VINE
45,4

Received 30 January 2015
Revised 3 June 2015
30 July 2015
Accepted 30 July 2015

Understanding knowledge leakage: a review of previous studies

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Abstract

Purpose – This paper aims to review research on the topic of knowledge leakage to establish the current body of knowledge and, on this basis, to suggest some promising avenues for future research.

Design/methodology/approach – The study consists of a systematic review of 57 refereed empirical articles on knowledge leakage.

Findings – The findings contribute to a more holistic view of the topic and complement the study of knowledge management. Additionally, a conceptual framework is proposed that aims at guiding and informing future research activities.

Research limitations/implications – This study may not have enabled a complete coverage of all empirical articles in the field of knowledge leakage. Yet, based on the chosen research methodology, it seems reasonable to assume that the review process covered a large share of studies available.

Originality/value – To the best of the authors' knowledge, no systematic literature review on knowledge leakage has previously been published in academic journals.

Keywords Knowledge management, Knowledge retention, Knowledge leakage, Knowledge preservation, Knowledge risk management, Systematic literature review

Paper type Literature review

1. Introduction

This article reviews research on knowledge leakage to establish the current body of knowledge and to suggest some avenues for future research activities. Knowledge leakage is closely related to knowledge sharing, which is about an individual's willingness to share with others his/her created or acquired knowledge (Bock *et al.*, 2005). Knowledge sharing, for example, is needed for transforming individual knowledge into organizational knowledge (Foss *et al.*, 2010). Additionally, given today's business environment, collaborations with other actors have become a necessity for companies to remain competitive. Thus, knowledge sharing is needed to increase the positive effects of those collaborations, e.g. to achieve the goals associated with the collaboration (Ritala *et al.*, 2015), and can have different outcomes, which brings us back to knowledge leakage. Knowledge leakage is "the loss of knowledge intended to stay within a firm's boundaries" (Frishammar *et al.*, 2015, p. 85). This definition suggests that knowledge leakage can comprise both core knowledge and non-core knowledge of a

VINE
Vol. 45 No. 4, 2015
pp. 568-586

0305-5728
DOI 10.1108/VINE-01-2015-0009

firm. The majority of the literature seems to identify core knowledge as the focal type of knowledge in the context of knowledge leakage. For example, Jiang *et al.* (2013, p. 984) define knowledge leakage as "the extent to which the focal firm's private knowledge is intentionally appropriated by or unintentionally transferred to partners". According to the authors, private knowledge comprises those knowledge assets, competences and skills that provide the basis for the companies' competitive advantage, so we are talking about the core resources of a firm. Similarly, Lau *et al.* (2010, p. 966) talk about technological knowledge leakage, which they define as "the risk of loss of proprietary technology owned by the case company". Anand and Goyal (2009) stress that the difference between knowledge leakage and information leakage is primarily that the former puts a stronger emphasis on companies' core resources. Critical knowledge, however, is in the eye of the beholder, i.e. what might be considered as core knowledge by one firm might be considered as non-core by another firm and vice versa, and still this knowledge could be of greatest interest to business operations. Furthermore, this relevance changes over time.

As mentioned above, knowledge leakage, in the meaning of knowledge leaking away from its origin, can occur in different situations and be positive, when the organization benefits from it, or negative, when it is detrimental to the organization (Mohamed *et al.*, 2007). This clarifies that knowledge leakage does not necessarily have a negative connotation. In collaboration, for instance, a positive knowledge leakage can occur in the form of knowledge spillover between cooperation partners (Ferdinand and Simm, 2007). On the other hand, a negative example of knowledge leakage can be when an actor, consciously or not, leaks knowledge about the local firm to another firm/another actor. Despite the serious consequences knowledge leakage can have on firms in either direction and the fact that knowledge management (KM) practices, such as knowledge transfer or knowledge acquisition have intensively been studied, the study of knowledge leakage appears to be underdeveloped (Parker, 2012; Ahmad *et al.*, 2014). This can be assessed as unsatisfactory. If organizations, be they private or public, fail to address the challenge of knowledge leakage, their organizational productivity and competitive advantage (Ahmad *et al.*, 2014) is at risk. This is particularly true in situations where critical organization members are leaving (Hall, 1992), when external partners misappropriate information and knowledge from the organizations in question (Currie *et al.*, 2008), or when organizations alone are no longer able to catch up with the newest developments (Dyer and Singh, 1998), to name just three examples. Therefore, this paper's aim is to draw attention to an under researched but from a strategic point of view important issue of KM. Indeed, the authors of this paper stress that when formulating knowledge strategies, one must take into account that organizational knowledge can best be exploited, when it is looked at from a holistic perspective. Thus, insights into the issue of knowledge leakage will help organizations to develop improved knowledge strategies, which, in turn, enable a more efficient resource allocation (Zack, 1999). Based on a systematic review, this paper proposes a conceptual framework that can be used to organize knowledge leakage research. This framework together with the determination of the current body of knowledge concerning knowledge leakage is considered the main contribution of this paper.

The next section provides more detailed insights into the exact procedure of the methodology chosen for identifying extant research in knowledge leakage. After that,

the results are presented. This is followed by a provision of possible future research opportunities. The paper concludes with implications for theory and practice.

2. Methodology of literature review

Our systematic review followed a combined approach of Jesson *et al.* (2011) and McNulty *et al.* (2013). Jesson *et al.* (2011) have proposed six principles for systematic reviews, which are as follows:

(1) Mapping the field through a scoping review.

(2) Comprehensive search.

(3) Quality assessment, which comprises the reading and selection of the papers.

(4) Data extraction, which refers to the collection of relevant data and the capturing of the data into a pre-designed extraction sheet.

(5) Synthesis, which comprises the synthesis of the extracted data to show the known and to provide the basis for establishing the unknown.

(6) Write-up.

McNulty *et al.* (2013) have proposed a list of criteria that can be used to establish the basis for a descriptive and analytical overview of research in knowledge leakage. These criteria formed the basis for our data extraction (Jesson *et al.*'s Principle 4) and synthesis (Jesson *et al.*'s Principle 5). Even though McNulty *et al.*'s (2013) study looked into corporate governance, their list of criteria can be transferred to other fields as well, as it enables to obtain quantitative and qualitative insights into the subject under investigation, which, in turn, is necessary to establish the current body of knowledge as intended by this paper.

In the following, we explain how we proceeded.

First, we developed a research plan comprising the research questions we were interested in answering. This also involved the keywords, and a set of inclusion and exclusion criteria. As we were interested in establishing the current body of knowledge regarding knowledge leakage and in identifying promising avenues for future research, we decided to use multiple keywords to identify relevant studies, such as knowledge leakage, knowledge loss, knowledge attrition and knowledge retention. The inclusion criteria were empirical research papers, peer-reviewed, English language and indexed in the databases: ABI Inform, EBSCO, Scopus and Web of Knowledge. We excluded gray literature such as reports and non-academic research, and other languages than English. Additionally, we produced an excel data sheet consisting of criteria relevant for establishing our understanding of knowledge leakage. These criteria were from McNulty *et al.*'s (2013) review and are presented in the next section. If suitable for our requirements, we also used the variables provided by McNulty *et al.* (2013). For example, in terms of the criterion journal of publication, we had to specify own variables to take our topic under investigation into account. We took advantage of the ranking provided by Serenko and Bontis (2013) and the Academic Journal Quality Guide (Version 4) as provided by the Association of Business Schools.

Second, one of us accessed the four databases and searched using combinations of the keywords set. We looked for combinations of these keywords in the title, keywords and abstract. The literature review included papers published until August 19, 2014. Depending on the combination of keywords used, different numbers of hits were

generated. Third, each of us manually scanned the abstracts of the respective papers and, if relevant, more parts of the articles to make sure that they actually fell within our scope of interest. This reduced the number of articles without duplications to a final number of 93 articles, which fulfilled our criteria and were then analyzed. Fourth, the papers were divided among the authors. That is, each author read 31 papers, respectively, and coded according to the criteria specified in Table I. Fifth, in the next stage, the individual data were synthesized into one. Then, each author individually worked through the merged sheet to check for consistency regarding the coding, specifically in the case where we could not take advantage of McNulty *et al.*'s (2013) variables, e.g. codes for the criterion topic. Our different views were shared and discussed during our discussion rounds. These discussion rounds led to a further reduction of the number of papers. At the end, 57 empirical papers formed the basis for analysis (see Appendix). Sixth, the final stage of our review process was devoted to the write-up of the findings.

Criteria	Meaning	Code description
Date of publication	Year of publication of the article	Stating of year
Author's nationality	Country where is located the first author's institution	Stating of country
Research team	Number of authors	1 one, 2 two, 3 three and more
Journal of publication	Title of the journal	1 KM/intellectual capital journal, 2 information science journal, 3 Management journal, 4 other journals
Topic	Main topic explored in the study	1 consequences, 2 succession planning, 3 KM governance, 4 KM tools, 5 KM, 6 knowledge retention, 7 new product development, 8 strategic alliances
Disciplines	Disciplinary background of study	1 law or economics, 2 sociology, 3 social psychology, 4 management
Number of disciplines	Number of disciplines used in the same study	1 one, 2 two, 3 three
Theoretical aim	Nature of the theoretical aim of the paper	1 exploratory, 2 development or elaboration, 3 testing, 4 other
Research setting	Continents of the empirical setting of the study	1 Europe, 2 North America, 3 South America, 4 Asia, 5 Australia, 6 Africa, 7 multi
Number of research settings	Number of countries of the empirical setting	1 national, 2 multi-national
Research methods	Instrument of data collection	1. Interviews, 2 (Participant) observation, 3 Archival and documentary, 4 Survey, 5 Experiment, 6 focus groups, 7 others
Number of methods	Number of different methods of data collection	1 single source, 2 multi-source
Level of analysis	Level of analysis of the study	1 individual, 2 group, 3 firm, 4 national, 5 relational, 6 multiple

Source: Adapted from McNulty *et al.* (2013, p. 187)

Table I. Description of criteria used to analyze research on knowledge leakage

2.1 Specification of criteria

In the following, the intention with each criterion is briefly outlined.

2.1.1 Date of publication. To determine when the current body of knowledge was made available to the research community, we captured the year of publication of every paper.

2.1.2 Country of authors' institutions. To get the information about the starting point of research on knowledge leakage, we coded the country of the first author's institution. This type of information would provide insights into where the body of knowledge in the field under investigation has been established. It may also signal certain countries preferences (McNulty *et al.*, 2013).

2.1.3 Size of research team. The size of the research team helped us in determining whether the existing work is a synthesis of different individuals' knowledge bases or whether it is more of a result of research performed by individual researchers.

2.1.4 Journal of publication. To get data concerning from which fields the existing body of knowledge emerged, we classified the journals according to the four broad categories:

(1) KM/intellectual capital journals;

(2) Information science journals;

(3) Management journals; and

(4) Other journals.

2.1.5 Disciplines. Knowledge leakage is a broad topic that has the power to attract scholars from different disciplines. Consequently, it would be interesting to know which discipline provides which theoretical framework, as this influences how knowledge leakage is considered and discussed. These frameworks can be used to probe different research questions in the context of the knowledge leakage phenomenon. To approach this factor, we coded for law and economics, sociology, psychology, management and five other disciplines of social sciences (Faigman, 1989).

2.1.6 Number of disciplines involved. To understand and study the complexity of knowledge leakage, scholars may take advantage of more than one discipline. Consequently, we coded for articles covering one discipline, articles with two disciplines and articles with three and more disciplines.

2.1.7 Theoretical aim. To understand the author's orientation (perception) toward the study of knowledge leakage, we were interested in gaining insights into the paper's theoretical contribution. Consequently, a paper's aim, from the perspective of the topic of knowledge leakage, could have been to explore, to develop (elaborate) or to test (validate). This understanding would indicate the maturity of the research field as well as the boundaries of the topic, i.e. a greater focus on empirical testing helps to develop consensus on the boundaries of the topic.

2.1.8 Research setting. Here, we looked into where research on knowledge leakage has been taken place to understand the extent of influence of national (culture) context. To do so, we coded for continents, i.e. Europe, North America, South America, Asia, Australia and Africa. We also coded for situations where more than one continent was involved. This also referred to articles that comprised more than one country in a continent (Dewah, 2013).

2.1.9 Number of research settings. This criterion tried to get more information about the influence of national cultural setting on research activities in the area of knowledge leakage. Are we talking about a national setting (i.e. country setting), and/or is there an emphasis on studying knowledge leakage across countries (i.e. multi-national settings)?

2.1.10 Research methods. To understand what the existing body of knowledge is based upon, we examined the instruments used to collect data. This information also contributes to the determination of any preferred research approaches (i.e. qualitative vs quantitative research).

2.1.11 Number of research methods. A combination of research methods does not only help to obtain a more holistic understanding of a topic. It also provides the opportunity of offsetting the weakness of one instrument with the strength of another one (Bryman, 2008). Consequently, we coded for "mono-method approach" and "mixed-methods approach".

2.1.12 Level of analysis. Knowledge leakage can happen at different levels. Therefore, it is important to find out at which level the researchers tried to capture it. We coded for articles that focused on individual, group level, firm level, national level and relational level of analysis (i.e. this refers to articles that study knowledge leakages that occur between individuals, groups and organization) and articles that used multiple levels of analysis. Multiple levels of analysis refer to studies that take advantage of a number of different levels of analysis, for example, firm and individual level.

2.1.13 Topic. As the study of knowledge leakage is a recent one, one would assume that the scope of activity is rather fragmented and mainly driven by individual scholars' and their preferences. Therefore, we decided not to specify any topics in advance but let them emergence from each author's perception and subsequent joined discussions.

3. Results

In the following, the results are presented, which cover both quantitative and qualitative insights into the study of knowledge leakage (see Appendix).

3.1 Date of publication

Among the 57 papers that formed the basis for our analysis, the oldest publication is from 2003 and the most recent ones are from 2014. The mass of research has been conducted in the 2010s, in 2013 in particular. This clarifies that this topic is still in its infancy. The short history of the research regarding knowledge leakage also explains why this area can be assessed as under-researched.

3.2 Country of authors' institutions

Our data show that authors from many countries have published articles about knowledge leakage, which indicates a global interest in the topic. So far, the study of the topic seems to be dominated by authors from the USA, followed by Australia and South Africa. We also observed many single contributions from individual countries, which suggests that the study of knowledge leakage is currently driven by individual actors or research groups/institutes.

3.3 Size of research team

Regarding the composition of the research team, our results show that 14 articles were produced by a single author. The majority of papers, however, have been the product of at least two researchers (20 papers) or three and more authors (23 papers). This indicates

that the majority of the existing research is a synthesis of different individuals' knowledge bases, which is not surprising, given the time and resources needed to develop a paper. Additionally, these joint activities provide the opportunity of including different perspectives, which, in turn, can increase the likelihood of taking a more holistic approach regarding the study of knowledge leakage.

3.4 Journal of publication

With regard to the journals that have published research on knowledge leakage, one can see a broad mix, i.e. journals can be assigned to the areas of management, KM and/or intellectual capital, information science, as well as education and operations and technology.

The majority of publications were found in the management area, which stresses the critical importance of managing knowledge leakage.

In a next step, we also organized our data regarding the topic's journal distribution. The largest number of articles has been published in the *Journal of Knowledge Management* with eight papers. This is followed by the journal *Management Decision* with three papers, the *American Water Works Association Journal*, the *International Journal of Human Resources Development and Management* and the *South African Journal of Information Management* with two articles each. All other papers have been published in other journals. This indicates that the study of knowledge leakage enriches a number of different research disciplines.

3.5 Disciplines and numbers of disciplines

The findings highlight that the study of knowledge leakage is dominated by a management background (51 articles). The remaining articles can be assigned to law and economics and psychology (1 article each), and two articles each to sociology and others (e.g. pedagogy). However, with regard to the number of different disciplines applied, we found that several authors made use of a number of disciplines. For example, of the 51 articles that had a management background, 20 articles used at least two different disciplines. Four articles took advantage of three disciplines. For example, Massingham and Massingham's (2014) paper aimed at highlighting the practical value of KM. To do so, the authors used theoretical lenses from the disciplines of management, economics and psychology.

3.6 Theoretical aim

There are different ways to develop theory or to contribute to its further development. Our findings showed that the majority of papers (25 articles) had an exploratory focus. Although development (or elaboration) and testing scored 16 articles each. This underlines that the topic of knowledge leakage is still in its infancy, which calls for more testing and validation to develop the field. It also implies that the study of knowledge leakage is rather fragmented and influenced by those researchers' personal interests.

3.7 Research setting and number of research settings

The majority of studies have been conducted in Europe (14 articles), followed by 11 papers from North America. Then, Asia follows with nine papers, Australia with seven papers and Africa with six papers. One paper was conducted in South Africa. Only four papers covered more than one continent or several countries in one continent. For example, Cattani *et al.* (2013) studied the evolution of knowledge over time in different

research settings (i.e. Europe, USA and Asia). In sum, our findings clearly indicate that research on knowledge leakage is driven by the Western world.

If one has a closer look at the research setting, our findings show that 44 articles were conducted in one national research setting. Six articles had multi-national research settings. The remaining seven articles did not provide clear information about the research setting chosen. This suggests that research on knowledge leakage is influenced by the national (cultural) context. Against the background that more and more business operations take place in a global world, this outcome is surprising.

3.8 Research methods

This criterion provides insights into the instruments used for collecting data on issues related to knowledge leakage. The findings demonstrate that there are three dominating collection instruments which are interviews (26 studies used them), 19 articles involved a survey and 17 articles used archival and/or documentation. The remaining instruments used were participant observation (five articles), experiment (three articles) and focus group (one article). We coded 12 articles as "other" comprising articles that used instruments such as workshops and automatic summarization method.

When we coded for this criterion, we found a mix regarding the specification of the research methodology. Some papers were clear and specific when it came to the description of the research approach and the data collections instruments used. Other articles, however, were lacking the necessary transparency regarding the instruments used (as part of their research process and research design). A likely consequence of this observation is that the findings presented should be taken with caution.

3.9 Number of research methods

Additionally, we coded for the number of data collection instruments applied. A total of 38 articles were based on a mono-method approach, and 19 articles used a mixed-methods approach. Even though the latter is promising, as it provides more in-depth insights into knowledge leakage, it also clarifies that there is a potential for more mixed-methods studies to develop further our understanding of knowledge leakage and its characteristics.

3.10 Level of analysis

The study of knowledge leakage offers the opportunity to approach it from many different levels of analysis. Our findings show that 30 articles were based on the firm level. This was followed by national (regional) level of analysis and group level (nine articles each). Five articles were at the relational level. We found only two articles that took a multiple level. For example, Massingham (2008) looked at the individual and group level to study the effects of knowledge loss due to departing personnel.

We noticed that with many articles, it was difficult to find out the level of analysis because those papers did not provide the necessary information. Our data also left the impression that only a small number of papers addressed the consequences of knowledge leakage at the individual level. This is surprising, as it is mainly the individual who initiates the knowledge leakage process. A similar observation was made with the multiple level of analysis; also, this level is seldom studied. From our point of view, however, it would be a promising perspective to get a more fine-grained understanding of knowledge leakage and its specific form in different contexts. An explanation for this situation might be that knowledge leakage is the outcome of

individuals who act in smaller groups, in organizations, between organizations (at micro and macro level); thus, the phenomenon's complexity is difficult to grasp.

3.11 Topic

Our analysis shows a significant interest in studying the consequences of knowledge loss/leakage in organizations, e.g. reduced organizational commitment, staff dissonance (Treleaven and Sykes, 2005) or performance (DeLong, 2009). We also get insights into the "triggers" of knowledge leakage, such as organizational change (Treleaven and Sykes, 2005; Sitlington and Marshall, 2011), retirement (DeLong, 2009; Carmel *et al.*, 2013) or personnel fluctuation/turnover (Acton and Golden, 2003; Chalkiti and Sigala, 2010). This highlights that the danger of knowledge leakage and possible positive or negative consequences are often found in company phases that will include change in the firms. There were also papers that examined the emergence of knowledge leakage/loss more deeply, e.g. in the context of small and spontaneous networks (Lwoga *et al.*, 2010) or existent information silos (Merrill *et al.*, 2008). These studies address an additional perspective which links different communication channels of knowledge leakage, e.g. networks, to possible organizational consequences.

Another topic that can be determined is the study of knowledge leakage in the context of succession planning. Given the likely (negative) consequences of losing experienced organization members, this focus is not surprising. Interesting in this context is that we found only two papers (Girard, 2006; Bleich *et al.*, 2009) that mainly looked at succession planning of managers or leaders. The other papers took a broader perspective of the topic, and thus implied that relevant knowledge resides everywhere in the organization and not only at management level (Frigo, 2006; Gotthart and Haghi, 2009; Durst and Wilhelm, 2011, 2012; Bessick and Naicker, 2013; Durst and Wilhelm, 2013). We found seven articles that can be assigned to the topic "KM governance". The articles identified dealt with decision-making (Capilla *et al.*, 2010), corporate culture (Raza *et al.*, 2008), trust (Jiang *et al.*, 2013) and knowledge risk management (Jafari *et al.*, 2011; Kaplan, 2013). Other papers took a generic perspective of KM governance and the governance's power to support initiatives regarding the issue of knowledge leakage in organizations (Parker, 2012; Peltokorpi and Tsuyuki, 2006). The findings indicate the role KM governance can play to better handle knowledge leakage in firms, but also KM in general, of which, knowledge leakage should be a critical part. The findings presented above also point to the contribution KM governance can make in dealing with business issues such as organizational change and succession planning/people replacement.

Seven articles can be assigned to the general theme of KM tools. Tools include the use of algorithms (Le *et al.*, 2013) and other statistics techniques (Calle *et al.*, 2013), methodologies (Trappey and Trappey, 2008) or more generic KM systems (Barbosa *et al.*, 2009). The tools may have been developed for sharing and retaining knowledge, or with another focus in mind, but are in the present papers tested/examined for their applicability in the context of knowledge leakage. What the tools proposed seem to have in common is that they are based on an exploratory research approach to approach different KM practices. Six articles can be assigned to the study of KM in general and covered knowledge leakage as well. For example, authors looked into KM in projects and highlighted how knowledge sharing and reuse could contribute to a better handling of knowledge retention (e.g. Loforte *et al.*, 2010; Gannon and Banham, 2011). Cattani *et al.* (2013) studied knowledge creation and knowledge loss over generations, while Mishra

and Bhaskar (2011) provide insights into KM in organizations. Five papers were assigned to the general theme of knowledge retention. These studies addressed knowledge retention from different sides, such as the role of knowledge storage (Fiedler and Welpe, 2010) and knowledge capture (Jackson, 2010), influential factors (Martins and Mayer, 2012), the handling of the topic in a specific sector (Dube and Ngulube, 2013) or specific actions that might be taken in organizations (Levy, 2011).

The issue of knowledge leakage in the context of new product development has been studied as well. Gurcaylilar-Yenidogan (2014) took a risk perspective when discussing knowledge sharing throughout the product development process. Other papers highlighted the challenges that may occur in the new product development process and its outcome (Ordanini *et al.*, 2008; Marsh and Stock, 2006; Kraaijenbrink, 2012).

The remaining papers discussed the issue of knowledge leakage as a consequence of strategic alliances (Norman, 2004; Oxley and Wada, 2009; Li *et al.*, 2012) and of being part of a supply chain (Lau *et al.*, 2010). Li *et al.* (2012) underlined the importance of finding a right balance between knowledge sharing and knowledge leakage; as a consequence, these authors also addressed the potential benefits KM governance could bring to meet this challenge.

4. Proposition of a conceptual framework for the study of knowledge leakage

In the following, we propose a framework that highlights some conceptual domains that can be used to organize knowledge leakage research (Figure 1). These domains were derived from the topics identified in our review and present higher-order terms.

In the following, the domains are briefly explained:

- Interactions refer to interactions between individuals/groups/firms and other individuals/groups/firms as well as between these subjects and infrastructure. The focus is on interactions between people.
- Consequences refer to the consequences of these interactions.
- Infrastructure refers to any tools and communication channels that are used in firms by individuals to let knowledge flow.

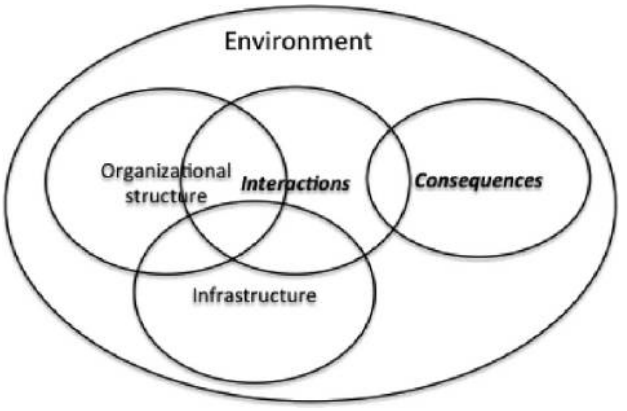

Figure 1.
Conceptual domains of knowledge leakage research

- Organizational structure refers to the mode of organizational structure which may be bureaucratic, functional, divisional, matrix, team, network and virtual.
- Environment includes both the internal and external environment. It covers cultural, economic and market factors that will influence firms and their behavior, e.g. organizational change as an initial situation (a "trigger") for potential knowledge leakage.

Even though the analysis of the papers left the expression that the domains have predominantly been studied in isolation to expand the body of knowledge of knowledge leakage, future research should also look at the intersections of the different conceptual domains, as illustrated in Figure 1.

5. Promising future research avenues

The intent of this section is to provide concrete "food for thought" for researchers that are interested in conducting research on knowledge leakage. The ideas are derived from the framework outlined above and the other findings presented previously.

We commence with the proposition of some research ideas of the other aspects before we turn to research ideas that were derived from the conceptual framework.

5.1 Research methodologies and methods

The findings have shown that there is a critical need to take a more rigor research approach when addressing the topic. At the outset, researchers should provide the necessary transparency regarding the research methodology chosen to demonstrate a rigor and comprehensible research approach and process. We are convinced that the study of knowledge leakage would benefit from the application of different world views (e.g. pragmatic perspective). With regards to possible research instruments, researchers may think of using different forms of data collection, e.g. to capture tacit knowledge. Additionally, given the fact that knowledge leakage and its implication do not need to show off immediately, future research should also design studies that follow a longitudinal approach. This would help to see whether the danger of knowledge leakage will actually turn into a real loss of knowledge or whether knowledge sharing with other partners will actually turn out into new knowledge and/or skills. Eventually, as knowledge leakage can be the outcome of international/global business operations, future research may take advantage of multi-national research settings.

5.2 Disciplines

Researchers may also consider bringing additional disciplines to the study of knowledge leakage or bringing together different disciplines, e.g. pedagogy and management. This would help to develop a more holistic understanding, i.e. more insights into the different facets of the topic; even though the inclusion of additional disciplines can increase the risk of fragmentation of the topic. For example, when debates on the matter across disciplines actually hamper the joint development of the topic instead of fostering it.

5.3 Level of analysis

This is another point we would like to draw the attention to. As outlined above, with many articles, it was very difficult, if not impossible, to make out the level of analysis. This again underlines the need for better thought out and documented research

approaches. As mentioned above, the addressing of the individual level of analysis and the multiple level of analysis would be promising approaches to a deeper understanding of the topic. One challenge will be to design studies that capture knowledge leakage at the multiple levels of analysis and over time, as this will require well-trained researchers.

5.4 Need for conceptualization

What has also become clear is that there is a need to work on the conceptualization of the term knowledge leakage. Therefore, researchers should strive for both the establishment of a general definition of the term and a clear differentiation from other terms, such as knowledge loss and knowledge attrition. Regarding the latter, theoretical work must also include the determination of the links and relations of knowledge leakage with those terms to establish knowledge leakage in its context. This work would require interdisciplinary research activities to consolidate existing knowledge and thus avoid a reinvention of previous work. Such a proceeding would also support efforts regarding the development of a holistic understanding of the topic. In sum, and in line with Ahmad *et al.* (2014), further theoretical development in the field of knowledge leakage is needed.

5.5 Research avenues derived from conceptual framework

Given the possible positive and negative consequences of knowledge leakage, the advancement of the field would benefit from studies that look into the measurement and assessment of activities related to knowledge leakage in general and to specific activities such as knowledge sharing. Possible outcomes of those research activities could be measurements that address KM in general or specific ones that are limited to knowledge leakage. This research would help to better understand the impact of KM practices on corporate success or failure and thus contribute to a stronger legitimation of those practices. Based on that more specific knowledge strategies will be possible as well.

The study of knowledge leakage at the strategic and operative level would be beneficial as well. For example, at the strategic level, it would be interesting to know what kind of knowledge is considered as suitable for sharing and which is not. What motives are behind these decisions? Are there any motives at all regarding that matter? At the operative level, it would be interesting to learn what is done to either share or protect different kinds of knowledge. Thus, the focus would be on the knowledge flow and content among different internal and external actors interacting with each other. In all these activities, the issue of time needs to be considered as well, as the availability of time influences firm activities and thus their likely dealing with the challenge of knowledge leakage. If speed is an issue in firms, how does it affect knowledge leakage?

The intersections between individuals/groups/organizations and organizational structure may also provide critical insights into subjects and their dealing with knowledge leakage. Given the fact that individuals can be assigned to different forms of organizational structures, e.g. functional structures, teams and networks, managing the challenge of knowledge leakage becomes a very difficult task, which may call for alternative forms of governance depending on the organizational structure and environment.

Negative knowledge leakage, i.e. it is detrimental to the firm, is not only the result of interaction of people but also the outcome of espionage, hacker and data theft. This incident would be an interesting one to study, as it covers all domains presented in Figure 1. For example, if espionage is an issue in specific industries, how do the firms concerned organize their organizational structure, e.g. their networks, interactions, e.g. interactions with other companies, information technology infrastructure to approach the issue of knowledge leakage? Are there differences between industries in their proceeding? How do firms address the issue of espionage in the organization, in their networks? What protection measures are working and when?

Finally, the interactions of the different domains call for an inclusion of a risk perspective as well. Transferred to knowledge leakage, which is not *per se* negative, future research would benefit from a more neutral and comprehensible perspective regarding knowledge and its contributions to organizations and the environment. For example, on a macro level, it would be interesting to study the positive contributions of knowledge leakage, e.g. with regard to new business formation, development of new and improved products/services. This perspective may also support in further developing the emerging field of knowledge risk management (Massingham, 2010), and bringing about the formulation of concrete strategies regarding KM in general and knowledge risk management in particular.

6. Conclusion

The starting point of this paper was to establish the existent body of knowledge regarding knowledge leakage. In the light of the interest regarding the study of KM and some KM practices (e.g. knowledge transfer), one may wonder why this is not the case when we are talking about knowledge leakage. Against the backdrop of the relevance of knowledge for organizational development and sustainability, it is rather dangerous to underestimate the possible effects of knowledge leakage. Indeed, one can argue that without an understanding of knowledge leakage and its possible consequences for organizations, the developed knowledge strategies will be less than optimal. Consequently, this paper reviewed extant research on knowledge leakage. We used the method of a systematic literature review to do so.

Based on a final number of 57 empirical papers, we determined the current body of knowledge regarding knowledge leakage. This contributes to a more holistic view of the topic and complements the study of KM in general. Based on the systematic review, we have developed a framework that highlights conceptual domains of knowledge leakage that can help in organizing the study of knowledge leakage and in informing future research. This framework can be considered as the main contribution of this paper. Additionally, we highlight a number of other areas that are regarded as worth to be addressed to further our understanding of knowledge leakage.

Our results have implications for both theory and practice. From a theoretical point of view, this paper is positioned as a contribution to a more holistic study of KM, which helps to overcome having a unilateral focus on considering knowledge (intangibles) mainly as something positive, something of value (Stam, 2009). Additionally, the findings provide a complement to the previous literature on knowledge leakage and offer suggestions for future research.

From a practical point of view, the findings not only highlight possible consequences of doing nothing with regard to knowledge leakage, they also offer insights into how to

cope with the challenge of knowledge leakage. Indeed, the study wants to underline that forward-looking organizations take a strategic approach to KM and have knowledge strategies in place that enable them to better manage and distribute their knowledge to increase the likelihood that the positive outcomes of knowledge leakage outperform the negative ones.

In conclusion, the authors of the present paper are convinced that the study of knowledge leakage is a fruitful step for advancement in KM theory and practices. Having such an advanced understanding will also make it possible to develop KM strategies that are more comprehensible.

The authors are aware that the present study is not without limitations. Because of the chosen research procedures, this study may not have enabled complete coverage of all empirical articles in the field of knowledge leakage. Yet, it seems reasonable to assume that the review process covered a large share of studies available. Finally, this paper proposes some future research directions, which are not exhaustive but represent initial stages.

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Appendix. List of articles reviewed

Articles

Acton and Golden (2003), Ahmad *et al.* (2014), Arif *et al.* (2009), Barbosa *et al.* (2009), Bessick and Naicker (2013), Bleich *et al.* (2009), Bresnen *et al.* (2003), Brosi *et al.* (2007), Calle *et al.* (2013), Capilla *et al.* (2010), Carmel *et al.* (2013), Cattani *et al.* (2013), Daghfous *et al.* (2013), DeLong (2009), Dewah (2013), Dube and Ngulube (2013), Durst and Wilhelm (2011, 2012, 2013), Fiedler and Welpe (2010), Frigo (2006), Gannon and Banham (2011), Girard (2006), Gotthart and Haghi (2009), Gurcaylilar-Yenidogan (2014), Jackson (2010), Merrill *et al.* (2008), Jafari *et al.* (2011), Jiang *et al.* (2013), Kalotina and Sigala (2010), Kamsu-Foguem *et al.* (2013), Kaplan (2013), Kim (2014), Kraaijenbrink (2012), Kuhar *et al.* (2010), Lau *et al.* (2010), Le *et al.* (2013), Levy (2011), Li *et al.* (2012), Loforte Ribeiro and Leitão Tomásio Ferreira (2010), Lwoga *et al.* (2010), Marsh and Stock (2006), Martins and Mayer (2012), Massingham (2008), Massingham and Massingham (2014), Messner (2013), Mishra and Bhaskar (2011), Mohamed *et al.* (2007), Norman (2004), Ordanini *et al.* (2008), Oxley and Wada (2009), Parker (2012), Peltokorpi and Tsuyuki (2006), Raza *et al.* (2008), Sitlington and Marshall (2011), Trappey and Trappey (2008), Treleaven and Sykes (2005).

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