at using information to challenge traditional mind-set to see things in different ways.

1. Awareness of information environment

1 I understand our company's procedures for receiving and sharing information.
2 I know how my company enables employees to get needed information.
3 I understand my team's acceptable ways of information sharing.
4 I am aware of the organization of information in my company.

1. Learning from information experience

1 I can identify what sources and processes will be helpful for finding and using information in the future.
2 When I find new information, I try to find out how I can use it new ways.
3 I revise my thinking as a result of group discussions or information collected.
4 Information makes me think or act beyond the boundary of my own job.

1. Information ethics

1 I always pay attention to the information security in our company's print and electronic environments.
2 I obtain, store and disseminate information according to laws and regulations.
3 I understand when to give credit or hide my information sources.

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