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Future research on information technology in knowledge management

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Abstract:	Over the past two decades, Knowledge Management (KM) and the use of Information Technologies (IT) has attracted increasing interest. IT is widely considered as a vital part of KM, providing means for knowledge creation, sharing and capture. However, failures of KM in organizational practice are often attributed to an overemphasis of IT. While KM and IT seem inextricably linked, research still struggles to identify a proper composition of the two. Via input from a global panel of KM experts from academia and practice (n=222), we identify social software, consumerization (of knowledge), human factors and the redesign of work, systems and practices as future key research areas. These are contrasted with review papers proposing research in technologies aimed at supporting KM. On this basis, we present a future research agenda that should enhance the relationship between KM and IT, including their intersection through technology enablers.

Introduction

Knowledge management and its associated knowledge management systems (KMS) have experienced two decades of academic research and industrial practice, as well as their fair share of expectation and hype (see e.g. Leidner 2000, Blair 2002 for a balanced view on the emergent field, Ragab & Arisha 2013 for a recent comprehensive review). In recent years, the potential and significance of KM has increased because of the fast development of technology and easy accessibility of data (Sarka et al. 2014). Development of new and improved technological enablers related to KM initiatives has the potential to transform the KM field and open up new horizons for KM (von Krogh 2012). This paper extrapolates themes for future research in the relationship between KM and technology enablers.

The objective of KM was early seen as a means and a strategy for capturing, utilising and transferring knowledge throughout an organisation (Demarest 1997), thus achieving the business goal of competitive advantage by developing the organisation's knowledge assets (Wigg 1999) or intangible resources (Wernerfelt 1984, Spender 1996). The process of knowledge generation and dissemination within organisations and associated influencing factors was deemed critical (Davenport & Prusak 1998). Knowledge management competence has been positively correlated with enterprise system success (Sedera & Gable 2010). More recently, it has been suggested that KM could be a vital mechanism for ensuring the survival of organisations in the contemporary globalised and hypercompetitive marketplace (Wu & Lin 2009, Ford & Mason 2013).

Information technology (IT) and KM have been strongly linked from the outset with IT as a contributor and enabler of KM (Davenport & Prusak 1998, Leidner 2000, Alavi & Leidner 2001, Alavi & Tiwana 2002, Schultze & Leidner 2002, Chalmeta & Grangel 2008, He et al. 2009, Baloh et al. 2012), whether for storage, distribution or search (Marwick 2001, Koch et al. 2003). IT presents opportunities for performing tasks more quickly and supporting knowledge sharing, consequently increasing the productivity of employees involved in knowledge work (Norton 1995, Sigala 2003, Casal et al. 2005, Ahuja et al. 2009). At the same time, it has been claimed that IT is as much part of the problem as the solution, in that failures of KM in practice are the result of the conflation of KM and IT systems (Swan et al. 1999), or focusing on the technology at the expense of human factors (Scarbrough & Swan 1999). Various KM studies have sought to mediate this tension by emphasising human factors and interactive technologies in KM (Ardichvili et al. 2003), the need for four balanced pillars of KM, namely leadership, organization, technology and learning (Mohamed et al. 2006), or

using participatory action research coupled with sound conceptual underpinnings when creating core IT KM artefacts (Butler et al. 2008). Even this brief introduction suggests that there are long-running and perennial themes within the KM academic literature, such as the purpose or value of KM and the role and effective usage of technology enablers for KM (Holsapple & Joshi 2000).

This paper focuses on the future for the intersection of KM and information technology, drawing upon a number of published reviews and forecasts and on the results of an extensive international study of 222 KM experts from academia and practice, conducted by a global network of more than twenty research partners. This analysis of previous studies, reviews and informed expert opinion enables reflection on the key lacunae and predicted growth areas of research as identified in the previous studies and on what is the contemporary perspective of the research challenges. The combination also yields insights into what might be characterised as "perennial" research themes and novel (though potentially "transient") lines of inquiry.

The remainder of this paper is structured as follows. Firstly, key reviews of the KM field which focus on the advances and areas for future progress are presented. Secondly, the methodology, data acquisition and analysis methods employed in the Global Knowledge Research Network's survey are described. Thirdly the survey results in the area of future research challenges for KM are detailed and analysed. These findings are discussed in the context of the prior reviews, highlighting key similarities and differences. Finally the paper draws a number of conclusions and makes suggestions for future KM research.

Background: Past predictions on future research themes

Since the beginning of the new century (Leidner 2000), several scholars have undertaken reviews and studies of KM research in order to suggest future research. We summarise ten contributions between 2001 and 2014 focusing on the aims, research methodology employed and the research directions suggested (see Table 1). We exclude general reviews of the KM field (Argote et al. 2003, Serenko & Bontis 2013, Tzortzaki & Mihiotis 2014) without particular emphasis or link to IT or information systems.

Alavi and Leidner (2001) reviewed the literature of knowledge management and its cognate fields in an effort to create a set of conceptual foundations for KM and to ascertain areas of promise for future research. Their approach reflected upon the consequences of the various perspectives on knowledge, whether it was the knowledge-information-data relationship, knowledge as object, process or

capability etc., and the different types of knowledge (explicit, tacit, social, declarative, procedural, conditional, causal, etc.). They constructed a framework based on the sociological theory of knowledge and organizations as "social collectives and knowledge systems", where there were four sets of "socially enacted knowledge processes" (creation/construction, storage/retrieval, transfer, and application). This led to their formulation of five research questions with associated sub-questions encapsulating what they saw as the key research issues in the field: (1) what conditions facilitate knowledge creation in organizations (this covered organizational culture and IT as well as issues relating to externally sourced knowledge); (2) what incentives are effective in encouraging knowledge contribution and sharing in organizations (also covering issues of context and trust in knowledge); (3) how can knowledge be effectively transferred among organizational units (including cultural, organizational and technical issues and whether IT inhibits searching externally (to the organization) for knowledge); (4) how can an organization encourage application of knowledge that is made available (the knowing-doing gap); and (5) what are the consequences of increasing the breadth and depth of available knowledge, via information technology, on organizational performance (including modification and trust in knowledge and the quality and utility of IT in KM initiatives).

Another review about Knowledge Management Systems (KMS) was undertaken by (Gallupe 2001) who proposed a Knowledge Practices Framework to identify both gaps and areas of strong research. He based the review on 40 articles, 15 books and various KMS-related websites, from academia and practitioners. Gallupe (2001) identified knowledge acquisition and storage (including knowledge maps, repositories and document management systems) as an area of research strength. Research gaps were identified by (Gallupe 2001) around topics such as knowledge creation (e.g. knowledge forums, communities of practice, electronic brainstorming tools), knowledge sharing (e.g. chat rooms, environmental scanning, search engines) and sharing previously solved problems via formal information training. Methodologically, it was identified that more research should be undertaken in field studies including surveys and benchmarking studies, as well as laboratory or experimental studies of KMS. Finally, Gallupe (2001) raised the need to understand the impact generated by KMS on the organization and people, and that research should develop measurement approaches about KMS impact.

Schultze and Leidner (2002) studied the topic of knowledge management in information systems research. They employed Deetz's discourse framework (Deetz 1996) as a means of exploring the

research themes, knowledge metaphors, and theoretical foundations of this area of KM research. They undertook a systematic literature search explicitly targeting academic research, rather than practitioner-led research, across six leading information systems journals on a timeframe of 1990 to 2000. They were able to categorize 79 of the qualifying articles according to one or other of the four discourse types (dialogic, critical, interpretative and normative), of which only two articles could be deemed a dialogic discourse and only one a critical discourse. Rather than providing a list of research question, the work sought to prompt researchers in their future work at a more philosophical level. They suggested that researchers should consider utilizing these under-represented discourses and should, in any event, be more willing to capture their underlying assumptions regarding knowledge and management when conducting or reporting KM research. They see this as helpful to strengthening the theoretical foundation of the topic and to better explore the "contradictory and double-edged nature of knowledge".

A review of KM with particular reference to applications and technologies was conducted by Liao (2003). This literature review targeted the timeframe from 1995 to 2002, capturing the state of the field as the Internet and World Wide Web exploded into the mainstream. 234 application and technology-related papers were classified into seven "technology" categories: knowledge management frameworks, knowledge-based systems, data mining, information and communication technology, artificial intelligence/expert systems, database technology and modelling. Despite focusing on the classification, Liao suggested that there were promising future areas of research and development in the integration of qualitative and quantitative methods into KM technologies and applications as well as the combination and integration of technologies themselves. An interesting observation was that social or technical change could either encourage or inhibit future KM application and technology development.

The aim of a global Delphi study (Scholl & Heisig 2003, Scholl et al. 2004) was to identify future research needs by understanding the advances, challenges and promising approaches in KM theory and practice. Their study included 45 KM experts in the first round and 25 in the second Delphi round. The advances in theory and practice were seen in a shift from a dominant IT-perspective towards prioritizing human factors. IT was not assessed as a promising approach to KM at all in this study, instead matching social and technical aspects and the integration of KM into business (organizational) processes were judged as the most promising. Research approaches should be interdisciplinary and multi-disciplinary. Organizational learning approaches were assessed as not yet being exploited.

Experts suggested there was a need for more research about communities of practice, social network analysis, and methods to assess knowledge and KM.

Antonova et. al. (2006) reviewed technological solutions for KM. Based on the main KM processes they presented a classification of different facilitating technological solutions described in theory and practice. Later, using data from a survey conducted by KPMG (KPMG 2004), Antonova et al. (2006) demonstrated that technologies play a vital role in KM processes. However, they emphasized the need for KM implementation to focus in the first instance on human and organizational issues and not technology. They further highlighted that KM tools are implemented to support knowledge processes in organizations and help managers and employees, thereby, the technologies are not standalone saviors but part of the organizational and human processes. A KM strategy must depend on the organizational processes and structures and respond to the organization's specific needs if it is to succeed (Antonova et al. 2006).

Venters (2006) explored the use of technology within KM by reviewing how technological artefacts are employed within KM interventions, discussing specifically the aspects most relevant to interventions. Although the literature has claimed that KM technologies are focusing on managing explicit knowledge (Alvesson & Kärreman 2001) and others have claimed that these technologies are incapable of capturing knowledge (Galliers & Newell 2003), Venters (2006) argued that technology remains an important artefact in our social world. Venters (2006) presented and explored a number of approaches to the design and configuration of KM technologies. His discussion emphasized a need to appreciate the human activity and the context within which these activities take place. Hence, Venters (2006) suggested future research should consider the situated role of technology within KM and how this can be designed and implemented in a socially constructed and already established work practice. Research should furthermore consider the sensemaking activities shaping how individuals use and understand the technologies.

Insert Table 1 here

Through an extensive literature review including studies from 1995-2010, Lee and Chen (2012) identified that KM themes have expanded into a broad spectrum of disciplines and they confirmed a great diversity within the focus of former KM research. They found that most of the identified research themes were spreading around the centre of their proposed strategic paradigm (Lee & Chen 2012). Finding that the KM field is neither focusing on a dominant paradigm nor fragmented into a

myriad of subfields, they concluded that the research directions in KM are still evolving and have not reached their maturity (Lee & Chen 2012). According to Lee and Chen (2012), the most important future research theme in KM studies is to explore KM challenges and to develop new methods for coping with knowledge reuse and innovation. Additionally, they found that technological enablers for KM have received attention throughout the entire period of focus. However, they reveal an ongoing discussion in the literature as to whether Information and Communication Technology (ICT) inhibits or facilitate knowledge creation and use.

Von Krogh (2012) argues that KM is changing fundamentally today. Previous KM initiatives often involved centrally managed knowledge repositories whereas, today, the trend is towards social software. According to von Krogh (2012), social software introduces more personalized tools that are more effective in meeting individual needs. Social software differs from traditional KM technologies by offering open, ubiquitous and mobile solutions at a low cost. By examining how the use of social software influences KM based on former research, von Krogh (2012) drafted a strategic research agenda. This consists of fundamental issues that should reinvigorate research in KM, namely the choices and implications of social software, barriers to and enablers of adoption of social software, ensuring the value of knowledge when using social software, the implementation of social software, the consequences of KM by social software for competitive advantage, and the dynamic recreation of organizational boundaries.

Qui and Lv conducted a recent review using bibliometric analysis of research indexed in the Web of Science database (Qiu & Lv 2014). They identified as the core research areas of the two decades from 1993 to 2012 the following research themes ”Knowledge Management,” ”Knowledge Sharing,” ”Ontology,” ”Knowledge,” ”Innovation,” ”Organizational Learning,” ”Knowledge Transfer,” ”Tacit Knowledge” and ”Intellectual Capital”. Their analysis indicated that ”Knowledge Sharing,” ”Ontology,” ”Tacit Knowledge,” ”Intellectual Capital,” ”Knowledge Management Systems,” ”Semantic Web,” ”Knowledge Creation,” ”E-Learning” and ”Project Management” are increasing topics while research about ”Information Technology” and ”Information Management” are becoming less important.

While these studies cover a period of about a decade (2001-2014), some research themes have been suggested by different authors at different times, such as research regarding the enablers or inhibitors for KM (Alavi & Leidner 2001, Liao 2003, Lee & Chen 2012) or particular KM technologies (von Krogh 2012), human and social factors (Scholl & Heisig 2003, Scholl et al. 2004, Antonova et al.

2006, Venters 2006), impact on performance (Alavi & Leidner 2001, Gallupe 2001) as well as KMS support for KM processes such as knowledge creation and knowledge transfer/sharing (Alavi & Leidner 2001, Gallupe 2001, Qiu & Lv 2014), or innovation (Lee & Chen 2012, Qiu & Lv 2014) and knowledge reuse (Lee & Chen 2012). Only one review (Schultze & Leidner 2002) looked at the theoretical foundations and suggested to apply more critical (Day 2001) and dialogic discourse methodologies, while others emphasized the need for more multi-disciplinary approaches (Scholl et al. 2004), or combined qualitative and qualitative approaches (Liao 2003) or field and laboratory studies (Gallupe 2001).

Research methodology

The literature on KM and technological enablers is extensive and has been conducted over many years. The existing literature reviews presented above have indicated many potential research themes across the entire discipline which could advance KM. Much research has been conducted within KM during the latest decades, creating a foundation upon which to build future research. However, KM is not firmly established as a management function in organizations, so we suggest that the literature may not be yielding a comprehensive research agenda. The involvement of practitioners from industry, government and international organizations in KM research has declined from 48.3% (1997) to 10.1% (2008) (Serenko et al. 2010). Literature-based reviews and prognostications of valuable future research may consequently be inadvertently biased towards the views of academia. To mitigate this, input in terms of the views and experiences of practitioners who work with KM in their everyday lives as well as academic experts must be combined with the literature perspective. This triangulation enables a comparison of findings from research with what is being reported to be missing by executors, in order to establish a more comprehensive view on which themes need to be addressed to advance KM research in the future. By undertaking a comprehensive study about future KM research including KM experts from a global panel, the aim is to help increase the relevance of the KM field (Booker et al. 2008).

This research is part of a large, global research project aimed at establishing a global research agenda for different research areas within the knowledge management discipline, including those relating to business outcome, human factors, KM processes, capabilities, strategy, environment and the societal level framed as knowledge economy or knowledge society (Reference anonymised during review).

This paper focuses in particular on the aspects related to information technology as one enabler for KM (Reference anonymised during review). The overall approach to the global KM research study is described in (Reference anonymised during review). Here, we will briefly outline the overall approach and mainly focus on the description of the methodology and analysis steps employed for this paper.

Research approach and instrument

A consortium of 27 research partners from 26 countries (recruited by one of this paper's authors) used an explorative approach to gather input from an international panel of KM experts regarding advances, challenges and future research needs in knowledge management. A semi-structured interview guide was conceptualised based on a previous Delphi study (Scholl & Heisig 2003, Scholl et al. 2004), core dimensions of KM frameworks (Heisig 2009) as well as practice-oriented KM guides accepted by KM communities in Europe (BSI 2001, BSI 2003a, BSI 2003b, BSI 2003c, CEN 2004, DIN 2012) and Asia (AS 2001, AS 2003, AS 2005, APO 2009). The proposed main research dimensions are also supported by domain analysis of the KM field (Nie et al. 2009).

KM experts were asked first about the advances, challenges and promising approaches in KM theory and KM practice (Scholl & Heisig 2003, Scholl et al. 2004) followed by their understanding of the core concepts 'knowledge' and 'knowledge management'. Then, a more focused reflection on research needs were triggered by prompts on eight thematic areas derived from the KM frameworks and KM guides such as: 'business outcome', 'human and social enablers', 'technology enablers', 'KM processes', 'organizational capabilities', 'strategy', 'organizational environment' and 'knowledge economy' and 'knowledge society'. A pre-test took place in Denmark and Germany with no modifications required. This paper focuses on the results concerning "technology enablers".

A purposeful sampling approach was applied which aimed to include ten KM experts (minimum 5 years KM professional experiences) per country, half from academia and half representing KM practice. These experts were selected from different disciplines representing the interdisciplinary character of the field (Ponzi 2002, Maier 2004, Jasimuddin 2006, Dwivedi et al. 2011, Qiu & Lv 2014). KM practitioners represented different industries in their country. The suggested and preferred format for data gathering was face-to-face or phone interviews. While 13 partners undertook 127 interviews (6900 minutes), 14 partners received written input from 95 KM experts. Interviews were recorded, transcribed and translated from national language into English by each partner. All transcripts and written input was collected by one of the authors, who integrated the data into Nvivo9.

Input for the final dataset was accepted until January 2014. Joining research partners were briefed by the coordinator about the study aims and introduced to the research instrument.

Sample

The study sample comprises valid replies from 222 KM experts. The KM experts of our panel have an average KM experience of 12.3 years. Our sample includes 77% male and 23% female experts. The following tables provide the distribution of the main demographic variables of our panel.

Insert Table 2 here

Insert Table 3 here

Insert Table 4 here

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Insert Table 6 here

Insert Table 7 here

Analysis

For this paper, the data analysis was performed using a four-step inductive bottom-up coding process, which allowed themes to emerge from the empirical data. In a first step, the coordinator coded the input data following the sections of the interview guide and forwarded the data to a pair of two researchers (between 100-160 pages per section). As a second step, these two partners independently analysed the interview data related to the section D3 – Technological enablers, and suggested categories of themes which emerged from the data (King 1998, Strauss & Corbin 1998). The third step included a three-day workshop attended by 22 researchers from 20 countries. During the workshop, the two researchers doing the second step analysis for this paper met for the first time in person and discussed their findings. Their suggestions were presented and discussed with the other researchers. A final thematic clustering was carried out in order to establish the main research themes derived from this study and reported in (Reference anonymised during review).

In the fourth step, a cross-check was performed using data mining and related literature. Relevant literature reviews related to the KM field and in particular to the (information) technology field were identified and summarised in regards to the research needs suggested (see Table 1). The authors refined their initial analysis from step 2 in order to provide a more comprehensive description of the research themes identified in step 3. Additionally, using a pre-set list of terms from the academic and

trade literature (e.g. "Big data") full-text searches were carried out within the entire dataset in order to double-check that all relevant topics were addressed. The authors aimed to verify the previously identified themes by going back to the original transcripts and input from the experts in order to understand the context of the contribution. We aimed to understand how novel research topics (e.g. "big data", "Bring Your Own Device") were addressed by the expert panel. Finally, the research themes that emerged from the global KM expert panel were discussed and compared to those suggestions derived from the reviews in literature. This procedure resulted in the identification of 4 main thematic areas and 18 future research themes. An overview of the process is depicted in **Error! Reference source not found.**.

In the following section, we will report the results from our expert panel. The quotations from the panel members are coded as follows: Country-Number-Sector-Role-KM experience-Discipline (see appendix for coding schema).

Insert Figure 1 here

Results and discussion

The research topics relating to technology enablers identified from the 222 KM experts were grouped into 4 main thematic areas such as 'social software', 'human factors', 'redesign of work' and 'systems & practices'. For each thematic area the sub-themes identified are described in the following sections.

Social software: An advancement in KM

A first overarching result from the global KM expert panel was that only one theme was assessed as an advance in KM despite the heterogeneous views expressed by all experts (Reference anonymised during review). '*Social media / social networking'* was assessed as "*the most important practical advancement in KM"* [AU-01-HE-PRO-17-BIS] or "*an effective under pinning for Knowledge Management, however you define knowledge"* [CA-06-HE-PRO-17-IS]. Some experts even claimed that without social software "*KM is barely possible anymore (...)"* [DE-09-CP-OB-5-NAT]. Experts highlighted different aspects of social software for their assessment. The ease of use is one aspect as "*… it's becoming so much easier"* [CA-06-HE-PRO-17-IS]. This technology, e.g. *Web 2.0 and social media* enables "*massive and ad hoc knowledge sharing inside and across organizations"* [HK-02-HE-PRO-24-ENG]. The spill-over effects from the increased use of social software in society "*for knowledge creation and sharing are significant developments in KM practice"* [ET-01-HE-PRO-12-

IS]) is another aspect mentioned. The use of social software for KM is also believed to help "*to get in touch with tacit knowledge available with experts in the organization"* [IN-03-HE-PRO-10-BM] which could be captured as "*user-generated"* [AU-01-HE-PRO-17-BIS] "*allowing the crowd to self-author knowledge articles"* [IE-01-ITS-OB-14-BM] or to create a "*sort of bottom-up directory of expertise"* [ZA-06-CG-OB-6-KM].

Further, full-text searches of keywords revealed that just over a third of experts mentioned social software related terms in their statements which increases to about half of all experts if we include the terms "wiki", "blog" and "web 2.0" into our search strings. The majority of the social software terms were mentioned by KM practitioners except for the analytical concept "social network analysis" which shows an equal distribution among those two groups.

The experts mentioned several future research themes in the relationship between social software and KM covering almost every thinkable context. The most emphasized themes can be related to the categories usage, connectedness, value, openness and sharing, extimacy and security.

Usage

The experts generally anticipated a continuing significant importance of social software on and for KM, therefore, they want research to focus on *"what social media is and what its role will be in the future"* [FI-03-CPS-NA-32-ENG]. They want to explore how to *"use 'social media' within the firm, use 'social media' for the firm"* [DE-01-ELE-IKM-16-ENG] and emphasis should be on *"how effective using web 2.0 technology on KM"* [HK-07-ELE-IKM-1-ENG]. Additionally, research should focus on how the usage of social software possibly can provide constraints for KM processes and what the potential outcome and prevention of these could be.

Because social software is an emerging field, there are as yet many unexplored or underexplored areas, e.g. *"Log analysis"* [AU-01-HE-PRO-17-BIS] and *"... some sort of figures and stats on the use of social media"* [GB-19-CP-OB-3-NAT] can help to better understand the potential benefits and usages of the tools in relation to KM. One challenge pointed towards by the experts is the applicability of the tools in various kinds of business situations and one expert also emphasized a need to examine whether *"... social media really allows to develop knowledge or is it only information overload?"* [TH-02-CPS-IKM-3-KM].

Additionally, research should focus on how to avoid or control so-called *"shit storms"* [DE-06-HE-PRO-23-BM]. The phrase refers to instances where a company releases some news, a product, etc., individuals take umbrage at some perceived or real slight, and protest against it in online fora. If such protests go "viral", a company can face a wave of rapidly (self-)-organizing hostility and publicity, requiring it to apologize, perform a *volte-face*, or in some other way defuse the situation before it escalates further. One of the criticisms of social software is that it can be a source of 'shit storms' if not managed and used optimally.

The experts acknowledge social software can provide new opportunities as well as challenges. Another area that needs to be paid attention according to the experts is the utilization of the varying tools available. In order to exploit the potential benefits of social software, businesses need to have a comprehensive understanding of the effectiveness and function of the different tools. As one expert stated: *"social media is influencing many aspects of our lives. We can examine and see how we can fully utilize them for KM*" [HK-05-HE-PRO-6-OD]. Research should focus on *"the interconnection between social networking platforms, mobile devices, and cloud computing, and services and software"* [CA-03-CPS-EKM-12-BM]. As organizations *"really do not really know how to operate it"* [DE-04-HE-PRO-15-BM] we need to further explore this area *"to understand the content of social media"* [HK-01-HE-SL-15-IS] and to identify *"what are the appropriate social media for KM?"* [HK-05-HE-PRO-6-OD].

One social software tool stood out as the most mentioned one: Wikis. Wikis are probably the most commonly used social software tool in organizations and *"to a very large extent can actually start replacing your formal document management systems"* [ZA-02-ITS-DIR-14-KM]. It was mentioned several times by the respondents, and wikis have been implemented in many organizations as a knowledge sharing tool. *"We can create little knowledge repositories dynamically with wiki's, and we can now enter into mass collaborations like we've never seen before"* [GB-04-CPS-DIR-19-CIT]. Some research has already focused on the use of Wikis in organizations, yet there still seems to be many challenges and opportunities to explore and exploit, according to the experts.

Connectedness of people

The world is experiencing increasing connectivity and a fading of boundaries. Globalization impinges upon our everyday life and organizations are not immune. This challenge was also addressed by the experts in relation to the use of social software for KM. As one expert stated: *"I think it points a lot*

towards behavioral changes, e.g. like with social media" [DK-06-BIF-DIR-1-BM]. The increasing distances between collaborators demands increasing connectedness, which social software is expected to be able to support. We are *"now about to experience a generation of workers who are much more used to that technology and therefore will knowledge sharing be easier given that you've got all these younger people coming in who are very familiar with using Facebook and potentially LinkedIn or social media tools, which the emphasis there is very much on networks, not necessarily professional networks but that could have quite a positive impact on the use of technology to support things like communities in practice"* [GB-17-SER-IKM-11-CIT].

However, globalization also introduces challenges e.g. in regard to lack of face-to-face communication. Despite being based on social relations and said to facilitate these in a virtual environment, social software present a different approach to connection than through physical co-location. Therefore, the experts also asked for research to explore the *"internet-based social networks and the negative impact of technology on social relations of people and, therefore, the impact on knowledge management"* [CO-01-HE-PRO-9-BM].

Value

Another important research theme pointed towards by the experts was the value of using social software. *"Many of the studies of social media that I have seen talk about adoption rates, usage rates and very little about business value"* [GB-01-CPS-EKM-20-GEO]. Future research should define and prove the potential that these tools could provide and *"we need to more proactively engage as knowledge managers in understanding and capitalizing on the potential of this technologies"* [MX-01-HE-PRO-23-PSY]. In order to achieve this, research should especially study *"how effective is social media in creating and sharing knowledge?"* [NG-01-HE-PRO-10-IS], the *"Impact of web 2.0 on knowledge availability in terms of quality and speed of response"* [LK-01-ITS-CKO-8-ENG] and *"on the inherent value, usefulness, potential for tools such as Twitter, social media sites"* [CA-06-HE-PRO-12-IS].

Openness and sharing

The KM experts also raised concerns regarding the impact, change and importance on organizational openness and sharing of information and knowledge when introducing social software as a KM tool. Therefore, research should examine *"how do you build, or can we more effectively build communities*

in practice for example through the use of internal social media, in micro blogging and technologies like that" [GB-17-SER-IKM-11-CIT].

For social software to be successful and beneficial, they stressed that a knowledge sharing culture built on trust needs to be embedded within an organization. *"It's about looking at issues of things like trust, and it's looking at the human and social aspects in those types of communication. So if you have to collaborate via technology, how does that impact on trust and quality of communication?"* [GB-07-HE-SL-13-SOC]. Future research should focus on how the use of social software in relation to KM impacts the organizational procedures and how to change these organizational settings to ensure an optimal knowledge sharing and management.

Social software creates an openness that will impact organizations. According to the experts, this impact should be thoroughly examined in future research by looking into *"what is the role of social media especially in socialization aspect"* [KE-02-HE-SR-3-IS] and *"how can we use social media as a means of facilitating shared knowledge in communities of practice"* [NG-03-REM-OB-12-ENG]. The introduction of social software introduces novel work methods and fundamentally changes organizational culture.

Extimacy

Extimacy indicates the nondistinction between the dual terms of the outside and the inside. The expression of the duality exteriority-intimacy is hypothetically replaced by the notion extimacy that joins ex-teriotiry with in-timacy (Pavón-Cuéllar 2014). New technologies have facilitated an interdependency between the spheres of what is private and what is public, leading us to reveal, in an increasingly natural manner, our experiences, thought and feelings. Personal things become collective and things belonging to others become our own. Hence, intimacy turns into extimacy.

The difference in attitudes to openness/sharing on social software and traditional knowledge confidentiality and protection were succinctly captured by one expert by the term "extimacy", who argued that *""extimacy" through social networking (Facebook and Twitter in particular) make up a very interesting and new landscape"* [ES-04-CPS-EKM-15-BM]. Other experts highlighted the opportunities for knowledge sharing agreeing that the use of social software has introduced a new landscape where *"knowledge is shared by default"* [ES-04-CPS-EKM-15-BM]. In order to enhance the exploitation of the benefits of these tools, future research should focus on this aspect.

Security

Social software represents new means of creating and sharing knowledge. However, the use of these tools has also presented new challenges for the protection of confidential information and knowledge along with other data that organizations do not want to share. *"We have technology becoming more social. It's going to become more personal. It's going to become more mobile, more and more mobile. It's going to become more and more threatened by invasiveness like cyber-crime and so on. We have security and many, many other technological challenges that we are going to be facing"* [CA-08-CPS-DIR-13-BM].

Crowd-sourcing has become a popular method for developing, maintaining, and innovating. However, this also presents a requirement for sharing organizational knowledge with people from outside the company. Therefore, there is a need to pay attention to *"crowd sourcing, especially from an environmental and safety and security perspective"* [ZA-02-ITS-DIR-14-KM]. The experts emphasized the need for research to explore how to avoid leaks of confidential material when implementing social software for KM.

Human factors

KM research has been accused of overemphasizing the use of technology. Nevertheless, the combination of the two seems inevitable due to the significant importance and quantity of knowledge sharing and capturing in organizations that would be impossible without supporting facilitation of technology. *"It was all IT and that was wrong and then it was all behaviors and that's not been great. So then we've gone swinging back round to IT but we do need to have this marriage between the two"* [GB-13-FA-IKM-8-SOC].

Rather than discussing whether KM research puts too much focus on technology and forgets about the human actors, the KM experts recommended that future research should consider a combination of both, so taking into account the human factors associated with incorporation of technologies.

The experts addressed several future research themes within this relationship. The themes were put into the categories behavior, cultural and generational.

Behavioral

Human behavior in general has considerable influence on the interaction between technology and KM. *"The technological evolution influences and changes our social behaviour"* [IL-04-HE-SL-12-

BM]. Behavior was expressed as an important element of research in the relationship between KM and technology in order to advance the combination of the two: *"So there needs to be a focus on human behaviors in general"* [DK-06-BIF-DIR-1-BM]. Additionally, the KM experts emphasized a need to not only focus on the technologies itself but also put attention on the different working styles they introduce. *"What is technologically easily enabled and which behavior will be created is not the right term, but which behavior is triggered or will more probably occur"* [DE-02-ELE-IKM-13-PSY]. Constantly changing and developing technologies require equally changing and developing working styles. Therefore, research should be *"observing the behavior of people in various technological environments"* [IL-04-HE-SL-12-BM] and *"documenting the behavior of "network sharks" (native) as opposed to traditional"* [IL-04-HE-SL-12-BM]. One expert even mentioned, that *"to make KM a success, the most important is to change the human behavior and believe in KM to help their job and business"* [HK-01-HE-SL-15-IS].

A constant overload of information can have a negative impact on people and their willingness to explore this information and engage in the necessary knowledge sharing. Because of the strong emphasis on technology in relation to KM and the ability of technology to share and offer enormous amounts of knowledge and information, the KM experts highlight a need for future research to focus on *"guidelines not to overwhelm people"* [DE-17-ERM-IKM-15-ENG].

Taking into consideration the human factors when focusing on technological enablers for KM is not the only way of addressing the issues. The KM experts also recommended exploring the combination of the two the other way around. They suggested also focusing on the human impacts on technology. *"The tool itself was not the answer, it was a different working style which the tool made possible"* [GB-01-CPS-EKM-20-GEO], thus, there is also a need to explore *"what are the actions which an employee needs to carry out"* [DE-06-HE-PRO-23-BM].

Cultural

New technologies occasionally results in changes in organizational culture. Especially, we have seen considerable cultural changes in recent years. As previously mentioned, the introduction of Web 2.0 and social software has started to change work processes and the behavior of employees. A culture of openness is being established. The importance of having the right culture for the relationship between KM and technological enablers to be successful was stressed by the KM experts: *"It's so important to get the correct product that fits the organization of culture"* [ZA-07-NA-HKM-NA-

NA]. *"Technological enablers are important, but not essential. In this regard, it is important to understand that if you create an organizational culture that values knowledge and clearly structured processes exist, it could have, for example an organizational memory with a relatively simple software tool"* [CO-05-SER-IKM-8-BM]. Technological enablers for KM can be *"very effective if you've got the right culture"* [GB-10-ERM-HKM-7-NAT], therefore, the experts recommended future research to focus on this relationship.

Generational

Emergent technologies such as social software have established a discussion of the different generational experiences and possibilities. *"We now about to experience a generation of workers who are much more used to that technology and therefore will knowledge sharing be easier"* [GB-17-SER-IKM-11-CIT]. In comparison, older generations do not have the same immersive experience but are instead introduced to a totally new and very different way of working and collaborating: "*I'm sitting with the different generations of people, so I'm sitting with the generation X & Y's but I'm also sitting with the generation for the baby boomers and this is your old medical doctors who don't want to have anything to do with technology"* [ZA-07-NA-HKM-NA-NA]. As "*we live in an age where technology is the thing to do, and as we're working with younger and younger generation you will always find that Web 2.0 or social media is the thing that they would like to use. Although people from my age group come from the paper society, we need to adopt to a new way of thinking"* [ZA-01-GOV-KPM-5-OD].

The KM experts expressed a need for future research to focus on the different needs and expectations of the different generations. Furthermore, focus should be on *"what are the differences between Y and Z generations' practices"* [HU-04-ITS-DIR-6-BM] in order to *"get more information about the behavior of new generations in relation to using IT tools"* [HU-04-ITS-DIR-6-BM].

Redesign of work

Another research theme that was addressed by the KM experts is the redesign of work. The environment, technologies and work processes are constantly and rapidly changing. New structures of market, hierarchy and ways of working are emerging. Organizations are facing a global market, increased mobility and an interconnection between technologies and people both independently and collectively. Equally, society in general is subject to constant changes and adaptation and later years technology has introduced a *"new way of living and people don't want to be office bound anymore"*

[ZA-01-GOV-KPM-5-OD]. One expert put it this way: *"I'm interested especially not in just the enablers, some things like social media become too big on their own, when they are just a bunch of tools among others. I see that technology enables re-design and re-organization of knowledge work, frees from the industrial mindset and models"* [FI-01-HE-PRO-11-KM].

The future research themes addressed by the experts were grouped into the categories globalization, supply chain, mobile/mobility, collective intelligence and interconnection.

Globalization

The globalization that organizations are facing has introduced new possibilities and challenges and *"distributed expertise in a global economy/society demands global infrastructures and IT-facilitation, including usable, customized software for KM"* [DE-15-HE-PRO-22-POL]. New ways of working are replacing old ones and collaboration and knowledge sharing are facing challenges because of the global distribution.

The KM experts reflected upon a need for future research to investigate this globalization and explore the challenges and potential benefits that it brings. In relation to globalization, the importance of technology for collaboration, knowledge sharing and knowledge capturing increases. Organizations have a *"terrific ability to do things with Web2.0 technologies on a global scale and on the unconstrained internet"* [GB-06-AE-IKM-25-ENG].

Supply chain

While technology for KM is the main focus of this paper, the KM experts were also asked about research needs in other KM areas as indicated in section 3. Among these, only within the dimension of organizational environment, did some panel members make the connection to technology.

The main research needs connected with the organizational environment from a technological perspective are related to the value chain or supply chain including customers and suppliers or 'extended enterprise' (Jagdev & Browne 1998, Post et al. 2002, Samuel et al. 2011) as emphasized by the following experts: *"I think the sharing of innovation and best practices with customers and suppliers would be kind of cool. So, just basically extending what we normally do with KM along the value chain, both forward and backward. I think that's cool."* [CA-07-HE-PRO-18-KM] *"Extended enterprise, yes. So up the chain and down the chain. And I think that there's quite a lot that could be done on that."* [GB-08-HE-PRO-30-BM] *"Environment influences have strong implications on the*

evolution of organizational knowledge due to the potential for innovation, entrepreneurship, and cooperation (mainly in the digital social media).” [IL-04-HE-SL-12-BM] *“Supply Chain KM that links all pieces to together.”* [US-02-CPS-EKM-15-KM]

Mobile/Mobility

Technology has introduced and supported an increasing mobility of people and *“mobility for example now has a greater potential for distributed work and distributed collaboration systems”* [MX-01-HE-PRO-23-PSY]. Mobile technology introduces new work processes and prerequisites and *“mobile tools are very important”* [GB-04-CPS-DIR-19-CIT]. *“It’s going to become more mobile, more and more mobile”* [CA-08-CPS-DIR-13-BM] and *“mobile technology is the way to go”* [ZA-01-GOV-KPM-5-OD]. Thus, employees are becoming more mobile and organizations need to adapt and exploit these potential possibilities. Therefore, future research needs to establish *“a recognition that mobile Internet access is becoming the norm”* [CA-04-HE-PRO-9-ECO] and that *“including mobile technology is extremely important”* [GB-05-CPS-DIR-17-NAT].

Collective intelligence

Another theme emphasized by the KM experts was collective intelligence. Due to the importance and competitive advantage of expertise and knowledge, collective intelligence is significant to organizations.

“Collaboration is a big thing” [GB-19-CP-OB-3-NAT] and is paramount in establishing and increasing collective intelligence. “*Collaboration and socialization are one of the key success factors in KM implementation”* [TH-07-ERM-IKM-11-BM]. Thus, organizations are required to embed *“tools to support collective intelligence”* [ES-04-CPS-EKM-15-BM] and enhance such collaboration and knowledge sharing. One expert put it this way: *“How can we employ web interactive tools to close the knowledge gap in virtual collaboration?”* [NG-03-REM-OB-12-ENG].

This relates to established research areas about competitive intelligence as articulated by this expert *“Yes, competitor intelligence is also done by Web2.0 tools. Yes, but it’s difficult for me to imagine any research in this area.”* [DE-02-ELE-IKM-16-ENG] and technological means for environmental scanning: *“Probably practical stuff. How can KM interventions support environmental scanning...what are the barriers to intra- and inter-organizational information and knowledge flows...are there any technological systems you can put in place to facilitate fluent and ongoing and*

fast information flows within your organization. How do you enable intra-organizational information flows? From a technology point of view what kind of dashboard can you put in place to continuously feed in relevant information? How do you filter information to avoid information overload? And also, what can KM interventions do to assist sense-making and understanding so that they don't only bring in information, but enable decision-makers fast and accurate understanding of the external environment." [ZA-06-CGOB-6-KM].

Interconnection

The KM experts also highlighted *"the interconnection between social networking platforms, mobile devices, and cloud computing, and services and software"* [CA-03-CPS-EKM-12-BM] to have a profound impact on organizations. Many new technologies constantly arise and organizations are facing a challenge in making all the different parts interconnect and consequently achieving objectives such as clear *"traceability of information evolution and decision making capturing"* [HR-06-ITS-DIR-3-IS]. Today knowledge sharing is happening through multiple different devices, platforms and technologies, thus, making it harder for organizations to maintain the knowledge and to make searching, capturing and validation possible and adequate. The experts saw this as a challenge for organizations in relation to KM that needs to be addressed in future research.

Systems and practices

The relentless pace of change (and perhaps progress) in technology poses an obvious problem for researchers in this area – "*If you see this from a research perspective, I believe it will be continuously out-dated*" [DE-07-AU-HKM-11-ENG] as the tempo of research from proposals to studies to analysis to documenting to final peer-reviewed publication of research is ill-matched with the rate of technological innovation. However, there is some support for research into technology and tools with it variously deemed "*vital"*, "*very important*" and "*highly important*", and a need for technology to be properly recognized "*One of things we've suffered from in the KM practitioner community is everybody putting technology down"* [GB-04-CPS-DIR-19-CIT]. This was a divisive area, as many respondents did not feel that research into the technological aspects of KM was important, although they sometimes indicated one or two exceptional technologies. In the academic literature, IT research in and of itself was assessed as not a promising approach (Scholl & Heisig 2003, Scholl et al. 2004, Qiu & Lv 2014), but rather one that needed to consider social, human and organisational cultural factors (Antonova et al. 2006, Venters 2006).

Technology and Tools

Numerous technologies were mentioned of being worthy of research interest, including intelligent systems, retrieval systems, collaboration technologies, and mobile technologies. The key element was that research was necessary to discern the value of new and emerging technologies – "*research needs to tell us what things are really important; what technological enablers are really important and what is overkill*" [CA-10-CPS-EKM-16-SOC]. In addition to the potential value, there was also an emphasis on how technologies and tools should be effectively used to deliver upon their promises "*because there is a lot of potential but there's also a lot of room for disillusionment, and because the rewards can be so high it's important to understand how to use it and what it can deliver"* [ZA-06-CG-OB-6-KM]. The integration of disparate technologies to deliver value was also seen as a potential route for progress - "*there's lots and lots of great technology that seems to have been developed – it may be in isolation, the handwriting recognition, but what we need to do is just link all this to the semantic tools so we understand the meaning behind the media and we can link it to business*" [GB-06-AE-IKM-25-ENG]. This not only links with Interconnection (section 4.3.5) but also to the future research direction of technology integration suggested in (Liao 2003).

A specific technology that was explicitly mentioned by multiple respondents was "Big Data", an area that exploded into many domains and the wider consciousness after the timeframe covered by all of the literature reviews. One KM expert described the research opportunities in technology in terms of a "so-called Big Data question": *"Particular elements for research questions? I think the two big opportunities here are around the so called, big data question. So, "How is it that you could use big data to understand what's going on externally?" The other one related to that, is, "How can we lead reach the sort of set of social networks that people have that extend outside of the organization in service of understanding what's going on, and/or influencing the market or government?" Professional service firms, some of them make quite a lot of money from government action, regulation, and if they can influence it, or, if they can know when something's coming down, they can actually make a lot of money."* [CA-03-CPS-EKM-12-BM]

Furthermore some respondents believed that the actual tools themselves should form part of the research purview in this area because "*We've no idea how to make them work in an enterprise*" [GB-06-AE-IKM-25-ENG] and that "*IT tools trigger behavior*" [DE-08-HE-PRO-17-BM]. Indeed "*It's all about the applications – how to dig information from the data and how to use it effectively at the right time. There are dozens of applications and challenges are similar to those of data integration*

in the corporate IT world" [PL-05-CPS-DIR-15-NA]. Even amongst experts who believed that human factors and organizational culture were more important, research into tools was "*important to the extent that new technologies that facilitate operational tasks, as the summary and synthesis of data, are applied correctly and based on clear processes*" [CO-05-SER-IKM-8-BM], to discern how to optimally apply specific tools, and to focus "*on the inherent value, usefulness, potential for tools such as Twitter, social media sites*" [CA-06-HE-PRO-12-IS] bringing it back to the business value. A number of practitioners stressed the importance of rules and (social) processes as being crucial in the effective deployment of tools, as "*it's less about the technology and more about the social process implementation of them and the enterprise*" [GB-06-AE-IKM-25-ENG]. On a pragmatic note, one respondent believed that while the research was needed, "*what's going to happen is we're going to see some innovative products that are going to be created by accident and I think they're going to come more from the technology companies than formal research*" [GB-04-CPS-DIR-19-CIT].

Consumerization (of knowledge)

One recent change to information technology usage in the workplace is the "consumerization of IT" with employees bringing their own smartphones, tablets, and even applications into the physical or virtual office and using them in preference to corporately owned and controlled IT systems and hardware. This trend of "Bring Your Own Anything" has its parallels within knowledge management, e.g. "*With the Web2.0 the general public has achieved an understanding about user interfaces with a general expectance which previously was the domain of the usability department in the company which was allowed to state what is right for the user and what wrong*" [DE-01-ELE-IKM-16-ENG] and even more broadly "*I think the things that have shaped KM from a technological point of view, have all come in the last five or ten years from outside the organization*" [CA-03-CPS-EKM-12-BM]. Google, mobile devices, social networking platforms, etc., are all seen as framing expectations for those within organizations. Again, these expectations post-date most of the literature, although future research in how IT is situated in KM and issues of work practices, as highlighted by Venters (2006), could be reframed to consider the altered work environment.

Supporting Practices

Organizational knowledge has always been an important strategic asset (even if not explicitly recognized as such) and much of that organizational knowledge resides within the minds of employees. With regard to technologies and tools, the experts articulated a requirement for investigations into the factors enabling or inhibiting knowledge sharing among employees – as one

stated "*It needs to get into an understanding of what can it actually be used for within knowledge sharing. This is why I think it is important. So that you not are afraid of new technological enablers but get a deeper understanding of what they can be used to and what does it mean if you use them*" [DK-03-BIF-CKO-10-IS] and how to accomplish viral knowledge sharing within an organization. Related to this were allied interests in accessing, retaining, combining, creating and systematizing knowledge.

Predicting Future Technology

Researchers and practitioners noted the relentless impetus of continuing innovation – one cautioned "*The world doesn't end at Web 2.0. Those who are infatuated with Web 2.0 and think that's the latest and greatest, I remember when things like Internet and portals were the latest and greatest. All those things eventually get supplanted by new technologies"* [CA-08-CPS-DIR-13-BM]. Others highlighted that KM needed to be more proactive with regards to technology and tools and have a sense of what might be the next breakthrough – "*it is important to predict what future tools will be*" [IL-06-HE-CKO-17-KM]. One expert urged the community in this way – "*We need to more proactively engage as knowledge managers in understanding and capitalizing on the potential of this technologies. KM must be ahead of social network analysis, of mobile computing and so forth. We are kind of lagging behind; we are reacting rather than anticipating*" [MX-01-HE-PRO-23-PSY].

Discussing panel results and comparing to literature

The comparison of the research themes which were proposed by different literature reviews and those which emerged from our expert panel showed some commonalities. One main research strand that is repeatedly suggested in the literature reviews and by our expert panel is concerned with the human factor dimension (Scholl et al. 2004, Antonova et al. 2006, Venters 2006). In this context, societal developments such as an aging workforce is reflected as a new research focus which supports recent suggestions in the literature (Tams et al. 2014) while behavioral and cultural dimensions are established themes within KM research (Holsapple & Joshi 2000, Helm et al. 2007) and KM frameworks (Heisig 2009).

The other main research strand that emerged from our dataset reflects research triggered by new technological innovations such as social software applications and the wide usage in organizational practice. This strand and the related research themes could be regarded as a specialization of an overall recurring interest into enablers and inhibitors of information systems supporting KM (Alavi

& Leidner 2001, Liao 2003, Lee & Chen 2012) as it was suggested that the '*usage*' and the '*value'* should be researched. The *'openness' and 'sharing'* dimensions are often regarded as either an enabler if the cultural norms support KM or as an inhibitor if the lack of the 'right' norms hinder KM activities. Both value and cultural aspects are "re-cycled" or perennial themes now being deployed to social software. Again, '*security*' is an established research topic, which is drawn more into the forefront due to the open character of social software applications. This aspect supports the view suggested by others, which was labelled with the concept 'knowledge protection' by von Krogh (2012).

However, given the extensive literature survey undertaken by Qiu and Lv (2014), it is surprising that the list of research themes suggested in that work did not include or mention 'social software' as an important area of future research.

A novel aspect that emerged from our dataset was the concept of "*extimacy*" which regards the use of social software applications as a form of "*knowledge sharing by default*" [ES-04-CPS-EKM-15-BM] as companies try to move internal communication away from email towards blogs and wikis in order to be able to exploit the contributions and exchanges made in these applications [DE-13-ITS-EKM-17-NAT] (Brown et al. 2013, Yuan et al. 2013).

The themes grouped under the research strand '*Redesign of work*' reflect different developments triggering the research interests articulated by the global expert panel. The dimension '*globalization*' describes the increasing global dependencies within the economy and within global organizations and networks with its effects on the handling of knowledge and the deployment of IT to support KM activities. The dimension '*mobile technology'* characterizes new devices enabling a higher degree of '*mobility*' of the workforce and those who hold knowledge and expertise. Research should investigate how these technologies trigger and supply change in work practices and the related use of knowledge. The research interest labeled '*collective intelligence*' draws the attention towards the potentials from collaborations beyond the organizational boundaries and direct suppliers or customers, outward to the wider public. These aspects go beyond the concept and scope of 'open innovation' (Chesbrough 2003) understood as the use of external knowledge for innovation and research and development (Lichtenthaler 2011). In this context, the new technologies reach beyond the corporate sector including the public sector, to be adopted by voluntary entities or ad-hoc groups to capture, share, and exploit knowledge. Even individuals are now empowered to apply these technologies to create and acquire knowledge from others who share the same interests or goals. The concept

'*interconnection*' addresses research required to understand how the different technologies (e.g. search), devices (e.g. tablets) and services (e.g. cloud services) fit together to support KM activities. '*Interconnection*' here goes beyond the purely technical aspects of interoperability of different technologies, e.g. in ensuring that distinct tools can process files created by other packages or communicate via Application Programmers Interfaces, to a knowledge-level and business-level integration.

The research strand '*systems and practices*' has been divided into five sub-areas '*technologies*', '*tools*', '*consumerization of knowledge*', '*tools supporting practices*' and '*forecasting*'. The two areas '*technologies*' and '*tools*' share a common interest regarding the value contribution of these artifacts as well as the more pragmatic question about '*how to best use them*' for KM activities. This latter interest overlaps in some regard with the long-standing interest in enablers and inhibitors for the use of these artifacts in a KM environment. This aspect is also addressed by '*tools supporting practices*'. '*Consumerization of knowledge*' denoting the impact of bring your own anything, Google, social media and other mass consumer technology trends on knowledge management is a novel research interest. Finally '*forecasting*' covers the need for knowledge management to anticipate rather than react to new technologies.

The literature reviews revealed that critical studies in KM are the exception as an 'optimistic' view dominates previous KM research (Schultze & Leidner 2002). Furthermore, more interdisciplinary research is required (Scholl et al. 2004) combining qualitative with quantitative approaches (Liao 2003) including field studies and laboratory experiments (Gallupe 2001). It seems that an 'optimistic' mindset is also dominant in our sample as only a few experts articulated the need for research investigating the "*negative impact of technology on social relations of people and, therefore, the impact on knowledge management"* [CO-01-HE-PRO-9-BM] or "*What are the negative impacts of the technological development on KM?"* [HU-05-CPS-DIR-14-BM]. The methodological approaches suggested by the panel members do not provide any new or novel approaches in this respect. The need to undertake more critical research was only mentioned once in the discussion of the technology dimension suggesting "*critical theory and an interpretive qualitative approach*" [DK-07-HE-PRO-8-ENG]. Panel members mainly suggested to employ classical quantitative (e.g. surveys, network analysis) and qualitative methods (e.g. interview, case studies) or a mixed approach, while observational studies, action research, experiments or longitudinal studies were only suggested by a few experts.

From our review we can derive two patterns of research interests and needs which might be applicable beyond the KM discipline and which are related to every technological innovation introduced into organizations, see Figure 2.

One pattern is the recurring perennial research interests in the 'human factors' perspective and how the new technology, in our case 'social software', affects human and organizational aspects. A second recurring research perspective focuses around the impact of the new technological tools onto the performance of the organization. A third perspective is related to the implementation and usage of the technological innovation by the organization and its actors.

The second pattern could be labelled as emerging themes which are those aspects that relate to the novel functions or novel form of use which are enabled by the new technology; these are exemplified by themes such as 'extimacy', 'security'(privacy)' or 'big data' in our study. Related to these areas are research interests in regards to the implementation and use of these new technologies in organizations and beyond in societies.

Insert Figure 2 here

Scanning the horizon shows that the KM discipline is often running behind the new IT trends that its main components are being shaped by. "*I think the things that have shaped KM from a technological point of view, have all come in the last five or ten years from outside the organization*" [CA-03-CPS-EKM-12-BM]. Whilst the KM discipline may not be alone in suffering from the different tempos between new technologies emerging and academic research undertakings, - KM and KM researchers interested in technologies might want to reconsider their basic research approach. There is a need for KM research to shift course from being very reactive into being more proactive and keeping pace with emergent technologies to exploit their potential.

KM researchers could use technology forecasts (e.g. Gartner) to direct their attention to the predicted future disruptive technologies and try to understand their impact on a conceptual level. Equally, experimental research combined with ethnographic approaches could be undertaken as 'embedded' KM researchers with or within the companies leading the new technologies. Such studies might be difficult to undertake given the confidentiality related to invention and patent disclosure, but a closer research alliance or collaboration might also provide new insights for the industrial partner, which could be overlooked by a pure technological and business-driven approach. One current example is research using RFID technology to create tags that store the interest and knowledge profile of staff

members. The RFID technology then matches a certain profile with other colleagues in order to recommend knowledge sharing interactions. Thereby, the technology establishes "know-about" between colleagues who randomly meet and who are not aware about each other's needs, interests and knowledge base. Experimental research on this is currently undertaken in Japan and the UK. While some regard such transparency as a danger, others regard this as helpful to identify the right person to talk to given the increasing turnover of staff in organizations.

For the foreseeable future, Big Data exploited by machine learning and social media represent the key technological drivers of knowledge-based innovation in organizations and society more generally. As a discipline, knowledge management is ideally positioned to address issues of human factors, technological impact, implementation and usage of these drivers. Even as knowledge has become ever more social and ever more business value is accrued from rich knowledge derived from vast datasets of often personal data, failures of data privacy and security have become a staple of news reporting globally. Legislation such as the EU's General Data Protection Regulation (GDPR), which through its extraterritoriality clauses protects the data rights of EU citizens wherever in the world their personal data may be stored or processed, provides a fresh opportunity for knowledge management to be relevant in practice. Knowledge mapping for data protection impact assessments, creation of enterprise-wide data/knowledge models (ensuring organizations understand what knowledge they hold, for what purposes they may legally use it, and for how long), and supporting data protection (both security and privacy) by default and by design in technology and processes, are, *inter alia*, tasks demanding knowledge management expertise.

Conclusion

Our comprehensive study has produced a set of future research themes presented in this paper on the technology and KM intersection, namely social software, human factors, redesign of work, and systems and practices. Social software was the clear advance that KM needed to consider, and the experts emphasized usage, connectedness, value, openness and sharing, extimacy and security. In human factors, the foci were behavioural, cultural and generational – a specific research requirement was to investigate the different needs, expectations and behaviors across the working generations from baby boomers to millennials. In redesign of work, the themes expressed by the experts could be grouped into the categories globalization, supply chain, mobile/mobility, collective intelligence and interconnection. In systems and practices, the expected emphasis on technology and tools and of supporting practice was joined by an interest in exploring the consequences of the consumerization

of knowledge and a call for the KM community to be proactive in identifying disruptive technologies which could be utilized to support KM in the future. These themes will support the field of KM in engaging with the practice of the discipline. The articulation of these themes creates an impetus for accelerating and focusing research in these areas, which will help establish a recognition of the KM discipline within organizational research and practice in the future.

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Appendix

Coding schema for experts

AU-01-HE-PRO-15-ECO

A coding schema for each interview partner was designed consisting of the following:

AU = Austria – Country working in

01 = Number of interview per country

HE = Higher Education – Industry

PRO = Professor – Role of the interviewee

15 = years of KM experiences (longest if two were given)

ECO = Economics – Academic: Discipline doing research / Industry: Discipline educated in

Country (ISO 3166)	Industry	Role	Education/Discipline
AU – Austria BA – Bosnia&Herz. BR - Brazil CA - Canada CH - Switzerland CL - Chile CO - Colombia DK - Denmark EG – Egypt ES – Spain ET – Ethiopia FI – Finland FR – France DE – Germany GB – Great Britain HK – Hong Kong HR - Croatia HU – Hungary IE – Ireland IN – India IL – Israel JP – Japan KE – Kenya LK – Sri Lanka MA – Morocco MX – Mexico NG – Nigeria PL – Poland PT – Portugal RI - Indonesia SE – Sweden TH – Thailand TT – Trinidad & Tobago US – United States UY - Uruguay ZA – South Africa	AE – Aerospace Industry AU – Automotive Industry BIF – Banking, Insurance and Financial Services CO – Construction CPS – Consulting and Professional Services CG – Consumer Goods CP – Chemical and Pharmaceutical ITS – IT and Software ELE – Electric Industry ERM – Energy and Raw materials ECM – Engineering, Capital Equipment and Metal FA – Food and Agriculture GOV – Government Administration **HE** – Higher Education, University MEF – Media & Film PWC – Paper, Wood, Glass, Ceramics TEL – Telecommunications TCF – Textile, Clothing, Shoes, Fashion TRA – Trading TRT – Transport and Tourism SER – Service s OTI – Other Industry NA – No answer	CKO – Chief Knowledge Officer KPM – Knowledge Program Manager HKM – Head of Knowledge Management IKM – Internal KM Consultant EKM – External KM Consultant DIR – Director, Manager OB – Other Business role **PRO** – Professor SL – Senior Lecturer /Lecturer SR – Senior Researcher OA = Other role academia	ARC – Architecture BM – Business & Management Research , Accounting CIT – Computer Sciences & Information Technology **ECO** – Economics ENG – Engineering GEO – Geology IS – Information Science, Library Science KM – Knowledge Management PHI – Philosophy NAT – Natural Sciences, Physics , Chemistry, Biology PSY – Psychology, Behavioural Science SOC – Sociology POL – Political Sciences LAW – Law HLA – Humanities , Languages, Art OD – Other Discipline

Table 1 – KM reviews and future research proposals

Authors	Research aim & subject	Methodology	Future research topics
(Alavi & Leidner 2001)	Review of literature in several fields in order to propose research themes arising from literature	Literature review with emphasis on management literature relating to knowledge and the firm, perspectives on knowledge, taxonomies of knowledge, and KMS, followed by a framework based on the sociology of knowledge and organizations as "social collectives and knowledge systems" (literature search approach / method not disclosed in paper)	• Knowledge creation: facilitating conditions, organizational cultures, IT support for weak and strong ties, evaluation of external input and issues of context for external input • Knowledge storage and retrieval: incentives for knowledge sharing and contribution, context issues, provenance issues, effectiveness of retrieval mechanisms • Knowledge transfer: degree by which IT supports transfer, facilitating strategies, social / cultural / technical attributes, IT inhibit external searches. • Knowledge application: how organizations encourage knowledge application, factors relating to knowing-doing gap, and organizational practices • Application of IT to KM: consequences of increasing available knowledge on organizational performance, effective modification of captured knowledge before application, capture of modification to knowledge, developing trust in knowledge when originator is not personally known, quality and usefulness of IT in KM initiatives
(Gallupe 2001)	Surveying the current state and propose a framework for research and use of KMS	Literature review (Summer 1999) of academic and practitioners articles (40), books (15) and websites about KMS.	• Research gaps: knowledge creation, knowledge sharing and training • Strong knowledge base available: knowledge acquisition and storage • Field studies, surveys, laboratory/experimental and benchmarking studies of KMS are required. • More studies on effect of KMS on the organizations, how KMS affect people and strategy and how the impact is measured.
(Schultze & Leidner 2002)	Analysis of IS literature on KM using a discourse framework to reveal research themes, knowledge metaphors, theoretical foundations, and implications, leading to recommendations for IS-based KM research	Literature search on six IS journals (focused on academic research) using keywords knowledge, knowledge management, organizational learning, learning organization and memory from 1990 to 2000, filtered to articles relating to organizational KM and able to be categorized using Deetz's (1996) discourse framework (dialogic, critical, interpretive, and normative) (79 articles)	• Encourage researchers to utilize the dialogic and critical discourses • Encourage researchers to capture their underlying assumptions regarding knowledge and management in their research
(Liao 2003)	Literature review and survey of KM technologies and applications, and categorization of technologies with suggestions for future research	Literature review on "knowledge management" keyword using Elsevier SDOS database in timeframe from 1995 to 2002, with filtering on applications and technology to 234 articles	• Suggest that social science techniques and methods need to be considered as part of KM technologies • Suggest integration of qualitative and quantitative methods in future research in KM technologies and applications • Suggest integration of technologies • Suggest change (social or technically driven) may enable or inhibit KM technologies and application development
(Scholl & Heisig 2003, Scholl et al. 2004)	Advancements, challenges and promising approaches in KM theory and KM practice	Delphi study (2001/02; global reach, n=1st round: 45/2nd round: 25	• Advancement in theory and practice was shift from the IT-perspective towards priority on human factors. IT was not assessed as a promising approach to KM. Matching social and technical aspects were seen as promising approach. • Integration of KM into business (organizational) processes seen as the most promising practical approach. • Most promising theoretical approaches are interdisciplinary and multi-disciplinary.

Authors	Research aim & subject	Methodology	Future research topics
			• Potential of organizational learning approaches not yet exploited. Communities of practice, social network analysis, knowledge assessment were suggested.
(Antonova et al. 2006)	Technological solutions applied in the organizations at different stages of the KM life cycle.	General literature review and classification of different technologies used to facilitate the main KM processes. Includes a presentation of survey data from a KPMG study on the real application of various KM technologies in organizations.	• Technology is vital to KM but a greater focus needs to be on human and organizational issues during the implementation phase. • A comprising KM strategy is required to achieve successful KM in organizations.
(Venters 2006)	Employment of technological enablers within KM interventions.	Unspecified literature review based on phenomenological writings.	• The situated role of technology within KM and how this can be constructed and introduced into socially constructed and ongoing work practices.
(Lee & Chen 2012)	Research themes and trends in KM	Literature review based on document co-citation analysis, pathfinder network and strategic diagram techniques. 1995-2010 (10.974 articles)	• Explore KM challenges and develop new methods for coping with the topic of knowledge reuse and innovation
(von Krogh 2012)	Influence of social software on KM.	Use authors own experience together with some former studies to draft a strategic research agenda	• What are the choices and implications of social software for knowledge processes in organizations, and how do these differ from those of traditional knowledge management? • What are the barriers and enablers to the adoption of knowledge management by social software in firms? • How does the firm ensure the value of knowledge when implementing knowledge management by social software? • How do firms balance implementations of knowledge management? • What are the consequences of knowledge management by social software for competitive advantage? • How do firms dynamically recreate boundaries?
(Qiu & Lv 2014)	Overview of research activity in the KM field	Bibliometric analysis, Web of Science Data base, 1993-2012 (12.925 documents)	• Core of research activities: ”Knowledge Management,” ”Knowledge Sharing,” ”Ontology,” ”Knowledge,” ”Innovation,” ”Organizational Learning,” ”Knowledge Transfer,” ”Tacit Knowledge” and ”Intellectual Capital”. • Growing research subjects: ”Knowledge Sharing,” ”Ontology,” ”Tacit Knowledge,” ”Intellectual Capital,” ”Knowledge Management Systems,” ”Semantic Web,” ”Knowledge Creation,” ”E-Learning” and ”Project Management”. • Decreasing research areas: ”Information Technology” and ”Information Management”.

Table 2 - KM experience in years

< 5 years:	5-9 years:	10-14 years:	15-19 years:	20-24 years:	> 25 years:
10.4%	23.5%	29.4%	20.8%	6.3%	6.8%

Table 3 - Started with KM in year

pre 1995: 15%	**1995-99:** 28.8%	**2000-04:** 26.9%	**2005-09:** 19.2%	**2010+ :** 10.1%

Table 4 - Regional distribution of KM experts

Europe: 52% (114)	**America:** 24% (54)	**Asia:** 14% (32)	**Africa:** 10% (21)
Austria, Bosnia & Herzegovina, Croatia, Denmark, Finland, France, Germany, Hungary, Israel, Ireland, Italy, Netherlands, Poland, Portugal, Spain, Sweden, Switzerland, United Kingdom	Brazil, Canada, Chile, Colombia, Mexico, Trinidad & Tobago, Uruguay, USA	Hong Kong, India, Indonesia, Japan, Sri Lanka, Thailand	Egypt, Ethiopia, Kenya, Morocco, Nigeria, South Africa

Table 5 - Distribution of KM experts by role

Practitioners				**Academia**		
KM role		Director / Manager	Other roles	Professors	Lecturers or researchers	Other role in academia
internal	external					
24.4% (54)	6.8% (15)	13.6% (30)	10.4% (23)	30.8% (68)	10.4% (23)	6 (2.7%)

Table 6 - Sectorial distribution of KM experts

Business: 50.2% (111)	**Academia:** 44.8% (99)	**Government:** 3.2% (7)	**International organisations / NGO:** 1.4% (3) / 0.5% (1)	
Consulting & prof. serv. 16.7% (37)	IT & Software 9.0% (20)	Energy & Raw Material 5.4% (12)	Aerospace 3.6% (8)	Government 3.2% (7)
Electric 2.3% (5)	Banking & Insurance & Finance, Chemical & Pharma., Engineering & Capital Goods Each 1.8% (4)	Construction 1.4% (3)	Automotive, Consumer Goods, Food & Agriculture, Tele-communications, Other services, other manufacturing Each 1.4% (2)	Media & Film and Trading 0.5% (1)

Table 7 - Distribution of KM experts by disciplines

32.4% (71) Business & Management	16.4% (36) Engineering	9.1% (20) Information sciences	7.3% (16) Computer Sciences	6.4% (14) Knowledge Management
each 3.2% (7) Economics, Sociology	each 2.7% (6) Philosophy, Natural Sciences, Psychology	each 1.4% (3) Business Information Systems, Law	each 0.9% (2) Architecture, Geology, Political Sciences	each 0.5% (1) Humanities, Languages, Art

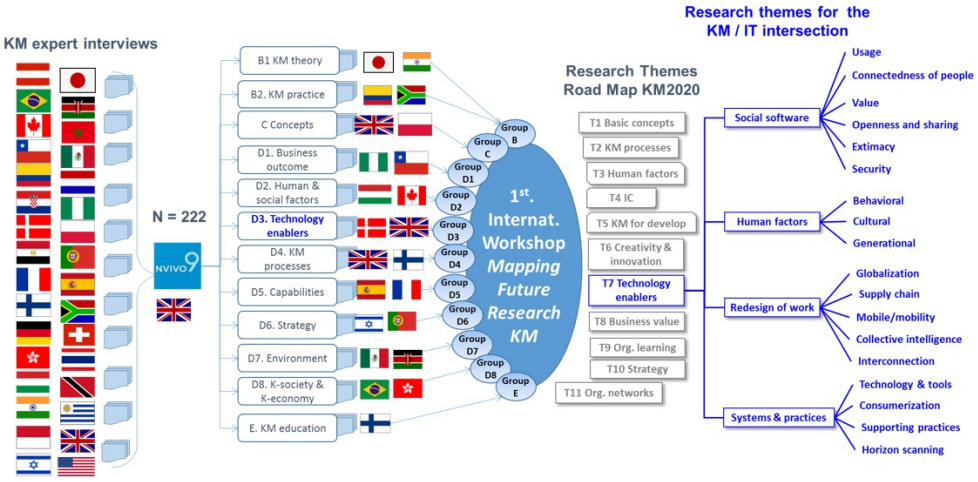

Figure 1 - Overview of research road mapping process including themes

145x73mm (200 x 200 DPI)

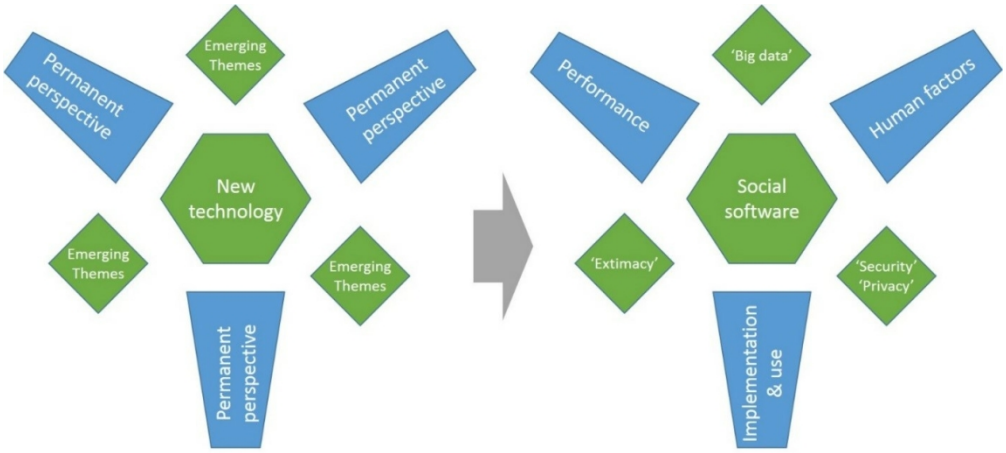

Figure 2 – Two patterns of research interests and needs

178x80mm (200 x 200 DPI)