

Knowledge Processes, Absorptive Capacity and Innovation: Contributions for a Systematic Literature Review

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Abstract: The present research shows a systematic literature review considering three related research topics: knowledge processes, absorptive capacity and innovation. The main purpose is to identify and describe main knowledge processes that have been tested by empirical articles during the 2009-2013 term. Following a systematic methodology we first search for key words and constructed a search string. Thus, using the web of knowledge database we obtained 608 references of which we chose 54 empirical articles, after title and abstract selection. The present review considered 24 empirical articles, where questionnaires were used for data collection. Also, innovation is considered as an output in the sample articles. Results show that knowledge acquisition, sharing, creation, codification and exploitation are the most popular topics in the knowledge processes-innovation relationship. Acquisition and exploitation dimensions reveal that knowledge processes are somehow aligned with the absorptive capacity construct (Cohen and Levinthal 1990), particularly with potential and realized absorptive capacity (Zahra and George 2002). The sample of papers in the review collected data mainly in manufacturing and high-technology industries. We presented information about the questionnaires used by the sample papers, showing that a large amount of valid and robust measures have been developed. As every study, this one has some limitations, as we considered only one database and empirical articles where questionnaires were used. This paper has several practical implications: first, academics should build some consensus around already existing measures for knowledge processes, as they show good psychometric characteristics. Second, overcoming some of the limitations of the present study, the search string can be adapted and applied to different databases, collecting other valuable references. In conclusion, the leading knowledge processes identified in our systematic review are aligned with the knowledge processes-Innovation literature, representing a knowledge lifecycle that is necessary to continuous innovation. Further research can confirm, replicate and upgrade our findings considering different databases or time spans. Moreover, researchers interested in studying the relationship between knowledge processes, absorptive capacity and innovation, found here evidence about used questionnaires that can help them in the decision making processes

Keywords: knowledge management processes; absorptive capacity; innovation; systematic literature review

1. Introduction

The aim of the present study is to contribute for a systematic literature review in knowledge management processes (KMP) and absorptive capacity (ACAP), considering studies that focused in their relationship with innovation.

Specifically, it is our purpose to develop a review that allow us to: (1) develop a comprehensive understanding about similarities and differences between knowledge management processes and absorptive capacity; (2) know which KMP have been recently studied in relationship with innovation; (3) identify industries where these topics have been studied; (4) detect future research needs.

1.1 Knowledge absorptive capacity and innovation

The increasing complexity of innovation, associated with the unavailability of all needed knowledge to innovate in one organization, turns external knowledge sources a key element for innovative firms. Thus, as stated by Cohen and Levinthal (1990) the ability to exploit externally acquired knowledge represents a crucial factor of innovation capacity. This capability of evaluate and use externally held knowledge depends on previous related knowledge. Therefore, Cohen and Levinthal (1990) coined absorptive capacity as “the acquisition or assimilation of information by an organization but also to the organization's ability to exploit it” (p.131).

Since Cohen and Levinthal (1990), few studies tried to develop or reconceptualize absorptive capacity or the underlying dimensions of identification, assimilation or exploitation (see Lane, Koka and Pathak 2006 for a discussion). One of the few attempts was made by Zahra and George (2002) that defined absorptive capacity as “a dynamic capability that influences the firm's ability to create and deploy the knowledge necessary to build other organizational capabilities (p. 188)”. On their reconceptualization, absorptive capacity encompasses four factors (acquisition, assimilation, transformation and exploitation). Together, acquisition and as-

simulation represent potential absorptive capacity, which capture organization's capability to value and acquire external knowledge but "does not guarantee the exploitation of this knowledge" (p.190). Transformation and exploitation represents realized absorptive capacity, meaning that the organization is able to combine and use the absorbed knowledge.

As noticed by Lane et al. (2006), this process approach of absorptive capacity focus on knowledge sharing and integration as critical enablers for absorptive capacity. This goes in line with social integration mechanisms that in Zahra and George's model appear as enablers of knowledge sharing and, eventually, knowledge exploitation, reducing the gap between potential and realized absorptive capacity.

2. Methodology

The present section details how the literature review was conducted. Understanding that a systematic literature review offers information about how the references were collected, selected (selection criteria) and analyzed (search strategy), it is our intention to clarify each step, ensuring that readers and future researchers can verify and develop the present review.

2.1 Systematic literature review

Originally used in medical sciences, systematic literature review (SLR), as a methodology, have been recently applied to management and organizational studies, where review protocols have been developed. Throughout this research, review protocols (as the one developed by Denyer and Tranfield 2009) and SLR examples (Pittaway, Robertson, Munir, Denyer and Neely, 2004; Kofinas and Saur-Amaral, 2008) were used as guidelines.

Therefore, before starting SLR, an exploratory search was conducted. Thus, papers that focused on KMP, ACAP and innovation were collected and filtered considering citations (Highest to lowest) as criteria. This approach led us to classic papers like Cohen and Levinthal (1990), Zahra and George (2002) and Scarbrough (2003), which gave us a general information about some of the most influential papers.

2.2 Search strategy

The search strategy section details how the SLR was developed, following previously planned steps:

- Identify keywords: to collect keywords we first search for papers that have "knowledge management" and innovation on title. Then, keywords from 42 papers (collected through Science Citation Index Expanded and Social Sciences Citation Index databases) were analyzed and led us to add Absorptive Capacity, Knowledge Creation, Organizational Knowledge, Exploitation, Exploration, Knowledge Management Systems, Knowledge Acquisition, Knowledge Application, Knowledge Processes and Knowledge Sharing to our search string.
- Exploratory search: using keywords previously identified, exploratory searches were made to verify if the results were suitable according to the SLR goals. Top 10 results, ordered by relevance, were checked.
- Search String development: after previous steps, a search string was created. Knowledge processes of creation, application, acquisition and sharing identified by our preliminary search are aligned with those identified by Hislop (2009). Although, knowledge codification category is missing and we added it to the search string. Considering the similarities between knowledge sharing and transfer/transmission the knowledge transfer/transmission process was also added to the string. As we are interested in understanding the role of absorptive capacity on innovation we also add assimilation and transformation as keywords, on the basis of Zahra and George (2002) model.
- Considering the innovation process, we adopted the broad definition of OECD (2005) that defines innovation as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations" (p.46). This definition led us to consider product innovation, process innovation, marketing innovation and organizational innovation as keywords to our search string but those keywords do not add or exclude results from our search as "innovation" by itself comprises the identified innovation types.
- Citations filter: the citations identified by the search string were filtered according to inclusion/exclusion criteria.

- Citations exportation: citations were exported from web of knowledge to Endnote (Online Version).
- Title analysis: references titles were read and a first inclusion/exclusion phase took place.
- Abstract analysis: after title analysis, abstracts of the remaining papers were analyzed and submitted to inclusion/exclusion and relevance criteria.

After the exploratory search and the key words collection, different search strings were tested and top 10 results were analyzed to confirm that the references lined up with the purpose of the present review.

The final search string was: TS= (("knowledge management" AND "Absorptive Capacity") OR "knowledge Creation" OR "Organizational Knowledge" OR "Exploitation" OR "Exploration" OR "knowledge Acquisition" OR "knowledge Application" OR "Knowledge process*" OR "knowledge Sharing" OR "knowledge trans*" OR "knowledge codification" OR "knowledge assimilation") AND TI=(Innovation)

With the ultimate string, a search was undertaken using Web of Knowledge's Science Citation Index Expanded and Social Sciences Citation Index databases. 608 results were obtained, comprising references between January, 2009 and December, 2013. We used last five years as inclusion/exclusion criteria because we want to review current research papers.

Thus, references were exported to Endnote (Online version) and were submitted to the following Inclusion and exclusion criteria:

- Papers written in English: Reasoning: being the dominant language of the scientific community, and considering the replicability goal of SLR, only papers written in English were included.
- Published in peer-reviewed journals. Reasoning: as we are concerned with papers quality, we assume that peer-reviewed papers will ensure higher quality and reliability.
- Articles: The present review only considers this document type, thus excluding, for example, reviews and conference proceedings.
- Quantitative empirical papers. Reasoning: aligned with our goals, only empirical papers that used quantitative measures were considered.

After applying inclusion/ exclusion criteria references were submitted to relevance criteria. Thus, relevant papers: (1) consider knowledge processes or absorptive capacity as major topics of the study; (2) analyze knowledge processes or absorptive capacity with innovation; (3) are published in specialized journals giving the research topics; (4) follow a management and organization studies standpoint.

References selection steps are illustrated in Figure 1.

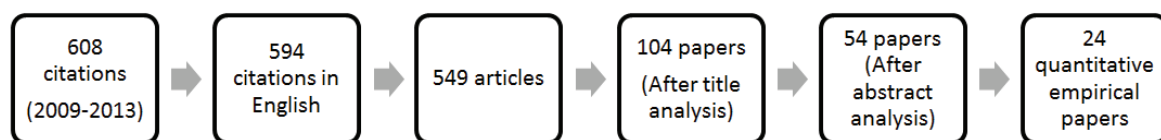


Figure 1: References selection steps

To confirm the empirical nature of the papers and use of quantitative measures, we access to papers full text 5 papers (out of 54) were excluded due to full paper accessibility. Finally, of the 49 papers, 24 completely fulfilled our inclusion/exclusion and relevance criteria. These papers, where questionnaires were used for data collection, represent our final sample.

3. Results

Reading the 24 papers first evidence appears: the majority of the papers focused on the KMP-Innovation relationship. Of the 24, only 5 papers quantitatively analyze the ACAP-Innovation relationship (Chao et al. 2011; Liao, Wu, Hu and Tsui 2010; Parra-Requena et al. 2013; Ritala and Hurmelinna-Laukkanen 2013; Wang and Han 2011). 21 articles focused on KMP-Innovation relationship. 2 papers (Liao et al. 2010; Parra-Requena et al. 2013) analyzed both KMP and ACAP.

3.1 Industries

One of the goals of the present review was to analyze main industries where KMP and ACAP were traditionally studied, in their relationship with innovation. An industrial analysis of the sample papers, presented in table 1, shows that data were mainly collected in manufacturing and high-technology industries.

Table 1: Industrial analysis of papers reviewed

Industries	Number of papers	% of the sample
Primary Industries	(5)	20.8%
Food and Agriculture	2	
Energy industry	3	
High-technology Industries	(15)	62.5%
Chemicals Industry	4	
Information and Communication	7	
Electronics/mechatronics/optoelectronics	3	
Petrochemicals and plastics	1	
Aerospace	1	
Medical, surgical and optical material	3	
Pharmaceutical Industries	4	
Biotechnology	2	
Pharmaceutical	2	
Manufacturing Industries	(16)	66.6%
Mechanical Machinery, equipment and material	4	
Electrical Machinery and Material	3	
Electronic Material and equipment	2	
Office equipment industry	1	
Textile (Clothing)	1	
Footwear Industry	1	
Automotive	3	
Service Industries	(7)	29.2%
Food/beverage	2	
Services to Companies	1	
Hospitals/Medicine/Health activities	1	
Financial	1	
Banking and Insurance	1	
Engineering/construction	3	
Non specified	(3)	12.5%

3.2 ACAP measures

Quantitative empirical papers that were obtained by our search string and analyze ACAP mainly focused on Zahra and George (2002) work to develop (or use previously existing) measures that considered potential absorptive capacity (Ritala and Hurmelinna-Laukkanen, 2013), realized absorptive capacity or both dimensions (Chao et al. 2011; Wang and Han 2011). Liao et al. (2010) used the Index of absorptive capacity developed by Nieto and Quevedo (2005) and Parra-Requena et al. (2013) adapted existing items to measure identification and combinative capability. Almost all measures present acceptable psychometric properties, although factors from Index of absorptive capacity used by Liao et al. (2010) show questionable reliability values, as Cronbach's alpha is below the .70 threshold.

Table 2 shows additional information of measures.

Table 2: ACAP measures

Paper	Measures	Dimensions	Items	Statistics	Items avail-ability
Chao et al. (2011)	Absorptive Capability Scale (Jansen, Van den Bosch and Volberda, 2005)	Acquisition	6	CV= .85	Yes, on the original.
		Assimilation	3	CV= .76	
		Transformation	6	CV= .91	
		Exploitation	6	CV= .91	

Paper	Measures	Dimensions	Items	Statistics	Items availability
Liao et al. (2010)	Index of absorptive capacity (Nieto and Quevedo, 2005)	Communication with the outside environment	4	$\alpha = .60$	Yes, on the original.
		Level of know-how and experience in the organization	3	$\alpha = .68$	
		Diversity and overlaps in the knowledge structure	3	$\alpha = .64$	
		Strategic positioning	4	$\alpha = .45$	
Parra-Requena et al. (2013)	Identification capability (adapted from McEvily and Zaheer (1999); Combinative capability (based on Van den Bosch et al. (1999), Cohen and Levinthal (1990), Zahra and George (2002) and Kogut and Zander (1992).	Identification capability	3	$\alpha = .88$; CR = .93 e AVE .81;	Yes
		Combinative Capability	6	$\alpha = .92$; CR = .94; AVE = .71.	
Ritala and Hurmelinna-Laukkanen (2013)	Potential absorptive capacity (based on Zahra and George, 2002)	Potential absorptive capacity	4	$\alpha = .78$	Yes
Wang and Han (2011)	Absorptive capacity (based on Zahra and George, 2002)	Acquisition	No information	$\alpha = .84$	No
		Assimilation		$\alpha = .87$	
		Transformation and exploitation.		$\alpha = .80$	

CV = Construct Validity; CR= composite reliability; AVE = Average Variance Extracted; α = Cronbach Alpha.

3.3 KMP definitions and measures

As noticed above, 21 papers examined the KMP –Innovation relationship. Of the 21 papers, 10 focused on 1 process (e.g., Camelo-Ordaz, Garcia-Cruz, Sousa-Ginel and Valle-Cabrera 2011; Garcia-Muina, Pelechano-Barahona and Navas-Lopez 2009), 7 analyzed 2 KMP (e.g., Li, Liu, Wang, Li and Guo 2009; Zhang, Shu, Jiang and Malter 2010) and 4 considered 3 or more processes (e.g., Andreeva and Kianto 2011; Kianto 2011; Zheng, Zhang, Wu and Du 2011). Knowledge acquisition appears to be the most studied process, followed by knowledge sharing, codification, creation and application. Table 3 shows KMP frequency and definitions.

Table 3: KMP definitions and frequency

KMP	Definitions	Count	% of the sample
Acquisition	Process of acquiring knowledge that is available outside the firm (other firms, suppliers, customers) (Andreeva and Kianto 2011; Lee, Leong, Hew and Ooi 2013), or that is available in employees themselves (Liao et al. 2010). “Firms ability to identify and acquire useful external knowledge” (Zheng et al. 2011, p. 1038)”.	10	47.6%
Sharing	Process through which internally developed or externally acquired knowledge is communicated to other individuals (Li et al. 2009); “act of placing knowledge possessed by an individual at the disposition of others within the organization” (Camelo-ordaz et al. 2011, p. 1444);	9	42.9%

KMP	Definitions	Count	% of the sample
Codification/ Storage/ documentation	“a process of structuring and storing of knowledge” that “formalizes knowledge and provides the possibility of utilizing it later” (Massa and Testa, 2009 cited in Lee et al. 2013, p.853) as codifiable tacit knowledge is converted into messages — patents, databases, user manuals, etc. — that can then be processed as information (Garcia Muina et al. 2009); This storage and documentation uses forms such as “written documents, electronic databases, codified knowledge in expert systems, documented organizational procedures and processes, and tacit knowledge located in individuals” (Alavi and Leidner, 2001 cited in Andreeva and Kianto, 2011, p. 1019).	6	28.6%
Creation	Organization’s ability to develop new and useful ideas and solutions regarding various aspects of organizational activities, from products to technological processes to managerial practices (Andreeva and Kianto, 2011); Firm’s new knowledge-based elements generated from the strategic alliance (Inkpen 1998, cited in Zhang et al. 2010, p.81). “An upward spiral process including socialization, externalization, combination, and internalization (SECI)” (Nonaka, 1994; Nonaka and Takeuchi, 1995, cited in Shu, Page, Gao and Jiang 2012).	5	23.8%
Exploitation/ application	The extent to which firms use existing competences, technologies and paradigms (March, 1991; Laursen and Salter, 2006), including technologies, managerial practices, human resources, equipment and so on (cited in Li, Li, Liu and Barnes 2011); exploitation practices are those utilized to leverage existing knowledge (Grant, 2002; He and Wong, 2004 cited in Donate and Guadamillas, 2011).	5	23.8%

One of the main goals of the present study is to develop a comprehensive understanding about similarities and differences between knowledge management processes and absorptive capacity, when the studies explore their relationship with innovation. Considering the ACAP dimensions identified by Zahra and George (2002) – acquisition, assimilation, transformation and exploitation – and the definitions of the main KMP presented in table 3, we can argue that there is some overlapping between definitions in the ACAP and KM literature. Specifically, no clear distinction can be made between knowledge acquisition and knowledge exploitation definitions considering both research streams, particularly when the KMP presents an external orientation.

Due to paper length restrictions a table of KMP measures cannot be fully displayed here. Although, Table 4 shows a brief example of 3 papers that used multiple knowledge processes measures.

Table 4: KMP measures

Paper	Measures	Dimensions	Items	Statistics	Items availability
Andreeva and Kianto (2011)	Knowledge creation scale (Kianto 2011); Knowledge storage and documentation scale (Kianto, 2011; Karadsheh et al. 2009; Bayona et al. 2001; Alavi and Leidner, 2001). Intra-Organizational Knowledge Sharing scale (Kianto 2011; Darroch 2003). Knowledge acquisition (Kianto 2011).	Knowledge Creation	4	$\alpha = .87$	Yes, on the original
		Knowledge Storage and documentation	4	$\alpha = .87$	
		Knowledge sharing	5	$\alpha = .88$	
		Knowledge Acquisition	3	$\alpha = .74$	
Zhou and Li (2012)	knowledge sharing (Schulz 2001); Market knowledge acquisition (Tsang 2002).	Knowledge sharing	3	CR = 0.85; AVE = 0.65.	Yes, on the original
		Knowledge acquisition	3	CR = 0.84; AVE = 0.64.	
Lee et al. (2013)	knowledge acquisition, knowledge sharing, knowledge application and knowledge storage (Lopez et al. 2006; Martinez-Costa and Jimenez-Jimenez 2009).	knowledge acquisition	5	$\alpha = .87$	No
		knowledge sharing	5	$\alpha = .83$	
		knowledge application	4	$\alpha = .81$	
		knowledge storage	5	$\alpha = .84$	

CR= composite reliability; AVE = Average Variance Extracted; α = Cronbach Alpha.

Analyzing the measures used by the sample papers shows that no single questionnaire stands out. Even in knowledge acquisition, the most studied KMP, only 3 (out of 10) studies used the same measure (based on Gold, Malhotra and Segars, 2001). When presented, scales show high reliability (mainly measured with Cronbach's alpha), convergent and discriminant validity. This means that a substantial number of reliable and valid measures exist and have been recently used or developed to measure KMP.

The analysis of the number of items reveals that an effort has been made to synthesize the number of items reflecting each process. Therefore, processes were measured using between 3 and 7 indicators each. The only exception is knowledge exploitation in Donate and Guadamillas (2011), measured with 11 items.

4. Discussion

The present SLR aimed to develop a comprehensive understanding on KMP and ACAP recent and relevant literature, in relationship with innovation, considering empirical papers, which used questionnaires to collect data, and were published between 2009 and 2013.

Traditionally, research on ACAP focused on proxies as indicators (see Lane, 2006 and Camisón and Forés, 2010), which have influenced current research and reduced the number of papers on ACAP considered in the present review due to inclusion/exclusion criteria. Therefore, the use of quantitative measures criteria reduced our ACAP-Innovation sample, thus limiting our potential to generalize results.

Considering the KMP-Innovation relationship results show that knowledge acquisition, sharing, codification, creation and application are the most frequent KMP. This result is in line with other reviews that focused on KM and innovation (see Xu, Houssin, Caillaud and Gardoni, 2010) and consequently are not surprising as they reflect major processes presented in the KM literature (Hislop, 2009; Xu et al. 2010). Once papers focused on KMP-Innovation relationship, it is explainable why knowledge acquisition, sharing, codification, creation and application are the most studied processes, as they represent a knowledge lifecycle that is necessary to continuous innovation (Xu et al. 2010).

The potential overlap between KMP and ACAP dimensions identified in the present review should be clarified in future research. Thus, we suggest that researchers conceptually analyze major ACAP reconceptualization's (Lane et al. 2006; Todorova and Durisin, 2007; Zahra and George, 2002), combining it with empirical research, identifying underlying KMP.

Rather than overlapped, we argue that KMP like acquisition, sharing and application are underlying in ACAP dimensions. For instance, external knowledge acquisition is related to exploratory learning (Lane et al. 2006; Lichtenthaler 2009) and potential absorptive capacity (Zahra and George, 2002). Also knowledge sharing (through social integration mechanisms) is critical for ACAP in Zahra and George's model, as pointed out by Lane (2006). Last, to reach commercial ends, organizations need to successfully apply previously identified and assimilated knowledge (Cohen and Levinthal 1990).

While researchers lean towards questionnaires development, no agreement emerges around specific scales. The decision to develop new scales can also reflect different definitions and conceptualizations of the KMP. An example can be brought with knowledge acquisition, which in the sample papers is defined as having either an external and internal focus, thus reflecting different measures.

Thus, we think that future research should focus on already existing scales to measure KMP or combine them in order to create a measure of ACAP dimensions. The similarities between KMP and ACAP dimensions suggest that some measures of KMP can be somehow combined and adjusted to reflect ACAP. Carefully done this can create a new stream of ACAP research that overcomes limiting assumptions identified by Lane et al. (2006). Specifically, non-R&D contexts can be explored and measures may reflect the fruitfulness of absorptive capacity as a dynamic capability. Here is important to clarify that we don't want to pass over researcher's efforts as made by Jansen et al. (2005) that developed a measure for potential and realized absorptive capacity. Although, our review collected diverse measures on KMP that can represent alternative ways to measure ACAP, thus creating a wide spectrum for researchers decision making.

Limitations of the present study include the use of 2 databases (Science Citation Index Expanded and Social Sciences Citation Index databases) from Web of Knowledge. While assuring high quality, peer reviewed papers, this decision limited our research spectrum and maybe interesting papers were excluded from the present review. Some restrictions applied with the search string (e.g. innovation must be in articles title) don't allow us to include in the sample papers relevant contributions (e.g. Lichtenthaler 2009).

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