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The Impact of Social Information System Governance, Utilization and Capabilities on Absorptive Capacity and Innovation: A Case of Austrian SMEs

Abstract

The aim of this study is to understand the influence of social information systems (SIS) on absorptive capacity (AC) and innovation in Austrian SMEs. For this purpose, a framework was developed and empirically tested using a nationwide, mixed-mode survey on a random sample of 138 SMEs of knowledge-intensive industries. The results show that the backbone of SIS utilization is SIS governance. SIS capabilities mediate the positive effects of SIS utilization on AC components, which build on each other and mediate the positive effects of SIS capabilities on innovation. Our findings provide a number of useful implications for research and industry.

Keywords: Social information systems, Absorptive capacity, Innovation, Dynamic capabilities, Empirical survey

1 Introduction

The rapid adoption of Social Information Systems (SIS) in recent years has given rise to new capabilities that have changed the way organizations act, interact, communicate, collaborate and conduct their businesses (Treem and Leonardi, 2012, Aral et al., 2013). SIS are information systems based on social technologies and open collaboration (Schlagwein et al., 2011). As such they contribute differently to firm value creation than to traditional business information systems. As economies become increasingly knowledge-based, firms strive to develop new capabilities in an effort to outperform their competitors (Higgins and Aspinall, 2011). The consensus view seems to be that these technologies have the potential to become a key instrument for creating business value (Andriole, 2010, Martin and Bavel, 2013). However, a recent article suggests that the impact of these technologies on organizations is rather unclear (Kane and Alavi, 2014). A key aspect is the complex dynamics that arise from the combination of new features that these technologies bring and existing firm resources and capabilities. The subsequent rise of novel capabilities is important, particularly for small and medium-sized enterprises (SMEs) that have limited resources, constrained opportunities, and

face mere survival challenges (Hunter, 2004, Montazemi, 2006). Understanding the value of this new class of information technologies for Absorptive Capacity (AC) and innovation purposes is crucial in grasping the dynamic and discontinuous environments in which firms must strategically develop and sustain a competitive advantage (Sher and Lee, 2004).

Although prior research has provided theoretical models associating AC to IT capabilities or innovation (Bosch et al., 2003, Roberts et al., 2012), there are few empirical studies considering the specifics of IT capabilities (Wang and Ahmed, 2007), and even fewer studies form an enhanced understanding of the dynamics effects created in SIS settings. In fact, scholars have called for a renewed look at even established theories, asking for consideration of how this new class of technologies could alter organizational dynamics (Majchrzak, 2009, Kane and Alavi, 2014). There is, to our knowledge, minimal to no empirical evidence explaining the value of SIS for different organizational capabilities, and whether the combination of these capabilities result in valuable outcomes such as innovation. This empirical deficit is all the more evident given that the business use of SIS has increased steadily in recent years, while enterprises struggle to reap the full potential benefits (Chui et al., 2012, Martin and Bavel, 2013).

To address this research gap, this study aims to broaden our understanding of the strategic role played by SIS by examining the nomological network of influences through which SIS impact organizational innovation. For this purpose, the research questions that were formed are: (a) What is the role of SIS governance and utilization in developing SIS capabilities? (b) Do SIS capabilities affect different components of AC? (c) Does AC mediate these effects on exploratory and exploitative innovation? In particular, as illustrated in Figure 1, we assume that SIS governance and SIS utilization foster a nomological network of four SIS capabilities (outside-in, spanning interpretation, spanning integration, and inside-out) that in turn nurture the development of an organizational dynamic capability, namely AC. We further propose that the dynamic effects generated by the combination of AC and SIS capabilities affect exploratory and exploitative innovation. Based on previous models of organizational AC (Bosch et al., 2003), we posit that SIS give rise to a class of antecedents of AC that catalyze the dynamic capability mechanism to generate new innovation outcomes. To test our research hypotheses and validate our measurement constructs, we conducted a partial least squares structural equation modeling (PLS-SEM) analysis (Wold, 1982, Lohmöller, 1989) of a random sample of 138 SMEs from a nationwide, mixed-mode survey conducted in Austria.

While SMEs generally provide a very important role in economic development (Dumitrescu, 2014) and regional innovation performance (Berlemann and Jahn, 2015), they are even more important in Austria in relation to other nations within the EU. Austria belongs to the top nations among the 28 EU member states in terms of number of SMEs (together with Germany, Romania and Luxembourg) and generated turnover (together with Luxembourg and Latvia). Austria is classified as innovation follower with a performance of product and process innovation among SMEs slightly above the EU average (European Commission, 2015). Our findings should therefore also be relevant for most developed countries relying heavily on SMEs, in particular to those classified as innovation followers.

For research, the discussion provides contributions to IS literature by highlighting the relationships between SIS, dynamic capabilities and innovation in the context of knowledge-intensive SMEs. For industry, given that SIS are rapidly increasing and proliferating in day-to-day work and personal lives, this research contributes by identifying the pertinent role that SIS have on learning and innovation.

2 THEORETICAL BACKGROUND

2.1 SMEs and the role of innovation

Small to medium-sized enterprises (SMEs) in Europe are defined as enterprises that employ fewer than 250 people, have an annual turnover not exceeding 50 million euros and/or an annual balance sheet total not exceeding 43 million euros (European Commission, 2005). Together with micro enterprises, SMEs account for over 99% of all non-financial companies registered in all EU countries (Urhausen and Sneijers, 2013). New businesses and product lines based on breakthrough ideas of innovation directives and activities are seen as critical and essential for the survival of SMEs (Alexiev et al., 2010).

While exploration capabilities describe a firm's ability to "*develop new processes, products and services that are unique from those used in the past*," exploitation capabilities are a firm's ability to "*improve continuously existing resources and processes"* (Yalcinkaya et al., 2007). Accordingly, exploratory (or radical) innovation involves the development or application of significantly new ideas or technologies in markets that are either non-existent or require dramatic behavior changes to existing markets (McDermott and O'Connor, 2002). It is an innovation that is difficult to achieve, as it tends to depart from established offerings and

understanding (Sainio et al., 2012). An empirical, cross-industrial study of 209 Finnish companies suggests that technological orientation enhances all dimensions of innovation radicalness, while a customer relationship orientation positively affects the technological and business model dimensions (Sainio et al., 2012). By contrast, exploitative innovations are typically extensions to a current product line or logical and relatively minor extensions to existing processes (McDermott and O'Connor, 2002). Exploitative (or incremental) innovation entails changes in the underlying technology, where the changes in the technological trajectory tend to be relatively small and place limited strains on a firm's existing competencies (Chandy and Tellis, 1998, Garcia and Calantone, 2003, Benner and Tushman, 2003).

A brief review of innovation literature indicates competing points of view regarding the relative emphasis that firms should place on exploratory versus exploitative innovations. For instance, it has been noted that while exploitative innovations can enable companies to remain competitive in the short run, only exploratory innovations can change the game; thereby, leading the way to long-term growth (Leifer et al., 2006). In contrast, another view suggests that breakthrough innovations could create a buzz in the boardroom and lesser forms of innovation may go unnoticed; hence, the "slow and steady" approach of incremental innovation usually beats exotic innovation strategies (Treacy, 2004). Other research proposes that successful firms must be ambidextrous; that is, they should be able to perform both types of innovation efficiently since findings suggest that exploratory innovations are more valuable in dynamic environments, while exploitative innovations are more useful to a unit's financial performance in highly competitive environments (Jansen et al., 2006).

2.2 Dynamic capabilities and absorptive capacity

The paradigm shift from static to dynamic markets has brought new research to strategic management by extending the resource-based view of firms to dynamic capabilities, which are commonly referred to as the ability of organizations to achieve new forms of competitive advantage by creatively manipulating their resources (Teece and Pisano, 1994, Teece et al., 1997). Considering the ongoing academic debate about the conceptualization of dynamic capabilities (Wang and Ahmed, 2007), it is apparent that no commonly accepted comprehensive definition currently exists.

The first fundamental ambiguity has to do with the different nature of capabilities. It is important to distinguish between dynamic capabilities and substantive capabilities, also

known as ordinary capabilities (Cepeda and Vera, 2007, Winter, 2003, Zahra et al., 2006). While substantive capabilities are responsible for performing basic functional firm activities, dynamic capabilities deal with the development of substantive capabilities (Cepeda and Vera, 2007). Typical examples of substantive capabilities are product development routines. In this case, a firm's dynamic capability is determined by the extent to which a firm has the ability to change or reconfigure these product development routines. The second fundamental ambiguity concerns the discussion of whether '*dynamic'* relates to the environment or the capability. The consensus view seems to be that, to cope with the challenges of rapidly-changing markets, firms need to continually recompose their capabilities (Teece et al., 1997). One drawback of this approach is that it ultimately considers dynamic capabilities only as a function of environmental volatility (Zahra et al., 2006). Another approach associates the term '*dynamic'* with the nature of the capabilities themselves, positing that, in order to accomplish specific objectives (like solving a problem or achieving an outcome) firms make use of dynamic capabilities to change their substantive capabilities independent of the market dynamism (Winter, 2003, Zahra et al., 2006). In this view, the role of the top manager is fundamental for dynamic capabilities as the top manager's vision and choices impact a firm's strategy and activities (Zahra et al., 2006).

AC was initially coined to describe a set of collective abilities that firms use to recognize the value of new information, assimilate it and apply it to commercial ends (Cohen and Levinthal, 1990). It can be seen as a dynamic capability essential for learning and innovation. Not only has knowledge been proposed as the most important resource (dynamic capability) for achieving competitive advantage, but also will become the only source of it (Drucker, 1993). In this study, we consider absorptive capacity (AC) as "*a set of organizational routines and processes by which firms acquire, assimilate, transform and exploit knowledge to produce a dynamic organizational capability"* (Zahra and George, 2002). It is important to understand several assumptions of AC (Roberts et al., 2012). First, it is cumulative as it depends on prior related knowledge of the firm and it is domain specific. This in particular means that a firm needs to accumulate a minimum level of domain specific knowledge to understand the potential value of additional external knowledge. Second, AC depends on the development of interaction and links between individuals, in particular between members of an organization and their individual capabilities (Cohen and Levinthal, 1990). Therefore, the entirety of network connections to foster the transfer of knowledge is of particular relevance for AC. Third, the available diversity and complementarity of collective knowledge in this network

seem to play an important role for AC (Zahra and George, 2002). It is essential to also build on a variety of different activities within a firm to successfully import and process external knowledge to successfully innovate. These three AC assumptions provide central arguments for the importance of SIS in developing related hypotheses in Section 3.

2.3 Social information systems and capabilities

Social information systems (SIS) have created an environment and social matrix that scholars predict will dominate the connections and engagement of employees, customers, and suppliers in future business innovation (Bughin et al., 2013). Reports have shown that enterprises from diverse industries have been modifying their entrepreneurial activities in search of greater benefits facilitated by the integration of these technologies (Bughin et al., 2009). Similar to the entrepreneurial activities associated with the identification and exploitation of opportunities (Zahra et al., 2006), Figure 1 depicts SIS activities as those organizational activities that center on the governance and utilization of SIS.

SIS are web-based technologies (often available as open source) that enable social interactions and do not have a predetermined number of participants (Schlagwein et al., 2011). While the core of SIS are social computing tools, such as social media (Kaplan and Haenlein, 2010), SIS have also been referred to as network IT (McAfee, 2006), enterprise 2.0 (McAfee, 2009), web 2.0 technologies (Andriole, 2010), social technologies (Chui et al., 2012), enterprise social software (Christidis et al., 2012), and enterprise social media (Leonardi et al., 2013). Such systems should also enable boundary less organizational structures, 24/7 real-time customer-centric communication, and virtual IS infrastructures delivered via cloud computing (McAfee, 2009). Further, these systems allow individuals to search for, acquire, post, edit or share relevant information, and/or generate, organize, formalize new ideas and important content, and/or collaborate on a specific task or project, and/or communicate via message with specific co-workers or broadcast messages to everyone in the organization (Chui et al., 2012, Leonardi et al., 2013). These wide ranges of usage possibilities have been analyzed from the viewpoint of the users (e.g. O'Riordan et al., 2012) based on the concept of perceived affordances (Norman, 1999). In this view, the users engage in a type of relationship with the technology that identifies “what the user may be able to do with the object, given the user’s capabilities and goals” (Markus and Silver, 2008). The shared usage of SIS in organizations affords new types of behaviors and changes organizational communication processes (Treem and Leonardi, 2012). Consequently, this should in turn lead

to new organizational SIS capabilities potentially supported by a variety of different SIS (Hass et al., 2008).

The current literature in information systems proposes that (outside-in, spanning and inside-out) IT capabilities facilitate AC components, especially when combined with complementary organizational capabilities (Roberts et al., 2012). Consistent with this framework and organizational activities related to AC that can be supported by SIS, we propose four specific SIS capabilities. 1) Outside-in SIS capabilities serve organizational purposes of acquiring external information. For instance, these capabilities facilitate the access and searching of external information relevant to organizational endeavors (Boyd and Ellison, 2007). 2) Spanning interpretation SIS capabilities (SP1) serve organizational purposes of assimilating new knowledge. For instance, these capabilities support the explanation and the relaying of important information, and make communication visible (Leonardi, 2014). 3) Spanning integration SIS capabilities (SP2) serve organizational purposes of integrating newly-assimilated knowledge into existing activities. For example, these capabilities allow for the efficient synthesis of different sources of information into a single interface, effective recombination of existing ideas into new ideas (Leonardi, 2014), or coordination and decision-making (Grant, 1996). 4) Inside-out SIS capabilities serve organizational purposes of exploiting refined or new competencies gained from external knowledge. For instance, they facilitate the presentation of modified working processes, visualizing prototypes, or advertising and merchandising new products and services (Kaplan and Haenlein, 2010, Leonardi et al., 2013).

We can now proceed with illustrating our basic research model, which will be expanded in the next section by developing research hypotheses. Consistent with Bosch et al.'s (2003) view of a firm's AC, we label SIS activities and SIS capabilities as antecedents of AC which should stimulate innovation as outcome (Figure 1). Following the Zahra et al. (2006) interpretation of the evolutionary processes in dynamic capability development, we argue that, in the earliest instance, SIS capabilities precede AC. The relationship becomes interrelated over time, as both SIS capabilities and AC impact innovation. Then, an understanding of SIS activities and capabilities is developed.

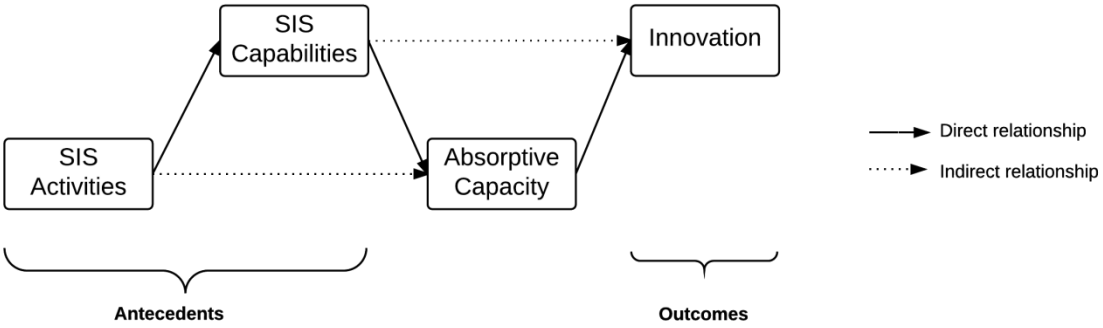

Figure 1. The SIS Model of AC for Innovation

3 DEVELOPMENT OF HYPOTHESES

Next, the aforementioned model (Figure 1) is extended by developing a path showing how exploitative or exploratory service and product innovation in SMEs unfolds from dynamic, higher-order capabilities captured as absorptive capacities, which are aligned and linked with SIS capabilities. For this purpose, we refer to the key constructs defined in Table 1 for the development of hypotheses and summarized in Figure 2.

Table 1. Research constructs

Construct	Operational Definition	Literature
SIS Activities		
SIS Governance (GO)	The extent to which top management has implemented a strategy, formulated guidelines and specified roles to encourage desirable behavior in the use of SIS.	(Weill, 2004, Zerfass et al., 2011)
SIS Utilization (UT)	The extent to which the organization uses SIS for work-related purposes (e.g. to communicate, access knowledge communities, share files or network).	(Hass et al., 2008)
Dynamic SIS-based Capabilities		
Outside In SIS capability (O-I)	The ability of the organization to envision and exploit SIS to search for external knowledge.	(Wade and Hulland, 2004, Lu and Ramamurthy, 2011, Kane and Alavi, 2014)
Spanning interpretation SIS capability (SP1)	The ability of the organization to envision and exploit SIS to understand and interpret new knowledge.	
Spanning integration SIS capability (SP2)	The ability of the organization to envision and exploit SIS to integrate and align existing knowledge with new knowledge.	
Inside Out SIS capability (I-O)	The ability of the organization to envision and exploit SIS to deploy improved or new skills (e.g. market new products or services).	
Absorptive Capacities (AC)		
Acquisition Capability (AC1)	The ability of the organization to locate, identify, value and acquire external knowledge that is critical to its operations.	(Zahra and George, 2002, Jimenez-Barrionuevo et al., 2011)
Assimilation Capability (AC2)	The ability of the organization to analyze, process, interpret and understand the information obtained from external sources.	
Transformation Capability (AC3)	The ability of the organization to develop and refine the routines that facilitate combining existing knowledge and the newly-acquired and	

	assimilated knowledge.	
Exploitation Capability (AC4)	The ability of the organization to refine, extend, and leverage existing competencies or to create new ones by incorporating acquired, assimilated and transformed knowledge into its operations.	
Innovation		
Exploratory Innovation (EXPR)	The ability of the organization to design radical innovations to meet the needs of emerging customers or markets.	(Jansen et al., 2004, He and Wong, 2004)
Exploitative Innovation (EXPI)	The ability of the organization to design incremental innovations to meet the needs of existing customers or markets.	

3.1 The role of SIS governance and utilization

Consistent with IT governance theory (Weill, 2004, Zerfass et al., 2011), SIS governance reflects the extent to which top management implements a strategy, formulates guidelines and specifies roles to encourage desirable behavior in the use of SIS. While the alignment of organization goals with SIS strategy is expressed by the organization's attitude toward SIS, specifying roles and responsibilities not only encourages usage but also guides employees along their various scopes of action (Shuen, 2008). SIS guidelines, on the other hand, provide clear instructions for SIS use, educating employees on how to deal with SIS information flows and teaching them how to participate in online environments (Zerfass et al., 2011). Kaplan and Haenlein (2010) suggested that it is vital for organizations to have guidelines for SIS, both to develop user appropriate behavior and to cope with the nature of SIS that are constantly updating. A recent report on digital leaders around the globe, listed building a SIS strategy that is broadly shared across the organization as most important for thriving in a digital word (Nadherny et al., 2010). Since SIS are new for everybody, organizations need a strategy to effectively utilize SIS for managing corporate knowledge and communication (Macnamara and Zerfass, 2012). We therefore posit:

H1: SIS governance positively impacts SIS utilization.

The implementation of IT governance requires the involvement of senior management in the adaption and change of organizational operations to meet present and future demands (Haes and Grembergen, 2004). To achieve desired goals, management that focuses on capabilities encourages particular desirable behaviors that sustain and reinforce the firm core competencies, which are in turn comprised of human capital, systems and intangible assets (Stalk et al., 1992). Creating and refining IT governance mechanisms encourages these particular usage behaviors, which are considered the most important predictors of which firms will derive value from IT (Weill and Woodham, 2002). For example, organizations implement

regulations (as one specific governance mechanism of the IT domain) for using SIS, considering that SIS create new forms of communication and change fundamental capabilities (Bell, 2010). All in all, we posit that SIS governance directly and indirectly affects SIS capabilities:

H2: SIS governance positively affects SIS capabilities: outside-in (H2a), spanning interpretation (H2b), spanning integration (H2c) and inside-out (H2d) SIS capabilities.

SIS have little value when used in isolation. Consistent with the characteristics of network IT (McAfee, 2006), we assume that the positive effects of SIS governance emerges through SIS utilization. The value of SIS seen as SIS capabilities should exhibit network effects (Katz and Shapiro, 1994) since it is likely to be positively affected by another organizational user joining in and enlarging the network characterized by reciprocal interdependence (Guzzo and Shea, 1992). This means that users need to interact and depend on each other in order to achieve a common organizational goal. It is the shared and similar exploitation of usage possibilities of IT, which is most likely to achieve organizational changes (Leonardi, 2013). Hence, we hypothesize:

M1: The positive effects of SIS governance on outside-in (M1a), spanning interpretation (M1b), spanning integration (M1c) and inside-out (M1d) SIS capabilities are mediated by SIS utilization.

The role of the social network is essential for developing AC. As mentioned earlier, AC is dependent on various aspects related to interaction, links or ties between people internal and external to the firm. It has been reported that the use of SIS has helped organizations to foster these relationships, which can be measured in terms of tie content, direction and strength (Garton et al., 1997). Relationship analysts suggest a correlation between tie strength and the support that community members give one another (Duck, 1986, Perlman and Fehr, 1987). Stronger ties should lead to more frequent interaction in multiple social contexts over a long period of time and larger networks tend to be more sociable, more communicative and hence more supportive (Wellman, 1992). This should in turn foster social integration seen as essential in developing AC (Zahra and George, 2002). Besides these general network reasons for explaining why the utilization of SIS should eventually support AC, the following view highlights how specific SIS may support tasks related to AC and SIS capabilities.

Related to acquiring and assimilating external knowledge, e.g., Wikis are useful for collecting and also for organizing external domain specific knowledge (Limaj and Bernroider, 2013). As such, Wikis can be also used to codify existing organizational knowledge into a single platform making it accessible to all its members. Blogs are used for harnessing collective intelligence (O'Reilly, 2007) and were considered to be the online equivalents of professional journals in which authors communicate new knowledge of their professional domains (Herring et al., 2004). As such, blogs are enabling professionals to participate in discussions of recent developments in their fields (Hsu and Lin, 2008). Previous studies found that corporate Wikis improved work processes, collaboration and knowledge reuse, while corporate blogs brought visibility, search ability and interlinking to ideas that had previously been hidden in personal archives (Farrell et al., 2008). Social networks, e.g. LinkedIn, enable the identification of external domain experts through profile services (Ashbrook and Ray, 2012), and are known to facilitate individuals' sense-making and relationship building (DiMicco et al., 2009).

Related to transformation and exploitation, Videosharing, e.g. Youtube, enables the peer-to-peer distribution of content-rich videos to efficiently deliver information or ideas in many contexts, from transmitting expertise to employees to reaching suppliers by tagging specific keywords or mailing links to them (Cheng et al., 2013). Likewise, shared databases not only enable the storing, collecting, delivering and exchanging of files, but also effective file synchronization and seamless collaboration among multiple users (Wang et al., 2012). Moreover, the use of social networks makes communication more visible (Leonardi, 2014) leveraging declarative (know-what) and procedural (know-who) knowledge (Borgatti and Cross, 2003). Danis and Singer (2008) illustrate how executives see a Wiki as a way of "*making researchers knowledgeable about relevant work going on elsewhere*". Wikis engage the knowledge worker in a more participatory knowledge management capability and environment (Hasan and Pfaff, 2008).

Based on the above reasoning, we propose a nuanced view on the above illustrated positive effects of SIS utilization divided into the four perspectives imposed on AC and SIS capabilities developed previously. Therefore, we firstly seek to test the extent SIS utilization directly affects the four SIS capabilities (H3) and their conceptually linked components of AC (H4):

H3: SIS utilization positively affects outside-in (H3a), spanning interpretation (H3b), spanning integration (H3c) and inside-out (H3d) SIS capabilities.

H4: SIS utilization positively affects AC for knowledge acquisition (H4a), assimilation (H4b), transformation (H4c), exploitation (H4d).

3.2 The role of dynamic SIS capabilities

Consistent with the view that specific IT capabilities facilitate AC components (Roberts et al., 2012), we propose that SIS capabilities (and not utilization *per se*) are needed to develop AC through SIS. Hence, we assume that the four dynamic SIS capabilities should directly impact their respective AC components (H5). In addition, SIS capabilities should act as mediators by which SIS utilization indirectly affects AC (M2), which extends our above analysis regarding direct effects of SIS utilization (H4). Therefore, the following hypotheses are proposed:

H5: Outside-in, spanning interpretation, spanning integration and inside-out SIS capabilities positively affect AC for knowledge acquisition (H5a), assimilation (H5b), transformation (H5c) and exploitation (H5d), respectively.

M2: The positive effect of SIS utilization on AC for knowledge acquisition, assimilation, transformation and exploitation is mediated by outside-in (M2a), spanning interpretation (M2b), spanning integration (M2c), and inside-out (M2d) SIS capabilities, respectively.

A number of studies enumerate ways in which certain IT capabilities can directly support innovation. For example, by applying the resource-based view, prior research has shown that a range of IS competencies differentially facilitate process innovation (Tarafdar and Gordon, 2007). Further confirmatory evidence suggests that creating company-wide IT capabilities provide a substantive basis for IT innovation (Bharadwaj et al., 1999). Other research on AC and knowledge management systems (KMS) presented evidence on indirect effects, suggesting that AC mediates the effects of IT use on innovativeness and agility (Hao et al., 2011). Consequently, we hypothesize that inside-out SIS capabilities which are related to the exploitation of new capacities may directly (H6) or indirectly (M3) affect innovation:

H6: Inside-out SIS capabilities positively affect exploitative (H6a) and exploratory (H6b) innovation.

M3: The positive effects of inside-out SIS capabilities on exploitative (M3a) and exploratory (M3b) innovation are mediated by AC for knowledge exploitation.

3.3 The role of absorptive capacities

The nature of AC in terms of how it develops has been widely debated in literature (Lane et al., 2006). A central and well accepted feature of AC is cumulativeness (Cohen and Levinthal, 1990), which supports the notion that partially developed AC in one area should help to develop AC in other areas. Our four-stage, multiple-level AC conceptualization based on Zahra and George (2002) suggests that AC has four different components, which are complementary and build on each other to eventually explaining how AC fosters innovation. This leads us to hypothesize that:

H7a: AC for knowledge acquisition (AC1) positively affects AC for knowledge assimilation (AC2).
H7b: AC for knowledge assimilation (AC2) positively affects AC for knowledge transformation (AC3).
H7c: AC for knowledge transformation (AC3) positively affects AC for knowledge exploitation (AC4).

Empirical evidence has shown that AC contributes both directly and indirectly to innovation and financial performance; albeit in different time spans (Kostopoulos et al., 2011). Other research has outlined the positive impact of personal networks on innovation, once it was realized that AC is activated to promote learning from information and knowledge retrieved in networks (Ahlin et al., 2014). Another conceptual model introduces AC as a mechanism that destination marketing organizations can exploit to redesign and refine innovation processes, practices and/or services (Daspit and Zavattaro, 2014). Overall, these cases support the view that the exploitation capabilities provided by AC are likely to directly influence product and process innovation (Zahra and George, 2002). We therefore hypothesize that:

H8: AC positively affects exploitative (H8a) and exploratory (H8b) innovation.

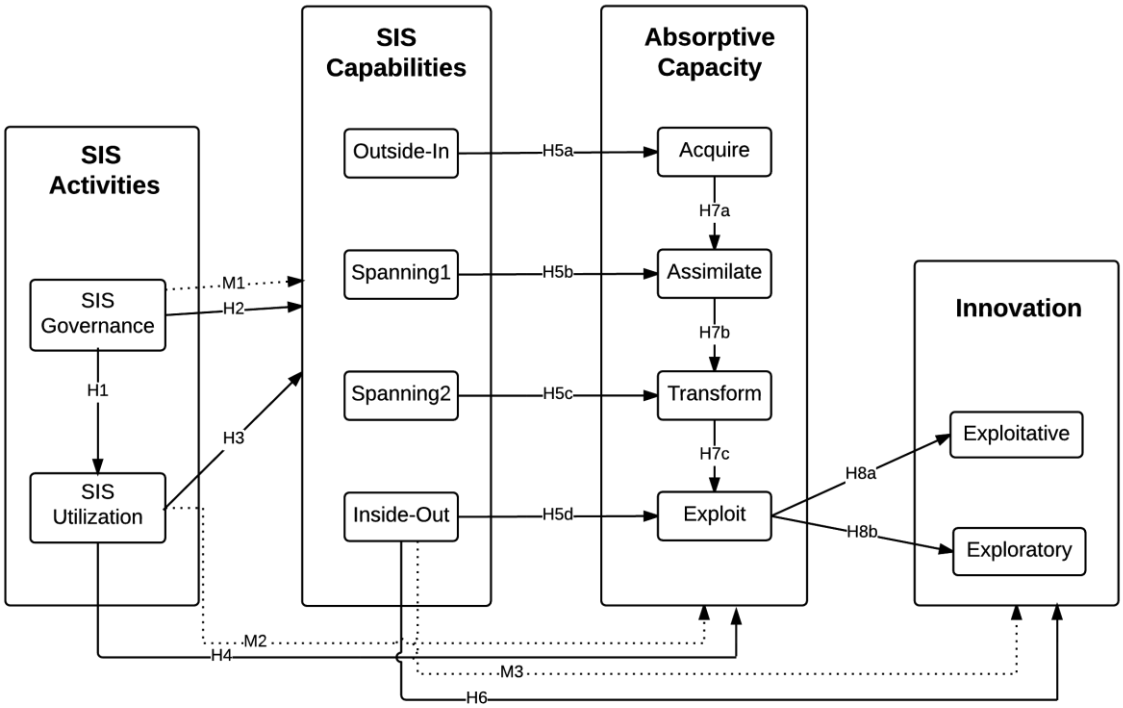

Figure 2. Extended Model and Hypotheses

4 RESEARCH METHODS

4.1 Research process and data

4.1.1 Sampling and pre-testing

The sampling frame for the empirical survey consisted of 1,000 randomly selected companies from the widely used and comprehensive Amadeus Database containing financial information on public and private companies across European countries (Bureau van Dijk, 2011). For the extraction we selected all active Austrian SMEs excluding micro enterprises assigned to knowledge-intensive industry sectors. This procedure potentially allows for future roll-outs targeting other countries.

Before implementing the survey instrument, three rounds of iterative pre-testing were undertaken. Each round was followed by an academic review of issues that resulted in further changes to the wording and structure of the instrument. The first two rounds of pre-testing were in conjunction with six participants from professional occupations, including IT and

management roles. The instrument was administered to three target persons in the third round of pre-testing; i.e., practitioners with management responsibilities in SMEs. Pre-test recommendations included changes to industry classification, orientation of the scales, shortening of lengthy questions and texts and wording-related issues. The questionnaire was originally developed in English and translated into German before the third round of pre-testing, in order to allow for a better understanding of the questions by the Austrian target persons. The back-translation method was used to assure identical or highly similar meaning across the different language versions (Brislin, 1970). The final German and English versions were validated and proofread for approval of the content, wording and clarity of the questions by four experienced academics.

4.1.2 Data collection process

The questionnaire was disseminated using a multi-stage process. The survey instrument contained an invitation letter assuring the participants of anonymity and confidentiality. The letter also provided an explanation as to the purpose of the study and the selection process, and sought the voluntary participation of the participant. For the first round, all participants were invited by means of a pre-notification letter that stressed the survey's legitimacy. Afterwards, the survey was mailed using the postal service and then emailed sequentially. This procedure was necessary to comply with the Austrian telecommunication law concerning bulk emails, which limits the number of email invitations to 50 companies per email. As an incentive, we offered access to the study results and case study collaboration. For the second contact round, 675 random companies out of our random sample were contacted by telephone to increase the response rate. While many immediately declined to participate and were consequently classified as "non-respondents," others allowed us to send an email with a link to the online questionnaire. Some agreed spontaneously to take part in an ad-hoc interview. This process took 66 full person days and concluded with 205 completed questionnaires, corresponding to a net return quota of 20.96% considering neutral dropouts (22 companies). Neutral dropouts did not reduce the return quota. As a note: neutral dropouts were identified as companies that could not be contacted as they ceased to exist, closed their business or could not be found due to an incorrect address.

4.1.3 Data sample preparation

The examination of collected data is considered to be a very important stage before applying PLS-SEM, as it attempts to identify the error component of the data and remove it from the analysis (Hair et al., 2014). Given that, we proceeded as follows to address data collection

issues and identify outliers. First, we established whether respondents are indeed SMEs by assessing the number of employees and turnover according to EU guidelines (European Commission, 2005). Consequently we dropped the non-targeted firms including 26 micro enterprises and 13 large enterprises. Second, we searched for missing data. It has been suggested that when the amount of missing data exceeds 15% on a questionnaire, or if a high proportion of data is missing for a single construct, then the observation is typically removed from the data file (Downey and King, 1998). The remaining datasets that included missing data, yet were not considered problematic, were handled using mean value replacement. Third, we looked for suspicious response patterns. We used the so-called "straight-lining" strategy to identify respondents that answered by selecting the same response for all questions. We also inspected for any inconsistency in answers to identify data inaccuracies. Removing inconsistent datasets helps to ensure the overall quality of subsequent analysis (Trochim and Donelli, 2006). In this regard, by using organization size as a screening question and when comparing SIS utilization with the later related questions, we were able to determine if inconsistent answers were provided. Fourth, we tested for outliers by applying the modified Thompson tau technique (Dieck, 2006). An outlier is considered an extreme response to a particular question, or an extreme response to all questions (Hair et al., 2014). The process resulted in 28 removed datasets and subsequently 138 observations were classified as useful for further analysis.

Next, we reviewed whether our sample size is appropriate for PLS-SEM analysis. One of the many advantages cited for using PLS-SEM is the low minimum sample size requirement (Fornell and Bookstein, 1982; Gefen et al., 2000; Hair et al., 2011). However, it is still recommended to consider it against a given model and data characteristics (Hair et al., 2014). In our model the maximum number of independent variables in any structural path is three. Therefore, assuming the commonly used level of statistical power of 80%, we needed at least 124 data sets for detecting R^2 values of at least 0.1 with an error probability of 5%. According to the often cited 10 times rules (Barclay et al., 1995) our recommended minimal sample would be only 40, given by 10 times the largest number of formative indicators used to measure a single construct (four in our case). Hence, the acquired 138 data sets are sufficient in terms of both requirements.

Non-response bias was inspected using the commonly applied wave analysis (Van der Stede et al., 2006). In this case, early respondents were compared to the late respondents based on

the assumption that late respondents are more likely to resemble non-respondents (Moore and Tarnai, 2002). This led to dividing the sample into two equally-sized groups based on the time the response was registered with regard to the online survey implementation. The groups revealed no difference in terms of the respondent characterized by gender (χ^2 test, p=.555) and age (two-sample unpaired t tests, p=.582), and the organization characterized by classifying companies according to reported employees (χ^2 test, p=.153) and turnover (χ^2 test, p=.476).

As the survey was based on a mono-method research design and a self-reporting survey instrument, it was tested for a common method bias or common method variance (CMV) (Podsakoff and Organ, 1986, Malhotra et al., 2006). CMV may cause a certain amount of covariance sharing within all the indicators. In this study, we used two *ex post* CMV remedies (Chang et al., 2010). First, we added complexity to the model by considering mediating effects guided from theory as a strategy for specifying relationships among dependent and independent variables to avoid oversimplification. Second, we applied the Harman's single-factor test as a diagnostic technique to test for CMV. This technique involved entering all the constructs into a principal components factor analysis, in an effort to establish whether either a single or general factor emerges that would account for the majority of covariance among measures (Podsakoff et al., 2003). Nine factors emerged. The first accounted for 37.5% of the variance. The other eight (with eigenvalues greater than one) contributed to the remaining 37.1% of the variance explained by the set, each accounting for 2.2% to 10.6%. This suggests that while there is likely to be some CMV, the effect is relatively small, implying that CMV cannot be regarded as a problem in this study.

4.2 Operationalization of constructs

4.2.1 Variable definition and measurement

All of the variables, except for SIS utilization, were operationalized using multi-item reflective indicators on a seven-point Likert-type scale. The seven point Likert scale is suggested to provide the most reliable scores and generally performs best for reliability and validity (Preston and Colman, 2000). Reflective indicators are essentially interchangeable factors that give rise to the latent variable, where changes in the latent variable will be reflected in a change in all indicators (Bollen and Lennox, 1991). In keeping with the research context and the pre-testing outcome, the selected reflective items were adapted in order to operationalize each dimension formed on the basis of a review of the main recent instruments proposed in the literature (see Appendix, Table A1.1). We made use of AC items that were

developed and tested in Camison and Flores (2010) and Flatten et al., (2011) and deemed valid and reliable. We conceptualized SIS utilization as the company-wide infusion of SIS for any kind of business related purpose and did not restrict SIS to non-company owned solutions. We generally assessed four different types of SIS by drawing upon a classification of SIS based on community criteria using illustrative examples (Hass et al., 2008). Accordingly, we assessed eight different tools consisting of linked pairs of SIS for each of the four different groups including SIS for networking, knowledge communities, sharing communities, and communication, which we conceptualized as formative constructs. Formative constructs are a composite of multiple measures where changes in the formative items cause changes in the underlying construct (Jarvis et al., 2003).

4.2.2 Control variables

This study also included control variables that may influence a firm's AC and innovation. First, we controlled for the size of the organization by including the number of employees and turnover in the last financial year. Additionally, two control variables capturing the importance of the respondent age (22–44 years, 45–59 years, over 60 years) and role tenure (i.e., under 3 years, 3–8 years, over 8 years) were included. Finally, two further variables were entered to distinguish between the industries in which organizations were operating based on NACE Rev. 2 classification (European Commission, 2008), and to indicate the respondents' gender.

5 DATA ANALYSIS AND RESULTS

5.1 Survey sample properties

The industry sector classification of survey respondents is based on the NACE (European Commission, 2008). An aggregation of the industry sectors resulted in five groups (see Appendix, Table A2.1) and in a distribution of which 46.3% of the firms offered professional, scientific and technical activities; 24.6% belonged to the information and communications sector; 9% offered administrative and support service activities; 8.7% belonged to manufacturing, and 2.3% offered financial and insurance services. The remaining 9.4% of the participant organizations could not be classified to any sector. As we selected only SMEs in the Amadeus database based on their assignment to knowledge-intensive industry sectors, all these companies are likely to engage in knowledge-intensive activities including the manufacturing firms and the non-classified cases. A large number of the respondents (51%) were aged between 45 and 59 years (see Appendix, Table A2.2). The majority of the

respondents were male (92%) and had been in employment with the firm for more than eight years (61%).

5.2 Measurement validation

The first step in assessing the quality of PLS-SEM results is to evaluate the measurement model for validity and reliability according to current guidelines (Hair et al., 2014). The findings revealed that all the measures were valid and reliable. Starting with the reflective measurement constructs (see Appendix, Table A3.1), we first tested for reliability. Internal consistency reliability was assessed by inspecting the composite reliability values, which takes into account the different outer loadings of the indicator variables. As all the values were well above 0.7, a high level of internal consistency was indicated (Nunnally and Bernstein, 1994). This finding is also supported by assessing the Cronbach's alpha values, which are more conservative measures of internal consistency. Following the same rule, all the Cronbach's alpha values were well above 0.7, which indicated high levels of internal consistency. To establish convergent validity at the construct level, we analyzed the communality of a construct with the average variance extracted (AVE). AVE values above 0.5 ensured that on average, the construct explained more than 50% of the variance of its items (Hair et al., 2014). All the AVE values were well above this threshold. Using the Fornell–Larcker criterion, it was observed that the square roots of the AVE values were larger than their highest correlation with any other construct; hence supporting discriminant validity (Fornell and Larcker, 1981). Additionally, indicator reliability was examined by inspecting the standardized indicator's outer loadings. All the values were above 0.7 and the indicators loaded higher on their intended construct than on other constructs (see Appendix, Table A3.2); thereby confirming indicator reliability and discriminant validity, respectively. Consequently, there was no need to consider removing any items of reflective constructs.

Next, the formative variable of SIS utilization needed to be validated with a different approach (Hair et al., 2014). Considering content validity, we established that the formative indicators captured all the major SIS before empirically evaluating the construct by carefully reviewing SIS taxonomies (Hass et al., 2008) that allowed us to include all the relevant SIS categories. Furthermore, we pre-tested the construct in the context of this study with the involvement of target firms in order to establish that we had included all the major SIS. In terms of assessing the empirical results of formative constructs we assessed variance inflation indicators (VIF) to determine the level of multicollinearity among indicators. The term 'multi-

collinearity' refers to a high degree of correlation among several independent variables (Hair et al., 1998). In the context of PLS-SEM, VIF>=5 is considered as problematic. We observed no problematic levels of multicollinearity among the formative indicators (see Appendix, Table A3.3). All the formative indicators except for SIS group for sharing communities were significant. We decided to retain the SIS group for sharing communities (having an outer loading above 0.5) in order to preserve content validity (Hair et al., 2014). In terms of relative contributions described by the outer weights, SIS for communication (0.426) is most important for SIS utilization, followed by SIS for networking (0.304) and SIS for knowledge communities (0.301), while SIS for sharing communities (0.163) is less important.

5.3 Test of the structural model

The second step in a PLS-SEM analysis is to evaluate the structural model results (Figure 3) on the basis of heuristic criteria. This involves: (i) assessing the significance of the relationships between constructs; (ii) assessing the R^2-level; (iii) assessing the f^2-effects; (iv) assessing the Q^2-predictive relevance, and (v) q^2 effect sizes (Hair et al., 2014). The results of the structural model are presented in the Appendix (Table A4.1). The R^2 values were adjusted to avoid bias toward complex models, whereby the model showed generally moderate predictive accuracy with higher R^2 values indicating better predictive accuracy (Henseler, 2010). The effect size f^2 of a latent factor results from analyzing the decrease in R^2 when excluding one independent latent factor. It was suggested that the f^2 values of 0.02, 0.15, and 0.35 imply small, medium, and large effects, respectively. The same approach and margins applied to the q^2 effect sizes based on decreases on Q^2. The model's predictive relevance (Q^2) was examined by using the blindfolding procedure on endogenous reflective constructs by means of the cross-validated redundancy approach. We used the results from bootstrapping with 5,000 subsamples as a non-parametric re-sampling procedure to calculate t-statistics and standard errors (Chin, 1998).

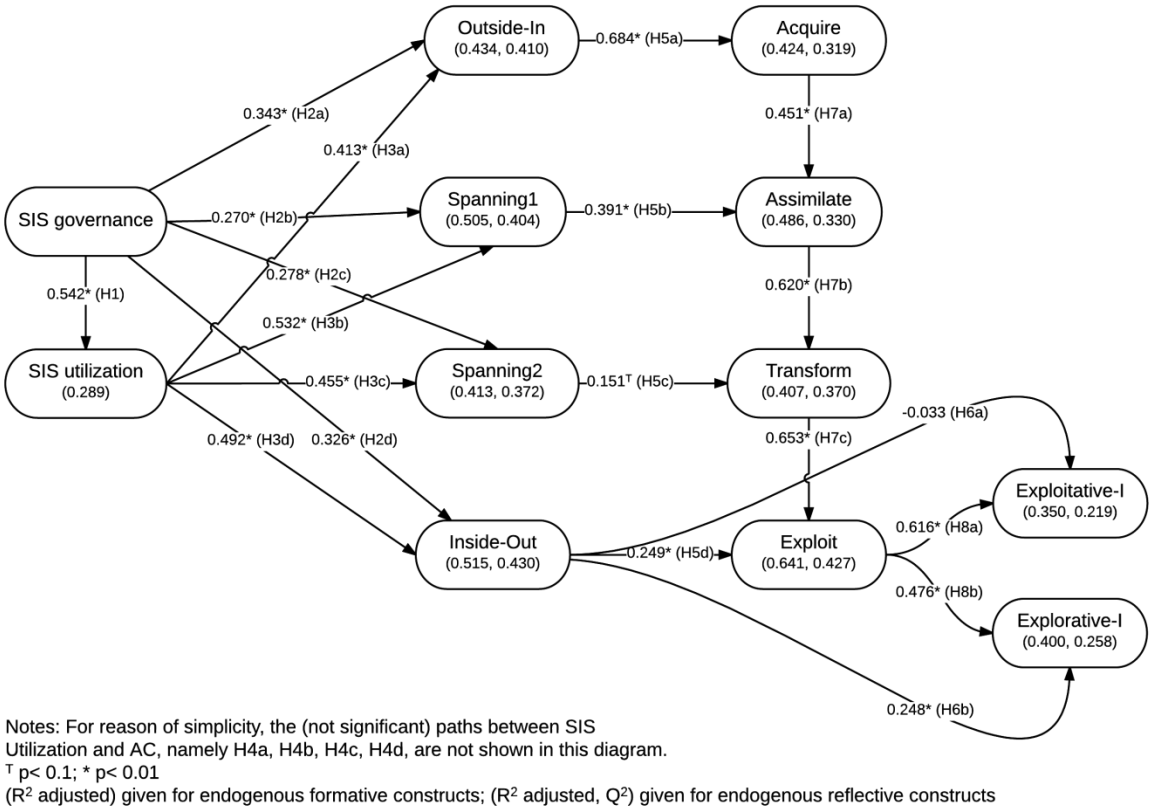

Figure 3. PLS-SEM results

5.4 Mediation analysis

Our research model included three mediation hypotheses (M1-3), which allowed us to understand the more complex cause–effect mechanism through which an independent variable is able to influence a dependent variable (Baron and Kenny, 1986). By adopting Baron and Kenny's causal step test, the conditions of these potential indirect effects were assessed. Further, the significance of the indirect effects was tested by performing bootstrapping with replacement (Shrout and Bolger, 2002) and the Sobel test (Sobel, 1982). The Sobel test provides a method to determine whether the reduction in the effect of the independent variable, after including the mediator in the model, is significant, and hence whether the mediation effect is statistically significant. The "Variance Accounted For" (VAF) was tested to determine the scope of the indirect effect in relation to the total effect, with a higher result indicating stronger mediation (Hair et al., 2014). Table A5.1 in the Appendix presents the results of the mediation analysis.

To illustrate the analysis, we refer to SIS utilization, which was suggested to mediate the relationship between SIS governance and SIS capabilities (M1). The results showed that

partial mediation was confirmed with regard to each of the four SIS capabilities. For example, in step 1 the significant direct effects of SIS governance on outside-in SIS capabilities without including the mediator variable (UT) were identified (ß=0.567, p<0.001). Next, the mediator variable was included in the PLS path model and the significance of the indirect effects had to be confirmed. Thereafter, the full model showed that the direct effect between SIS governance and the SIS capability was significantly reduced, which indicates mediation effects. As the indirect effects were significant, step 2 was satisfied, that then allowed the calculation of the VAF, which showed SIS utilization partially mediating the relationship between SIS governance and outside-in SIS capabilities. VAF values above 20% indicated partial mediation, while values exceeding 80% indicated full mediation (Hair et al., 2014). Partial mediation reflects SIS governance also exercising direct effects on this SIS capability. This and the other mediation results are discussed together with the results from the structural model tests in the next sub-section.

5.5 Evaluation of hypotheses

We can now proceed with presenting the evaluation of hypotheses by integrating the results from the structural and mediation tests. The results highlight the importance of SIS governance and utilization. While SIS governance has a large positive direct effect on SIS utilization (supporting H1), it also has small direct positive effects on outside-in, spanning interpretation, and spanning integration SIS capabilities, and medium direct positive effects on inside-out SIS capabilities (supporting H2a-d). Moreover, it also has indirect positive effects on these SIS capabilities that are mediated by SIS utilization (supporting M1a-d). SIS utilization has large positive direct effects on outside-in and spanning interpretation SIS capabilities (SP1), and medium positive direct effects on spanning integration (SP2) and inside-out SIS capabilities (supporting H3a-d). Considered together, consistent with our argumentation, SIS utilization is the springboard and a necessary condition for developing SIS capabilities on the backbone of SIS governance, which explains about 29% of the variance in SIS utilization.

However, SIS utilization does not directly impact any of the four AC components (thereby rejecting H4a-d), which can be explained by the mediating role of SIS capabilities. Instead, based on our findings, SIS utilization has indirect relationships with AC on the basis of outside-in, spanning interpretation and inside-out SIS capabilities (supporting M2a-b, d) as mediators, but not in terms of spanning integration SIS capability (rejecting M2c). While the outside-in SIS capability exhibits large positive direct effects on AC for knowledge

acquisition (explaining 42% of its variance), the other three SIS capabilities have small positive direct effects on their respective AC components (explaining between 40-64%). In terms of the spanning integration SIS capability these effects are only marginally significant ($p<0.1$). These findings highlighted the importance of all the four SIS capabilities for positively affecting their peer AC components (supporting H5a-d). However, their direct effects on innovation are limited. While inside-out SIS capabilities had small positive effects on exploratory innovation (supporting H6b), they had no direct effects on exploitative innovation (rejecting H6a). The importance of inside-out SIS capabilities became evident when considering indirect effects, as AC for knowledge exploitation acted as a full mediator cancelling out the direct effects on exploitative innovation (supporting M3a) and as a partial mediator for passing on its effects on exploratory innovation (supporting M3b).

Finally, we confirmed that AC components build on each other and eventually explain innovation. On the AC chain, the AC components exhibited medium positive effects from acquisition to assimilation to large positive effects from assimilation to transformation and exploitation (supporting H7a-c). AC for exploitation had large positive effects on exploitative innovation and medium positive effects on exploratory innovation (supporting H8a-b), and together with inside-out SIS capabilities explained 35% and 40% of the variance of the respective innovation variables. Table 2 below summarizes the findings.

Table 2. Summary of findings

ID	Hypothesis	Verdict
SIS governance positively impacts SIS utilization:		
H1	*SIS governance* positively affects *SIS utilization*.	Supported
SIS governance positively impacts SIS-capabilities:		
H2a	*SIS governance* positively affects *outside-in SIS capabilities.*	Supported
H2b	*SIS governance* positively affects *spanning interpretation SIS capabilities.*	Supported
H2c	*SIS governance* positively affects *spanning integration SIS capabilities*.	Supported
H2d	*SIS governance* positively affects *inside-out SIS capabilities.*	Supported
SIS utilization positively impacts SIS capabilities:		
H3a	*SIS utilization* positively affects *outside-in SIS capabilities.*	Supported
H3b	*SIS utilization* positively affects *spanning interpretation SIS capabilities.*	Supported
H3c	*SIS utilization* positively affects *spanning integration SIS capabilities.*	Supported
H3d	*SIS utilization* positively affects *inside-out SIS capabilities.*	Supported
SIS utilization positively impacts absorptive capacity:		
H4a	*SIS utilization* positively affects *knowledge acquisition (AC1).*	Not supported
H4b	*SIS utilization* positively affects *knowledge assimilation (AC2).*	Not supported
H4c	*SIS utilization* positively affects *knowledge transformation (AC3).*	Not supported
H4d	*SIS utilization* positively affects *knowledge exploitation (AC4).*	Not supported

SIS capabilities positively impact absorptive capacity:		
H5a	*Outside-in SIS capabilities for knowledge acquisition* positively affect *knowledge acquisition (AC1).*	Supported
H5b	*Spanning interpretation SIS capabilities* positively affect *knowledge assimilation (AC2).*	Supported
H5c	*Spanning integration SIS capabilities* positively affect *knowledge transformation (AC3).*	Marginally supported
H5d	*Inside-out SIS capabilities* positively affect *knowledge exploitation (AC4).*	Supported
SIS capabilities positively impact organizational innovation:		
H6a	*Inside-out SIS capabilities* positively affect *exploitative innovation.*	Not supported
H6b	*Inside-out SIS capabilities* positively affect *exploratory innovation.*	Supported
Absorptive capacity cascades from acquisition, assimilation, transformation to exploitation:		
H7a	*Knowledge acquisition (AC1)* positively affects *knowledge assimilation (AC2).*	Supported
H7b	*Knowledge assimilation (AC2)* positively affects *knowledge transformation (AC3).*	Supported
H7c	*Knowledge transformation (AC3)* positively affects *knowledge exploitation (AC4).*	Supported
Absorptive capacity positively affects organizational innovation:		
H8a	*Knowledge exploitation (AC4)* positively affects *exploitative innovation.*	Supported
H8b	*Knowledge exploitation (AC4)* positively affects *exploratory innovation.*	Supported
Mediation effects of SIS utilization for SIS governance on SIS capabilities:		
M1a	The positive effects of *SIS governance* on *outside-in SIS capabilities* are mediated by *SIS utilization*.	Partial mediation
M1b	The positive effects of *SIS governance* on *spanning interpretation SIS* are mediated by SIS utilization.	Partial mediation
M1c	The positive effects of *SIS governance* on *spanning integration SIS capabilities* are mediated by SIS utilization.	Partial mediation
M1d	The positive effects of *SIS governance* on *inside-out SIS capabilities* are mediated by SIS utilization.	Partial mediation
Mediation effects of SIS capabilities for SIS utilization on AC:		
M2a	The positive effect of SIS utilization on *knowledge acquisition (AC1)* is mediated by *outside-in SIS capabilities.*	Full mediation
M2b	The positive effect of SIS utilization on *knowledge assimilation (AC2)* is mediated by *spanning interpretation SIS capabilities.*	Full mediation
M2c	The positive effect of SIS utilization on *knowledge transformation (AC3)* is mediated by *spanning integration SIS capabilities.*	No mediation
M2d	The positive effect of SIS utilization on *knowledge exploitation (AC4)* is mediated by *inside-out SIS capabilities for knowledge exploitation.*	Partial mediation
Mediation effects of AC for SIS capabilities on innovation:		
M3a	The positive effects of *inside-out SIS capabilities on exploitative innovation are mediated by knowledge exploitation (AC4).*	Full mediation
M3b	The positive effects of *inside-out SIS capabilities on exploratory innovation are mediated by knowledge exploitation (AC4).*	Partial Mediation

6 DISCUSSION AND FUTURE WORK

In this study, we examined how the nomological network of SIS capabilities impacts AC and innovation in Austrian SMEs. Arguments were made for a more nuanced understanding of the relationships between SIS, AC and innovation by initially contending that SIS governance impacts SIS utilization, and that both of these antecedents in turn feed SIS capabilities.

Second, it was demonstrated that the dynamic effects created from the combination of SIS capabilities with AC have a positive impact on exploitative and exploratory innovation outcomes. As reported above in Table 2, there was generally strong support for our hypotheses. SIS governance strongly impacts SIS utilization and has both direct and indirect effects on SIS capabilities. The indirect effect is mediated by SIS utilization, which also affects all SIS capabilities. Further, SIS capabilities and AC are generally in alignment, except for the linkage between SP2 and AC3, which is only marginally significant, and they impact innovation in such a way that AC basically mediates the effects of SIS capabilities on innovation. The strong relations between the AC components showed that AC cascades from acquisition, assimilation, transformation to exploitation. Having discussed the results of this study, we will next discuss the theoretical and practical implications of this study.

6.1 Theoretical implications

This study contributes to IS research on dynamic IT capabilities in multiple ways. First, we have added to literature by providing new insights into the relationships between governance, utilization, and dynamic capabilities in the context of SIS and knowledge-intensive SMEs. Much of the previously introduced IS literature (Dennis and Valacich, 1999; Dishaw and Strong, 1999; Goodhue and Thompson, 1995) has assumed that IT capabilities affect use. Contrary to this assumption, our findings for H3a-d show that in the world of SIS, it is the shared utilization of SIS that generates value by fostering specific SIS capabilities. This suggests that the more SIS are utilized over an extended period of time, the more SMEs can benefit from developing rare, firm-specific capabilities. SIS utilization displays similar results with network effects where a firm gains more from SIS as (internal and external) organizational stakeholders utilize these technologies (Katz and Shapiro, 1994). In considering SIS as networks, the value of each network (in this case, each SIS) is positively affected by the number of its users and increases with network size (Saloner and Shepard, 1992). The obtained results are also compatible with the characteristics of network IT that do not impose organizational complements upfront; rather they emerge over a period of usage time (McAfee, 2006). These complements may then help building up relationships among users, which in turn should further increase the utilization of SIS and in turn strengthen and advance SIS capabilities. According to a global survey on how organizations were benefiting from Web 2.0, 69% of the 1,700 executives reported that their companies have gained measurable business benefits. Integrating Web 2.0 technologies into work flows of their employees and using Web 2.0 tools to link with customers and suppliers cultivated capabilities of having better access to knowledge, additional innovative products and services,

more effective marketing, lower costs of doing business and higher revenues (Bughin et al., 2009). This study emphasized that organizations that made greater use of such technologies reported improved benefits. The special role of shared SIS utilization for generating benefits warrants further investigations and probably different theoretical treatments, which may also include the design of interventions and complements. While it was suggested that utilization of network IT should not be enforced too strictly (McAfee, 2006), in our context higher levels of SIS governance are beneficial in fostering such enterprise wide SIS utilization. Future research could investigate in more detail whether different forms of governance moderated by freedom or independence among users affects SIS utilization.

While recent studies have been important in advancing our understanding of SIS, in particular from the perspective of affordances (O'Riordan et al., 2012, Treem and Leonardi, 2012), this study advances our understanding of the processes and routines affected by SIS capabilities. As with any technology, SIS in itself are not rare or hard to replicate (McAfee, 2006). In our context, if we account for SIS capabilities as mediators, the utilization of SIS has no direct effects on AC (rejected H4a-d). There are only indirect effects. Thus, SIS capabilities need to be developed first, which positively affect all four AC components (supported H5a-d). More specifically, our findings suggest that SIS utilization is more beneficial in improving the upstream AC components: The findings for M2a-b show that SIS capabilities fully mediate the effects of SIS utilization on the first two components of AC; namely, knowledge acquisition and assimilation. However, the findings could not support mediation effects of SIS capabilities on knowledge transformation (rejecting M2c) and we observed only partial mediation effects on knowledge exploitation (M2d). Consequently, it seems that SIS has a particular value for developing the first two components of AC. This reasoning is consistent with previous research, which focused on highlighting the importance of SIS for knowledge acquisition and assimilation only (Limaj and Bernroider, 2013). Future research could focus on identifying organizational complements needed to make SIS capabilities more effective in improving downstream AC components.

Our findings also provide more empirical clarity to existing AC theory and its relation to dynamic IT capabilities. As related literature generally lacks empirical studies (Wang et al., 2012), in particular investigating the relationship between AC components, the examination of H7a-c fills that gap by confirming relationships between the AC components in our research context. This result complements Zahra and George’s (2002) suggestion that AC

components are complementary and build upon each other to produce a dynamic organizational capability. It was suggested that developing organizational complements (in terms of additional capabilities such as coordination or socialization) produces synergies that positively affect AC (Roberts et al., 2012). We specifically show that SIS capabilities and their respective AC components are complementary resources and together clarify how to achieve both exploitative and explorative innovation; hence help to achieve a competitive advantage. Our results indicate that the combination of inside-out capabilities and AC4 is generally valuable but supports innovation types differently: While explorative innovation is affected both directly by inside-out capabilities and over AC4 (supported H6b, M3b, and H8b), exploitative innovation improves only through AC4 (supported M3a and H8a but rejected H6a). Future research could further investigate whether SIS provide different value for different types of innovation, for instance, by examining the effects of SIS capabilities and AC on other types of innovation, such as open or technical innovation, in order to identify possible differences in those effects.

Finally, this study has sought to build theoretical synergy by developing a research model incorporating different theoretical perspectives of SIS, AC, dynamic capabilities, and organizational innovation. Our empirical results demonstrate the usefulness of this integrative approach. Researchers have pointed out the need to re-evaluate established theories in light of the new potential of SIS (Majchrzak, 2009, Kane and Alavi, 2014) and our integrative model helps fill this gap.

6.2 Practical implications

From a practical viewpoint, we argue that managers in SMEs should consider capability-based management and acknowledge the central role of SIS in the development of dynamic capabilities and AC to generate valuable explorative or exploitative innovations. Our findings for H1 suggest that, in order to effectively utilize SIS, a strategy should be implemented, guidelines should be formulated, and roles should be specified in the context of SIS governance. Such activities may then give rise to new firm-specific capabilities (demonstrated here by the supported H2a-d and M1a-d) that can change organizational routines and processes, which eventually stimulate innovation.

Particularly SMEs should profit from the adoption of SIS given their specific characteristics. Among SMEs, for example, knowledge mobilization to foster innovation seems to be predominantly characterized by socialization (Desouza and Awazu, 2006), which helps move

tacit knowledge between individuals. SIS in particular support collaboration and socialization activities (O'Riordan et al., 2012; McAfee, 2009; Schlagwein et al., 2011). Our findings for H3b-c suggest that the utilization of SIS (in particular the SIS groups for communication and sharing communities) enables SMEs to gain valuable spanning interpretation and integration capabilities to encourage socialization. Additionally, spanning interpretation and integration capabilities are essential to form a common knowledge base among employees in SMEs, which is usually another specific requirement for SMEs (Desouza and Awazu, 2006). While knowledge in large organizations is typically distributed across various sectors, essential knowledge in SMEs needs to be known to all members. SIS enables a sharing context for interpretation, increases communication visibility and the speed of knowledge transfer (Leonardi, 2014), which are all important determinants to form common knowledge among employees. Successful SMEs have an ability for exploiting sources of external information (Robinson, 1982), diverse to large organizations that are less apt to do so (Prahalad and Ramaswamy, 2004). Especially when SMEs depend on external knowledge, utilizing SIS and developing outside-in SIS capabilities should allow SMEs to be well-connected and effectively acquire external knowledge. Finally, SMEs cannot invest the same level of resources into evaluating and implementing IT when compared to large enterprises (Bernroider, 2013). SIS adoption is neither costly nor very difficult in this regard (Zeiller and Schauer, 2011; McAfee, 2006; Schaupp and Belanger, 2014). Specifically, as the market becomes more complex and dynamic, SIS represent viable IT solutions for SMEs to strengthen AC and consequently innovation.

6.3 Limitations and future research

Finally, there are a number of limitations that were encountered, which suggests some future directions. First, this study makes use of the SIS definition introduced by Schlagwein (2011). Although this definition is appropriate for the purpose of this study, the literature shows a general lack of precision and confusion with regard to the conceptualization and terminology of SIS, let alone in terms of its measurement. SIS as a formative construct was measured based on the actual utilization of inquired SIS. However, future research could focus on developing a more comprehensive conceptualization and operationalization of this construct. Second, a new set of SIS capabilities were introduced, which were measured as the extent to which SIS assist in the accomplishment of each AC component. This type of measurement could arguably present another limitation of this study, as could the potential for measurement error in the self-report questionnaire. It is often argued that self-reported data leads to artificially elevated measures of covariation, producing percept-percept inflation in

correlations between measures. However, a previous large scale meta-study showed that percept-percept inflation may be more the exception than the rule in microresearch on organizations and cannot be considered self-evident (Crampton and Wagner, 1994). Future research could consider other measurements and possibly other metrics for SIS capabilities to confirm the results. Third, this study focuses on a specific national context. Future research could test concerns of nationality bias by utilizing the Amadeus data for other countries.

6.4 Conclusion

The aim of this study is to understand the influence of social information systems (SIS) on absorptive capacity (AC) and innovation in Austrian small- to medium-sized enterprises (SMEs). From our empirical study, it was found that the development of effective SIS capabilities emerges from the frequent utilization of SIS. While SIS capabilities impact and are in alignment with AC, the dynamic effects are derived from the combination of SIS capabilities and AC that nurture exploitative and explorative innovation. With SIS on the increase and proliferating in day-to-day work and personal lives, such an understanding is critical for building and maintaining a productive bridge that can promote an ongoing dialog between the fields of IS research, knowledge management, innovation management and organizational learning.

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APPENDICES

A1. Measurement scales and items

Table A1.1. Measurement scales and items

Construct	Type and Scale	Items	Support
SIS governance	Reflective; Agree (7) to Disagree (1)	1. Our organization has a strategy for utilizing social information systems (RO). 2. Our organization has defined roles and responsibilities for utilizing social information systems (RS). 3. Our organization has defined guidelines and procedures for utilizing social information systems (GU).	Self-developed based on (Weill, 2004, Zerfass et al., 2011)
SIS utilization	Formative; Never (1) to Very often (7)	1. SIS group for networking (Net) a. Social Networks b. Microblogging 2. SIS group for communication (Com) a. Web Conferencing b. Instant Messaging 3. SIS group for knowledge communities (Kn-C) a. Wikis b. Blogs 4. SIS group for sharing communities (Sh-C) a. Video sharing b. Shared database	Self developed based on (Hass et al., 2008)
Exploratory innovation and exploitative innovation	Reflective; Agree (7) to Disagree (1)	Exploratory innovation 1. Our organization accepts demands that go beyond existing products and services (EXPR1). 2. We invent new products and services (EXPR2). 3. We experiment with new products and services in our local market (EXPR3). 4. We commercialize products and services that are completely new to our organization (EXPR4). 5. We frequently utilize new opportunities in new markets (EXPR5). 6. Our organization uses new distribution channels (EXPR6). Exploitative innovation 1. We frequently refine the provision of existing products and services (EXPI1). 2. We regularly implement small adoptions to existing products and services (EXPI2). 3. We introduce improved, but existing products and services for our local market (EXPI3). 4. We improve our provision's efficiency of products and services (EXPI4). 5. We increase economies of scale in existing markets (EXPI5). 6. Our organization expands services for existing clients (EXPI6).	(Jansen et al., 2004)
Absorptive capacity	Reflective; Agree (7) to Disagree (1)	Acquire 1: Searching for relevant external information is every-day business in our organization (ACQ1). Acquire 2: Our employees are encouraged to identify and consider external information sources (ACQ2). Acquire 3: We expect that our employees acquire relevant external information (ACQ3). Assimilate 1: Ideas and concepts obtained from external sources are quickly analyzed and shared (ASS1). Assimilate 2: We work together across the organization to interpret and understand external information (ASS2). Assimilate 3: In our organization, external information is quickly exchanged between business units (ASS3). Assimilate 4: We regularly organize and conduct meetings to discuss new insights (ASS4). Transform 1: Our employees have the ability to structure and use newly collected information (TRA1). Transform 2: Our employees are used to preparing newly collected information for further purposes and making it available (TRA2). Transform 3: Our employees are able to integrate new information into their work (TRA3). Exploit 1: Our employees have immediate access to stored information, e.g. about new or changed guidelines or instructions (EXP1). Exploit 2: Our employees regularly engage in the development of prototypes or new concepts (EXP2). Exploit 3: Our employees apply new knowledge in the workplace to respond quickly to environment changes (EXP3).	Adapted from (Camisón and Forés, 2010, Flatten et al., 2011)
SIS	Reflective;	Outside-In 1: SIS assist in searching for relevant external information (OI-1).	Self-developed

capabilities	Agree (7) to Disagree (1)	Outside-In 2: SIS assist in identifying and considering external information sources (OI-2). Outside-In 3: SIS assist in acquiring relevant external information (OI-3). Interpretation 1: SIS assist in analyzing and sharing ideas and concepts (SP1-1). Interpretation 2: SIS assist in interpreting and understanding external information (SP1-2). Interpretation 3: SIS assist in quickly exchanging information between business units (SP1-3). Interpretation 4: SIS assist in discussing new insights (SP1-4). Integration 1: SIS assist in structuring and using newly collected information (SP2-1). Integration 2: SIS assist in preparing newly collected information for further purposes and making it available (SP2-2). Integration 3: SIS assist our employees in integrating new information into their work (SP2-3). Inside-Out 1: SIS assist in accessing stored information, e.g. about new or changed guidelines or instructions (IO-1). Inside-Out 2: SIS assist in developing prototypes or new concepts (IO-2). Inside-Out 3: SIS assist in applying new knowledge in the workplace to respond quickly to environment changes (IO-3).	based on (Kane and Alavi, 2014, Lu and Ramamurthy, 2011, Wade and Hulland, 2004)

A2. Sample descriptives

Table A2.1. Distribution of sample firms by industry

Sector (%)	Sector	No. of organizations	% of organizations
Information and communication (24.6)	Telecommunications	4	2.9
	Media and publishing activities	4	2.9
	Computer programming and consultancy	22	15.9
	Information service activities	4	2.9
Financial and insurance activities (2.3)	Financial and insurance services	3	2.3
Professional, scientific and technical activities (46.3)	Legal and accounting activities	15	10.9
	Management consultancy	14	10.1
	Architectural and engineering activities	18	13.0
	Scientific research and development	10	7.2
	Advertising and market research	7	5.1
Administrative and support service activities (8.7)	Other service activities	12	8.7
Manufacturing (8.7)	Manufacturing	12	8.7
	Total	125	90.6
	Unknown sector	13	9.4
	Total sample size (N)	138	100

Table A2.2. Respondents

Item		%	#
Sex	Men	92	127
	Women	8	11
Age	22–44 years	40	55
	45–59 years	51	70
	≥60 years	7	10
	No response	2	3
Respondents' role tenure	<3 years	8	11
	3–8 years	26	36
	Over 8 years	61	84
	No response	5	7

A3. Measurement validation

Table A3.1. Internal consistency, convergent and discriminant validity for reflective constructs

Latent Construct	Comp. Reliability	Cronbach's Alpha	AVE	GO	OI	SP1	SP2	IO	AC1	AC2	AC3	AC4	EXPI	EXPR
SIS Governance (GO)	0.929	0.885	0.812	**0.901**										
Outside-In (OI)	0.973	0.959	0.924	*0.567*	**0.961**									
Spanning 1 (SP1)	0.940	0.915	0.797	*0.559*	*0.786*	**0.893**								
Spanning 2 (SP2)	0.972	0.957	0.921	*0.525*	*0.767*	*0.831*	**0.960**							
Inside-Out (IO)	0.934	0.895	0.826	*0.593*	*0.787*	*0.851*	*0.892*	**0.909**						
Acquisition (AC1)	0.910	0.851	0.771	*0.423*	*0.656*	*0.525*	*0.408*	*0.499*	**0.878**					
Assimilation (AC2)	0.889	0.832	0.670	*0.435*	*0.367*	*0.590*	*0.369*	*0.469*	*0.636*	**0.818**				
Transformation (AC3)	0.962	0.941	0.895	*0.240*	*0.172*	*0.299*	*0.318*	*0.323*	*0.399*	*0.637*	**0.946**			
Exploitation (AC4)	0.866	0.767	0.684	*0.373*	*0.351*	*0.432*	*0.373*	*0.512*	*0.516*	*0.688*	*0.751*	**0.827**		
Exploitative-Inn (EXPI)	0.922	0.902	0.667	*0.258*	*0.275*	*0.271*	*0.246*	*0.282*	*0.374*	*0.372*	*0.405*	*0.599*	**0.816**	
Exploratory-Inn (EXPR)	0.919	0.895	0.656	*0.379*	*0.390*	*0.430*	*0.386*	*0.492*	*0.374*	*0.481*	*0.353*	*0.603*	*0.454*	**0.810**

Notes: Composite reliability (ρ_c) = $(\Sigma \lambda_i)^2 / ((\Sigma \lambda_i)^2 + \Sigma \text{var}(\varepsilon_i))$, where λ_i is the component loading to an indicator and var (ε_i) = $1 - \lambda_i^2$; AVE is the average variance extracted (AVE) by latent constructs from their indicators; on the diagonal are the square roots of AVE in bold font and in the lower right triangle are the correlations among latent constructs in italic font.

Table A3.2. Cross-loadings for reflective constructs

Scale Items	AC1	AC2	AC3	AC4	EXPI	EXPR	GO	IO	OI	SP1	SP2
ACQ1	**0.865**	0.515	0.301	0.385	0.379	0.346	0.323	0.365	0.542	0.414	0.260
ACQ2	**0.888**	0.583	0.375	0.509	0.291	0.266	0.436	0.487	0.634	0.520	0.420
ACQ3	**0.881**	0.575	0.371	0.457	0.322	0.379	0.347	0.454	0.547	0.442	0.384
ASS1	0.654	**0.820**	0.469	0.541	0.276	0.478	0.386	0.539	0.478	0.622	0.468
ASS2	0.549	**0.892**	0.492	0.552	0.275	0.408	0.410	0.413	0.312	0.513	0.323
ASS3	0.505	**0.869**	0.599	0.618	0.337	0.459	0.373	0.365	0.270	0.460	0.292
ASS4	0.336	**0.676**	0.538	0.546	0.346	0.187	0.236	0.168	0.088	0.297	0.070
TRA1	0.406	0.634	**0.943**	0.703	0.390	0.361	0.216	0.305	0.158	0.291	0.290
TRA2	0.350	0.584	**0.940**	0.694	0.389	0.301	0.268	0.299	0.173	0.302	0.341
TRA3	0.376	0.588	**0.955**	0.734	0.371	0.339	0.199	0.313	0.158	0.257	0.272
EXP1	0.487	0.544	0.622	**0.774**	0.604	0.434	0.193	0.302	0.244	0.268	0.201
EXP2	0.349	0.511	0.509	**0.811**	0.388	0.544	0.343	0.529	0.342	0.419	0.389
EXP3	0.440	0.642	0.720	**0.892**	0.489	0.520	0.386	0.445	0.288	0.386	0.338
EXPI1	0.366	0.426	0.488	0.667	**0.883**	0.422	0.207	0.229	0.187	0.205	0.172
EXPI2	0.380	0.315	0.435	0.577	**0.882**	0.327	0.177	0.229	0.227	0.180	0.200
EXPI3	0.209	0.253	0.215	0.332	**0.733**	0.305	0.183	0.187	0.178	0.277	0.244
EXPI4	0.324	0.307	0.321	0.512	**0.906**	0.380	0.237	0.249	0.261	0.241	0.223
EXPI5	0.178	0.178	0.091	0.290	**0.689**	0.458	0.250	0.223	0.245	0.227	0.176
EXPI6	0.289	0.255	0.240	0.369	**0.782**	0.388	0.267	0.294	0.306	0.275	0.235
EXPR1	0.276	0.421	0.297	0.541	0.349	**0.779**	0.293	0.408	0.326	0.330	0.261
EXPR2	0.398	0.483	0.386	0.618	0.354	**0.872**	0.332	0.413	0.304	0.329	0.308
EXPR3	0.307	0.373	0.378	0.537	0.439	**0.860**	0.270	0.412	0.325	0.359	0.356
EXPR4	0.275	0.397	0.227	0.438	0.425	**0.879**	0.390	0.452	0.362	0.419	0.380
EXPR5	0.294	0.338	0.168	0.359	0.303	**0.726**	0.177	0.234	0.238	0.252	0.179
EXPR6	0.250	0.296	0.192	0.366	0.326	**0.728**	0.360	0.438	0.333	0.398	0.377
RO	0.306	0.321	0.174	0.265	0.192	0.314	**0.894**	0.477	0.480	0.462	0.445
RS	0.418	0.413	0.246	0.341	0.275	0.337	**0.916**	0.544	0.540	0.512	0.486
GU	0.409	0.433	0.224	0.392	0.227	0.369	**0.894**	0.575	0.510	0.532	0.485
IO-1	0.523	0.393	0.238	0.385	0.237	0.342	0.512	**0.878**	0.751	0.777	0.773
IO-2	0.387	0.419	0.282	0.495	0.227	0.480	0.506	**0.915**	0.677	0.778	0.810
IO-3	0.461	0.462	0.351	0.506	0.301	0.502	0.594	**0.933**	0.725	0.771	0.846
OI-1	0.575	0.307	0.169	0.287	0.288	0.390	0.525	0.718	**0.940**	0.718	0.717
OI-2	0.671	0.395	0.174	0.387	0.284	0.392	0.553	0.773	**0.974**	0.779	0.738
OI-3	0.642	0.351	0.153	0.333	0.223	0.342	0.556	0.776	**0.969**	0.766	0.754
SP1-1	0.547	0.501	0.279	0.430	0.243	0.384	0.479	0.812	0.791	**0.883**	0.773
SP1-2	0.477	0.582	0.245	0.392	0.252	0.423	0.562	0.817	0.737	**0.928**	0.764
SP1-3	0.462	0.526	0.287	0.361	0.223	0.391	0.468	0.742	0.692	**0.920**	0.763
SP1-4	0.388	0.495	0.259	0.361	0.252	0.332	0.483	0.664	0.580	**0.839**	0.667
SP2-1	0.410	0.361	0.280	0.363	0.220	0.414	0.517	0.877	0.748	0.812	**0.953**
SP2-2	0.383	0.374	0.327	0.360	0.224	0.353	0.519	0.844	0.729	0.796	**0.959**
SP2-3	0.382	0.327	0.307	0.352	0.264	0.343	0.475	0.848	0.730	0.786	**0.967**

Notes: Bold numbers are the loadings of indicators on their own construct.

Table A3.3. Outer weights and loadings, t-values and p-values, and VIF for formative construct

Latent Construct	Weights (Outer Loadings)	t Values	p Values	VIF
SIS Utilization (UT)				
SIS group for communication (Com)	0.426 (0.873)	3.336	0.00*	1.766
SIS group for knowledge communities (Kn-C)	0.301 (0.795)	2.951	0.00*	1.803
SIS group for networking (Net)	0.304 (0.859)	2.189	0.03**	1.782
SIS group for sharing communities (Sh-C)	0.163 (0.785)	1.220	0.22	1.475

Note: * p <.01; ** p <.05

A4. PLS-SEM results

Table A4.1. Verdict on structural relationships

Path	Path co-efficient (β)	Effect size (f^2)	Effect size (q^2)	Standard error	t Value	Verdict (based on f^2)
Hypothesis 1						
GO → UT	0.542	0.42	N/A	0.065	8.307*	Large Effects
Hypotheses 2a-d						
GO → OI	0.343	0.15	0.14	0.080	4.300*	Small Effects
GO → SP1	0.271	0.10	0.06	0.070	3.890*	Small Effects
GO → SP2	0.278	0.10	0.06	0.081	3.426*	Small Effects
GO → IO	0.326	0.16	0.11	0.068	4.821*	Medium Effects
Hypotheses 3a-d						
UT →OI	0.413	0.22	0.19	0.079	5.200*	Medium Effects
UT →SP1	0.532	0.41	0.26	0.066	8.016*	Large Effects
UT →SP2	0.455	0.25	0.19	0.076	5.955*	Medium Effects
UT →IO	0.492	0.36	0.25	0.066	7.497*	Large Effects
Hypotheses 4a-d						
UT →AC1	-0.046	0.00	0.00	0.074	0.621	No Effects
UT →AC2	-0.056	0.00	0.00	0.075	0.738	No Effects
UT →AC3	-0.103	0.01	0.01	0.085	1.209	No Effects
UT →AC4	0.078	0.01	0.00	0.062	1.206	No Effects
Hypotheses 5a-d						
OI → AC1	0.684	0.53	0.33	0.071	9.635*	Large Effects
SP1→ AC2	0.391	0.14	0.07	0.090	4.326*	Small Effects
SP2 → AC3	0.151	0.02	0.02	0.089	1.700^{T}	Small Effects
IO → AC4	0.249	0.09	0.03	0.076	3.295*	Small Effects
Hypotheses 6a-b						
IO → EXPI	-0.033	0.00	0.00	0.091	0.366	No Effects
IO → EXPR	0.248	0.07	0.04	0.086	2.869*	Small Effects
Hypotheses 7a-c						
AC1 → AC2	0.451	0.30	0.15	0.074	6.101*	Medium Effects
AC2 → AC3	0.620	0.55	0.45	0.074	8.410*	Large Effects
AC3 → AC4	0.653	1.07	0.45	0.060	10.879*	Large Effects
Hypotheses 8a-b						
AC4 → EXPI	0.616	0.43	0.21	0.084	7.341*	Large Effects
AC4 → EXPR	0.476	0.27	0.14	0.082	5.795*	Medium Effects

Note: * $p < .01$, ^{T} $p < .1$

A5. Mediation results

Table 5.1. Results of mediation analysis

M1	**DV: O-I**		**DV: SP1**		**DV: SP2**		**DV: I-O**	
	1	2	1	2	1	2	1	2
Path GO → UT → DV	0.567	0.343	0.560	0.270	0.525	0.278	0.593	0.326
Sobel mediation test	Z-value: 4.41		Z-value: 5.62		Z-value: 4.83		Z-value: 5.53	
Two-tailed probability	$p < 0.001$		$p < 0.001$		$p < 0.001$		$p < 0.001$	
VAF	39%		52%		47%		45%	
M2	**DV: AC1**		**DV: AC2**		**DV: AC3**		**DV: AC4**	
	1	2	1	2	1	2	1	2
Path UT → SIS C → DV	0.363	-0.046	0.163	-0.056	-0.017[n.s.]		0.234	0.078
Sobel mediation test	Z-value: 4.68		Z-value: 3.91				Z-value: 2.98	
Two-tailed probability	$p < 0.001$		$p < 0.001$				$p < 0.001$	
VAF	119%		80%				43%	
M3	**DV: EXPI**				**DV: EXPR**			
	1		2		1		2	
Path I-O → AC4 → DV	0.292		-0.033		0.498		0.0248	
Sobel mediation test	Z-value: 2.95				Z-value: 2.82			
Two-tailed probability	$p < 0.001$				$p < 0.001$			
VAF	128%				32%			

[n.s.] not significant → Step 1 not fulfilled

Note 1: **DV** represents dependent variable, **SIS C** represents each O-I, SP1, SP2, I-O capability respective to DV.

Note 2: **Column (1)** represents direct path coefficients that are estimated *without* including the mediator variable for the given DV. **Column (2)** represents direct path coefficients that are estimated for the full model (i.e. including mediator) for the given DV.