

Knowledge Sharing and (In)Security: towards a comprehensive view of managerial aspects

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Abstract: The present study characterizes the global dynamics of academic publications about Knowledge Sharing and Information Security through a research restricted to articles and conference proceedings present in Thomson Reuters Web of Science. It is an exploratory and descriptive study for which techniques recommended by Bibliometrics were used. Thus, during the period established for this study, a total of 78 authors contributed to 28 publications, distributed by 17 titles of journals and 19 conferences proceedings, with almost 60% of these authors contributing with three or more publications. About 60% of the scientific output was the responsibility of Malaysia, Sweden, Iran, Greece and England whose research reaches respectively 18%, 11%, 11%, 11%, 11% of total productivity, showing a great geographical dispersion. However, there is some concentration in terms of scientific journals and research areas, being identified, mostly, the Computer Science, Information Sciences and Engineering areas. Due to this confluence and constant interaction with other disciplines, apparently the field of Knowledge Sharing has not yet crystallized as a theoretical territory. The articles identified related to Knowledge Sharing and Information Security were submitted to a bibliometric analysis using VOSviewer software. This method was applied in two phases, primarily, a descriptive analysis was conducted and then a co-citation analysis was performed recurring to VOSviewer software. The results obtained from co-citation analysis include two clusters, namely: cluster 1 - Information Security and sharing of knowledge under the user's perspective and cluster 2 - Knowledge Sharing and Information Security under the organisation's perspective and translate a gap in terms of research about Knowledge Sharing and Information Security, thus pointing to a path to be explored. There is also the need to foster new research and strengthen the networks of researchers, in order to broaden the framework and theoretical crystallization as an autonomous scientific discipline.

Keywords: Knowledge Sharing; Information security; Bibliometrics; co-citation analysis.

1. Introduction

The way organisations capturing, developing, distributing and effectively using organizational knowledge is defined as Knowledge Management (Davenport & Prusak 1998). This specific process lead organisations to create value as well they make the best use of knowledge.

In this procedure, is crucial when firms share their knowledge (internally or externally) enabling them to serve their customers more efficiently and effectively gaining a competitive advantage. Knowledge sharing among employees constitutes one essential stage in the development of an organizational knowledge base. In this sense Leal et al. (2016) demonstrate the positive and direct knowledge sharing' influence over organisational performance and innovation (Marques et al. 2015).

Niwa (1990) was the first author to publish about knowledge-sharing in management, but under an engineering vision. This Japanese researcher defined what he called a *knowledge-sharing paradigm* and highlighted the importance of the knowledge flow, suggesting some strategies of creation of knowledge-based systems. These systems would consist in a paradigm shift as they were an attempt to establish a knowledge platform to firms and suppliers sharing their knowledge for "effective problem solving" (Niwa 1990, p.278). Despite being the first author mentioning knowledge-sharing practices, it was done under an IT user's perspective leaving the management issue to a second place.

As similar with Knowledge Management, Information Security has become a globally recognized discipline within organisations and at the Academy (European Network and Information Security Agency (ENISA) 2009). Affecting

individuals and organisations on a daily basis (Albrechtsen 2007; Winkler 2011) by protecting the confidentiality, integrity and availability or accessibility of information (Grama 2014).

The first article relating KS to information security was presented on a Medical Conference and published just in 2003. In his paper, Wright have explored the Risk Information Management Resource (RIMR) as a tool to share knowledge in communities of practice (Wright 2003).

It is evident that knowledge sharing and information security have become well-established concepts in Academia and within organisations. However, it appears that the intersection of these two practices, has received inadequate attention.

So this paper intends, under a systematic literature review recurring to bibliometrics techniques, to unveil how academia has demonstrated its interest in these two subject through publications that are able to articulate information security questions with knowledge sharing, as so far as dynamically investigates the international research production in the wider field of knowledge sharing .

The objectives of this study are: (1) to ascertain the quantity and spread of papers published available through the Thomson Reuters web-based databases; (2) to identify the authorship patterns deal with relevant literature; (3) to find out the active authors and affiliations involved in the published works; (4) to explore the JCR.s subject categories of the major journals; and (5) to identify the main co-cited references and ways they are grouped (i.e. clusters).

The situation of scarcity in the information concerning research in these two adjacent practices proves clearly the need for a systemic exploration. Thus, the review presented below, which aggregates bibliometric data, sought to systematise the various publications in this field and identify the main topics studied in recent decades, as well as how these streams have evolved. The results of this study would (a) present an overview of the worldwide status of publication productivity of researchers and practitioners; (b) identify the main subjects of academic activity of these experts and (c) forecast the trends of future lines of investigation.

The remainder of the paper is organized as follows: the theoretical background comprises knowledge sharing and Information Security questions. In section 3 the research methodology, data collection is discussed. The results obtained are presented in section four. Contributions to, and implementation of the research are explained in section five. The conclusion, limitations and future work are all described in section six.

2. Literature Review

Presently, and probably because the explosion of knowledge and information, greater emphasis is placed on knowledge work and the identification of information and knowledge in Management and Business (Spender & Grant 1996).

In this sense, knowledge management, processes that naturally exist in organisation (e.g., knowledge sharing or knowledge acquisition) are vital to organisations, since knowledge is not uniformly disseminated within them, consequently, it is necessary to identify, capture, create, and accumulate knowledge to enable both resource structuring and capacity building, which have been found to significantly increase firm performance (Wang & Wang 2012).

To achieve such aim, (e.g. increase firm's performance) knowledge sharing plays an important role in assisting the organization achieving its best practices, and in minimizing both the learning curve and the effort invested on the part of employees to master new fields of expertise (Hansen 2002). Managers are now trying to facilitate the spontaneous emergence of communities of practice in organisations to encourage alignment of changing practices, thereby assisting the transfer of knowledge throughout the organization.

According to de Vries et al. (2006) knowledge sharing is the process where individuals mutually exchange their (tacit and explicit) knowledge and jointly create new knowledge, been recognized as a positive force for survival of an organization (Yang & Chen 2008). Wang et al. (2016) stated that Knowledge-related competence and organizational performance can be enhanced by effective KS, because KS can make jobs easier and improve process efficiency by the exchange of relevant information, best practices, insights, experiences, preferences, lessons learned, as well as common and uncommon sense (Wu & Lin 2013) it is why KS is the best way to effectively and efficiently create, sustain, and transfer knowledge (Wang et al. 2014).

Wu and Lin (2013) define knowledge sharing as a process which comprises a set of shared understandings related to providing employees with access to relevant information and using existing knowledge within organizations. Darr and Kurtzberg (2000) go further and define knowledge sharing as the deliberate action in which employees diffuse relevant information to others across and outside the organisation.

Undoubtedly, information has a key role in this new knowledge paradigm, and above all, “users should play an active part in the information security work by preventing unwanted incidents; protecting an organisation’s material and immaterial assets; and reacting to incidents” (Albrechtsen 2007, p.276).

To Parsons et al. (2014) information security concerns to defending information from unauthorized access, disclosure, use, modification, disruption, or inspection. In other words, confidentiality, integrity and reliability of information are important in information security (von Solms & van Niekerk 2013). In this sense, information security management is an issue for both users and organisations playing a vital role in mitigating the risk of information security breaches

Albrechtsen (2007) stresses that, generally, within organisations, information security awareness is inadequate, each individual perform very few information security actions; people are not familiar with possible threats and are not aware of possible consequences of security breaches; and the worst, some of them may not see the value of their information security role in the holistic security work of the organisation.

Haldin-Herrgard (2000) signs the importance that information security has to knowledge sharing to organisations. As the author refers: “a great deal can be done through modern information technology to diffuse explicit knowledge” (Haldin-Herrgard 2000, p.363). Still, and according to this author the difficulties with sharing of knowledge can however also be to advantage for the organisation, due to the barriers created to copying by outsiders.

Safa and Von Solms (2016) presented an interesting study where they tested a knowledge sharing of information security model. They highlighted the importance of motivational factors on one's attitude towards information security knowledge sharing behaviour, in particular, the relevance of extrinsic motivational factors.

3. Methodology

In order to accomplish the aims of this study, some research questions were defined:

- i. What are the total number and geographical spread of publications in knowledge sharing and information security?
- ii. Who are the active contributors, their status and affiliations?
- iii. What are the core of knowledge sharing and information security journals and their disciplines?
- iv. Starting from the co-citations analysis of this sample is it possible to determine that there are tendencies for certain types of studies or thematic?

Therefore, to perform this study and answer these questions, a systematic approach was applied to the literature review, making use of a rigorous protocol and definition of steps in order to carry out the research and an analysis of the literature based on scientific articles published in the Web of Science. The articles found related to the topic of knowledge sharing and information security were submitted to a bibliometric analysis.

According to Pritchard (1969, p.349), bibliometrics deals with "the application of mathematics and statistical methods to books and other media of communication". Similarly, Hawkins (1977) defines bibliometrics as the application of quantitative analysis in the bibliographical references of the body of literature. In sum, bibliometrics study patterns of authorship, publication and literature use by applying mathematics and statistical analyses.

Potter (1988) divided bibliometric studies into two categories. Firstly, descriptive, which attempts to study the body of a literature by counting its contributing countries, authors, Journals, year of publications, and disciplines. The second category of bibliometrics, attempts to study the use of a body of literature by using citation analysis. For example, it can be concluded that in a specific field and period of time the most cited papers, and also the most co-cited papers tend to neglect a particular methodology or thematic. This method looks at the work others have done and seeks to build upon those previous works with a needed, new interpretation.

As suggested by Di Stefano et al. (2012, p.1199), although this analysis does have its limitations, “if compared to alternative techniques, citations are less prone to systematic biases in providing an objective assessment of the influence of publications or authors.

Bibliometrics has been widely used in the social sciences, in different research areas, namely applied to knowledge management (Akhavan et al. 2016; Serenko et al. 2011; Serenko & Dumay 2015). Many of these systematic reviews are based on an explicit quantitative meta-analysis of available data.

This study has, therefore, a quantitative nature and can be characterized as an exploratory-descriptive study (Abrams 2009). Data were collected in February 2017 through the ISI Web of Science (SCI-EXPANDED) and Social Sciences Citation Index (SSCI) databases, using a Boolean combination of relevant keywords. Table 1 presents the research criteria used in this study.

Table 1 Research criteria used

Keywords (TOPIC)	Period	Database	Research Areas	Document Types
"knowledge sharing" and "Information security"	1900 a 2017	Web of Science SCI-Expanded	Business Economics Information Science Computer Science	Articles Proceedings papers

After applying these criteria, a database of 28 records was obtained. The proceedings papers were considered because the records were retrieved, in their majority (68%), from these type of publications.

In addition to the outputs generated by WoS, we used the VOSviewer software to obtain different clusters according to study's objectives. The VOSviewer was particularly useful to find the clusters resulted from the co-citations analysis.

4. Results:

4.1. Brief characterization – a descriptive analysis

A preliminary examination of the works published revealed a significant amount of literature addressing information security available, but much of it is very technical. Besides, despite an evident concern to security of information, there is an apparent gap in research regarding the intersection between knowledge sharing and information security, regardless the relevance already recognized of human resources behavior in these areas.

During the period established for this study, a total of 28 studies (articles and proceedings papers) were found distributed by 61 journal titles. A total of 63 authors published their works since 2003, 87% of them contributed with just one publication. In terms of countries, the list is leading by Malaysia (5 records), England, Greece, Iran and Sweden (3 records), Australia, Finland, Italy and USA (2 records), verifying a large geographic polarization.

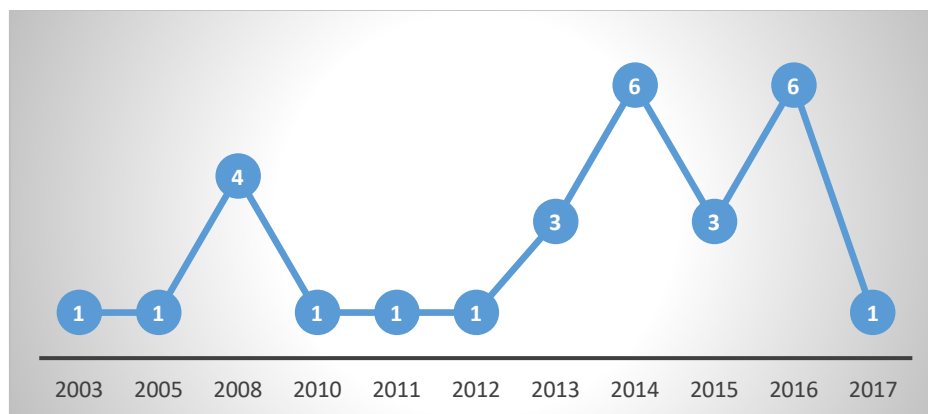


Figure 1 knowledge sharing and Information Security – year-wise distribution of papers on WoS

Figure 1 exemplifies a scarcity of works published on WoS connecting knowledge sharing and Information Security. The first work published, Risk information management resource (RIMR) modeling an approach to defending against military medical information assurance brain drain, occurred just in 2003 and belonged to an American researcher, Woodring Wright, presented at a Medical Conference. The years of 2014 and 2016 were the years with more publications (6) the rest of the period did not achieve an average of 2 publications/year. In

2014 we found the first work published in Management Science which related knowledge sharing and information security, (Ahmed et al. 2014).

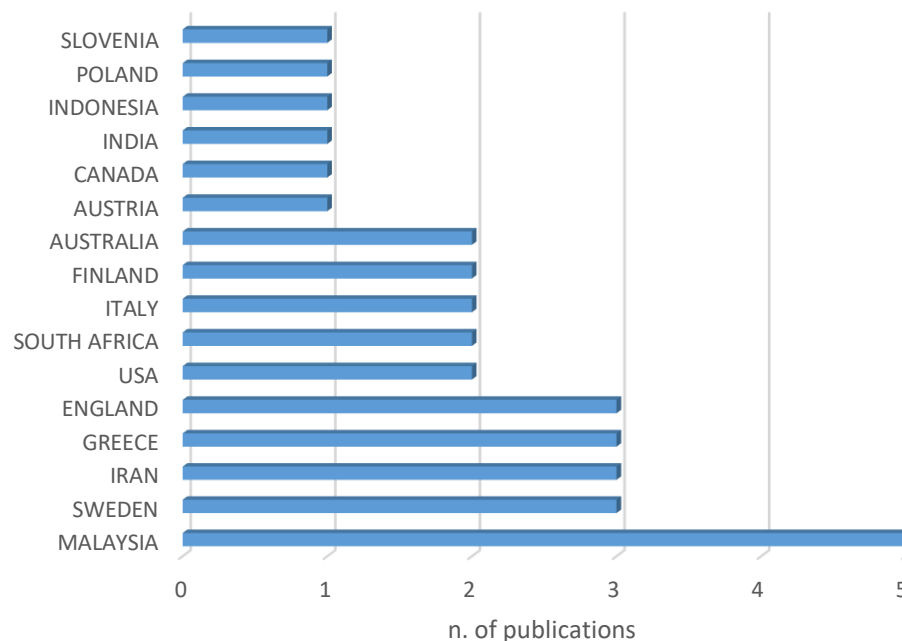


Figure 2 Publications - geographical distribution

Figure 2 shows publications geographical affiliation. Malaysia is the country with the majority of publications, four countries (Sweden, Iran, Greece and England) have almost 50% of the studies published, followed by USA, South Africa, Finland, Italy and Australia. The remaining six countries contributed with one paper each during the period studied. Data shows a geographical high dispersion not highlighting any particular country or continent.

Table 2 stresses a large prominence that Proceedings from European Conference on Knowledge Management (ECKM)) have in this sample (21%). Besides, other conferences from Computer Science have also been highlighted. Almost 60% of the sample was published in Proceedings, mostly from Information and Computer Science area.

Table 2 – Publications: Source Titles

<i>Source Titles</i>	<i>Records</i>
Proceedings of the European Conference on Knowledge Management	21,4%
Computers Security	10,7%
Proceedings of the annual Hawaii International Conference on System Sciences	7,1%
International Conference On Research And Innovation In Information Systems	7,1%
Computers in Human Behavior	7,1%
2013 International Conference On Research And Innovation In Information Systems ICRIS	7,1%
Technological Developments In Education And Automation	3,6%
Science Of Computer Programming	3,6%
Proceedings of the Society Of Photo Optical Instrumentation Engineers SPIE	3,6%
Proceedings of the 12th International Symposium On Open Collaboration Opensym	3,6%
Knowledge Based Software Engineering	3,6%

In terms of authorship, Table 3 illustrates the most cited and the ones with highest number of publications. Some authors, despite having 2 or more publications, do not have any citations, this fact is probably due to the predominance of papers presented at international conferences.

Table 3 – Top 10 - Authors – Publications

<i>Authors</i>	<i>Records</i>	<i>Citations</i>
Tamjidyamcholo, A	10.7%	26
Papadaki, K	10.7%	0
Bin Baba, M	10.7%	26
Von Solms, R	7.1%	5
Stoll, M	7.1%	0
Safa, N	7.1%	5
Polemi, N	7.1%	0
Paivarinta, T	7.1%	3
Gholipour, R	7.1%	18
Yazid, S	3.6%	0

Given this data, it is possible to summarize some characteristics of this sample. Regardless of a large number of publications concerning to knowledge sharing and to information security which emphasize their significance, both academically and professional, it appears that in the intersection of these two themes little publications have been presented. Furthermore, within this sample, built from Thomson Reuters Web of Science database, it is possible to find a prevalence of journals and conference proceedings from Compute Science and Information Systems areas. The Figure 3 illustrates and reinforce this idea showing the keywords more used by the authors from this database.

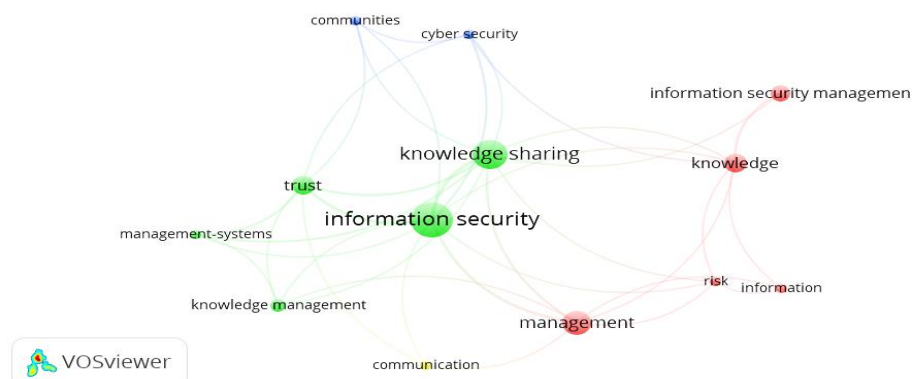


Figure 3 – Keywords use

Using the Vosviewer software it was possible to define this map (Figure 3) locating the keywords, tracing the relationships between them and offering a visual illustration of the principal terms applied. Again, within the 28 publications which constituted the sample, terms related to information security were more relevant than the ones related to knowledge sharing (in number of citations).

4.2. Co-citation Analysis

According to Di Stefano et al. (2012) a co-citation analysis is a bibliometric method used to examine relationships between articles or authors contributing to the development of a research field, based on the assumption that two often co-cited documents are related to each other and address the same broad research questions.

In this paper, the focus will be over the most influential contributions dealing with the knowledge sharing and information security concepts. Using the Vosviewer software it was possible to define two very distinct and separated groups of authors (see Figure 4). Given the small sample size the criteria used to run the co-citation analysis was the author has been cited three times, at least. This criteria gave an output of 59 references divided into two clusters (one with 30 references and the second with 29). In terms of dimension these two clusters are practically balanced.

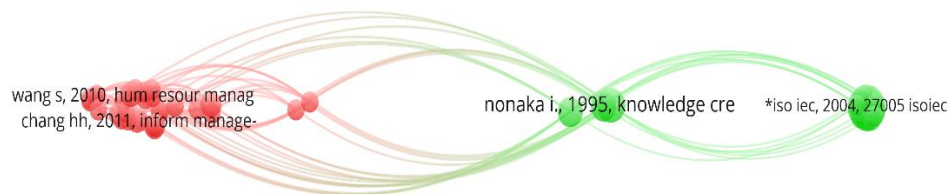


Figure 4 – Co-citation analysis - clusters

Small (1973) believes that the strength of a co-citation is related to the number of times that two earlier documents are cited together by a new article. Thus, in Figure 4 it is possible to see the authors most cited on the papers from WoS' sample obtained previously.

Additionally, Table 4 points out the two clusters found and list the five most cited references from each of groups.

Table 4 – Clusters composition - the top 5

Authors	Citations	Cluster
Chang and Chuang (2011)	47	1 <i>Information Security and sharing of knowledge under the user's perspective</i>
Chin et al. (2003)	36	
Choo (2011)	36	
Fornell and Larcker (1981)	36	
Hsu and Lin (2008)	36	
Hsu et al. (2007)	110	2 <i>knowledge sharing and Information Security under the organisation's perspective</i>
Dhillon and Backhouse (2001)	92	
Nonaka (1994)	92	
ISO/IEC (2005)	84	
Brown and Duguid (2001)	84	

For reasons of space limitation it was decided to present in this paper only the 5 most cited authors of each cluster. Thus, in cluster 1 we have a homogeneous nucleus of works focused mostly on the issue of information security but from the user's perspective, in this sense, it was decided to name this cluster as *Information Security and sharing of knowledge under the user's perspective*.

In turn, and as it is possible to analyse from Figure 4, the cluster 2 has two separate yet interrelated groups. All the papers from this cluster emphasize the organisational perception from knowledge sharing and information security, their benefits and risks. Although the papers approach these two concepts under an organisational vision, they do not neglect the individual influences, motivations, etc. Even though in this cluster it is not so clear a certain technical vision, still is felt, mainly in relation to the information security.

As it was recognized throughout this research, also in these two clusters, very few articles related simultaneously and in organizational terms the 2 concepts (knowledge sharing and information security).

5. Conclusions, limitations and some suggestions

This study identified two clusters, enabling to identify which authors have contributed the most to knowledge sharing and information security and which areas have been most often studied.

However, the results reflect a gap in literature respecting to research focusing on these two concepts simultaneously, pointing therefore a way to explore. Ryan (2006) mentioned that a possible "conflict" between

knowledge sharing and information security is an area that needs vital exploration before moving onto the next step of attempting to achieve knowledge security. Regarding to outputs obtained in the present investigation, this exploration is still undergoing, and this is probably the most important result from this investigation.

Despite the obvious relevance of knowledge sharing and information security practices, recognised by academics and practitioners, this study found: i) a scarce number of publications relating the two concepts; ii) most of studies published are concerning to technical aspects; iii) the investigation has been focused commonly in user's perspective, revealing a lack of studies related to a more holistic managerial vision of organisations.

Relating to research questions defined previously and concerning to bibliometric descriptive analysis, regardless a large number of publications concerning to knowledge sharing and to information security, which emphasize their significance, both academically and professional, it appears that in the intersection of these two themes little publications have been published. Furthermore, within this sample, built from Thomson Reuters Web of Science database, it is possible to find a prevalence of journals and conference proceedings from Compute Science and Information Systems areas, but then, a small number of publications in management has been registered. Likewise, as cited by Leal et al. (2017), the results achieved reveal a great importance of Conferences such as ECKM in spreading of these topics, being an opportunity to exchange and diffuse the research. But these kind of events are a first approach to publish a paper and an opportunity to receive contributions to improve the work. However it is noted a lack of publications in Journals which probably would boost the works and, consequently, the results. The present situation indicates little research that most often cited conditioning, perhaps, the advance of science.

On the other hand, and regarding to co-citation analysis, the results point out to an incipient stage of investigation of issues relating to organisational management. A large part of the (empirical) studies, found have focused on technical and structural aspects of information security and on the user's (motivations, behaviours) perspective on the information (that can be shared or not).

Consequently, the main implication of this work lies on this clear flaw found on the body of literature. It is necessary to note that this gap remains unfilled either through exploratory studies or through empirical work.

This work can be seen as a primary step to a broader investigation relating knowledge sharing practices, information security and intellectual capital, as these three concepts have in common the human resources of organisations and it seems important to study how these three elements can be related in order to improve firms' performance.

Some limitations can be presented to this study, first of all, the results are conditioned to papers published in Thomson Reuters Web of Science database. Secondly, the way the queries are defined may determine the results, so some author's subjectivity may be pointed.

Based on these limitations this study intends to be just a first attempt to this issue, paving the way for further empirical studies in order to make aware of the importance of sharing of knowledge and of security of the information shared in an organizational perspective.

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