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Review of semantic Absorptive Capacity (AC) in information system research

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Abstract

This paper is a semantic review research as a preliminary study to analyze the use of Absorptive Capacity (AC) theory in Information Systems (IS) research. This study aims to contribute to filling the gaps in the AC literature by analyzing the evolution of AC theory and models. A systematic literature review was carried out using an analysis of articles from ten leading journals in the IS field based on Scientific Journal Rankings. The selection of SI journals in the 1st quartile status aims to cover research related to research topics with good quality. The results show that the implementation of AC in IS is different from the initial concept of AC that was formed. The study identified the main driving factor for AC that has not been fully revealed in AC research in IS, namely Organizational Behavior. This study opens up future research opportunities to explore each dimension of AC development.

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1. Introduction

Absorptive Capacity theory (AC) has evolved since a new theory was introduced [1]–[3]. This theory is introduced by Cohen [4] for the first time in social science. There are at least 278,000 articles found in Google Scholar engine that discuss about AC [5]. It shows that AC theory is an interesting topic to be researched about. The first time the theory was discussed in scientific research, it was described as the organization's ability to learn about identifying, assimilating and exploiting the knowledge from the environment [4]. AC is an important theory in Information System research (IS) [6].

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Cohen and Levinthal (1990) [4] suggest paying attention on individual cognitive ability for AC improvement. It is considered as part of organization's construction [1]-[3]. Although AC (AC) relates to learning and knowledge, many AC's researches do not focus on individual role contribution in this development [11]. They are more focused on structural and procedural processes in the organization [3]. According to Zahra and Goerge [1], there are many ambiguities in the description of measurement, definition, component, antecedent, and result of AC. The organization's competitive advantage can be achieved through AC. Therefore, the organization gives the maximum support to it [7]. It is important to understand how researchers observe and explain how far AC engagement in the organization is. This is necessary so that organizations can utilize these capabilities optimally [6]. Meanwhile, there are differences in theory interpretation and implementation as aforementioned (and see Absorbive Capacity definition section). Responding to these problems, this study seeks to provide an overview of the literature on the development of AC theory since its inception until now and clarify the construct of individual role on it. Specifically, this study is expected to contribute to AC theory which fills the gap between formal AC process and how the organization can achieve their competitive advantage. In addition, this study also presents what components of AC are consistently used in the article. The next part of this paper describes the literature review, the third part is the research method, the fourth part is the results of the study and the last part is the conclusions and suggestions for further research.

2. Literature

A review of the development of AC since it was first introduced [4] and its evolution is needed to provide a context for analysis. This is because there are differences in the construct and conceptual AC. This review highlights the basic developments of AC in IS research and provides a comprehensive summary of the complexities of AC theory.

2.1. Absorbive Capacity (AC) definition

Absorbive Capacity (AC) is introduced by Cohen for the first time in a science article as the organization's learning ability to identify, assimilate and exploit knowledge from the environment [4]. Furthermore, in its development, the theory has undergone evolution. At least five great works, including Cohen [4], have contributed to its development. They are Zahra [1], Lane [3], Todorova [2], and Volberda [12]. There are many conceptual differences in its implementation according to those experts. According to Cohen [4], AC is the organization's ability to absorb knowledge for commercial purposes. The value recognition process plays an important role in it. It becomes easier if they have prior knowledge. Assimilation process may occur if there is prior learning and knowledge acquisition. This process also relies on the effectiveness of proliferations and socialisation from new external information. The new external information in the organization is considered as the new knowledge exploitation for its commercial advantages. Technology has the power to facilitate this exploitation process. Different ideas emerge from Zahra and George's (2002) findings [1]. Modification and expansion of the initial idea is done by stating the 4 dimensions of AC, namely acquisition, assimilation, transformation and exploitation. Zahra and George divided these dimensions into two models, the first one is AC potential (PAC), which consists of Acquisition and Assimilation. The acquisition dimension did not appear in AC parts which was introduced by Cohen [4]. The second model is AC realisation or RAC, which consists of commercial exploitation [4] and transformation. The transformation dimension also did not appear in Cohen's study [4]. Zahra and George's idea simply shows that the organization has the ability to change and exploit as much acquired knowledge as possible. Then the process of assimilation follows. The organization innovation can be achieved if the ratio of RAC to PAC is at maximum. However, this idea is considered deviant by Lane et al. [3]. Because it is not in accordance with the original purpose of the AC construction introduced by Cohen [4], Lane redefined AC as the concept, namely recognizing new knowledge through knowledge exploration, knowledge assimilation through transformative learning and used them to develop the new knowledge and commercial goal through exploitative learning. Todorova and Durisin (2007) [2] argue that there is serious ambiguity and omission in AC reconceptualized by Zahra and George because the "identify dimension" was missing and the placement of the previous dimensions were incorrectly done. While Folberda, Foss, and Lyles (2010) [12] express the need for the integration of Zahra and George's idea, by considering Organizational antecedents and managerial antecedents as a significant driver of AC. Intra organizational antecedents emphasize organizational structure and how it helps processes related to knowledge [12]. In general, these structures include organization, incentive structures, informal networks, and facilities for internal communication within the organization. All of them are

essential for the proliferation of newly acquired knowledge. Although there are different ideas from experts regarding AC as described previously, they consistently express 4 dimensions as the constituent expresses 4 dimensions as AC factor, namely: exploration, assimilation, transformation and exploitation. In previous studies, it was revealed that the routines and processes that contribute to organizational AC vary according to the individual learning abilities of the organization [13][14]. Creating cross departmental teams or scheduling time to meet with individuals from other departments to share different ideas and perspectives can be important in assimilating new knowledge or transforming an existing knowledge base, encouraging assimilation and transformative learning [15]. Meanwhile, in another AC study, it was stated that recombining knowledge in new and different ways can develop exploitative learning [16]. Furthermore, subsequent studies revealed that individual organizations play an important role in the success of AC [8][17][18]. The organizational learning process [19] in AC is inseparable from the informal interaction [20]. The organization’s ability to absorb knowledge is ultimately related to the organization’s long-term financial performance [21]. This is in accordance with AC concept expressed by Cohen that the organization's ability to absorb new knowledge aims for the company's commercial achievements.

2.2. Construct development

The AC concept was introduced in 1990 by Cohen and Liventhal[4]. Several years after the AC concept was introduced, it’s construct underwent changes by several researchers. In summary, the AC construct from year to year is presented in Table 1.

Table 1. AC model components.

		Model Components													
Article	Year	Antecedents							ACAP Components						
		Knowledge Source/ Complementarity/ Interorganizational	Prior Knowledge	Intra Organizational	Managerial Antecedence	Learning Relationships/	Environmental Conditions	PACAP	RACAP	Recognizing the value	Acquire	Assimilate	Transform	Apply/ Exploit	
[4]	1990	x	x								x		x		x
[1]	2002	x	x					x	x			x	x	x	x
[3]	2006	x	x				x	x			x		x		x
[2]	2007	x	x								x		x	x	x
[12]	2010	x	x	x	x	x	x	x	x			x	x	x	x

		Model Components															
Article	Year	Contingent Factors									Outcomes						
		Regimes Of Appropriability	Activation Triggers	Social Interactio Mechanisms	Environmental Conditions	Organizational/ Mental Models	Organizational Strategies	Organizational Structures and	Power Relationships	Innovation	Innovative Performance	Knowledge Output	Exploitation/ Exploration	Commercial Outputs	Flexibility	Performance	Competitive Advantage
[4]	1990	x										x	x				
[1]	2002	x	x	x								x			x	x	x
[3]	2006					x	x	x					x		x		
[2]	2007	x	x	x								x			x	x	x
[12]	2010	x			x							x		x		x	x

Although there is a change in the construct of AC, assimilation with the rationale of organizational behavior does not change. Previous research has found that often individual interactions are informal and undefined, leading to learning within organizations[20]. By definition, organizational citizenship behavior is “individual behavior that is independent, not directly or explicitly recognized by the formal reward system, and which overall promotes the efficient and effective functioning of the organization”[22]. This shows that Organizational Citizenship Behavior (OCB) is a type of behavior that fills the gap between how companies organize their learning processes and what is actually needed to create a competitive advantage. OCB affiliation can be defined: Behavior that is cooperative and generally non-controversial [23] and relationship strengthen [24]. OCB affiliation generally consists of helping [22], sportsmanship [22][25], organization loyalty[26], organizational compliance [26], individual initiative [27], civic

policy [25] and self development [28]. The development trend of the AC construct will be presented in the next chapter. The selection of quality literature from leading journals with a Q1 quartile index is expected to produce an accurate trend of AC development.

Table 2. Data collection process.

Phase	Data Collection Process	Result
1	Google Scholar Search in Topic "Absorptive Capacity"	28.000
2	Choice of Top 10 Q1 Journal in Information System Scope	
3	Search in topic: "Absorptive Capacity"	588
	<i>Search in article title, abstract, keywords: "Absorptive Capacity"</i>	
	<i>Limit to Subject Area: Information System</i>	
	Total Article	51

3. Research method

This research is a semantic review research as an initial research related to AC. In management and strategy research, SLR is used to provide impartial transparency, clarity, and inclusive coverage in a particular area [29].

Table 3. Journal list.

No	Journal	Number of Article
1	IEEE Transactions on Information Theory	9
2	MIS Quarterly: Management Information Systems	9
3	Information and Management	7
4	Information Systems Research	7
5	Science and Technology	5
6	Information Systems Journal	4
7	European Journal of Information Systems	3
8	Journal of Strategic Information Systems	3
9	Journal of Service Research	1
10	Journal of Supply Chain Management	3
	TOTAL	51

Transfield et al [30] state that the most popular form of research synthesis is “narrative review that attempts to identify what has been written about a subject or topic” [30]. Therefore, this study aims to contribute to the development and understanding of AC construction through a systematic review of literature. SLR can be defined: locating existing studies, selecting and evaluating contributions, analyzing and synthesizing data, and reporting evidence in such a way as to allow fairly clear conclusions to be reached about what is known and what is not [31]. This research is expected to complement AC references from various perspectives based on AC research trends. To find, select and assess as many relevant studies as possible [31].

3.1. Data collection

Data collection in systematic review is an important phase to be able to provide high quality semantic review results [30]. Therefore, this study considers the indexing platform and reputation of quality publications based on the ranking on Scimagojr [32]. The data is taken from a reputable Information System Journal with index Quartile 1. In the same way as Sarka and Ipsen [33], an automatic search is developed through a comprehensive search string, with keywords: Absorption Capacity. The search focused on “Article Title, Abstract, Keyword” in the Journal. This research focuses on the field of Information Systems, therefore the scope of the search is limited to journals that have an IS scope.

Table 4 presents several behavioral dimensions that appear constantly from the 51 selected articles, such as: Relationship, Social, Individual Development and Intrinsic Motivation. Furthermore, the percentage of OCB manifestations in Table 4 is presented specifically in Fig. 2.

Table 4. Journal list.

Dimension	Reference
Knowledge Source/ Complementary/ Inter-organization Antecedence/ Management (19 articles)	[34][35] [36][37][38][10] [39][40] [12] [41][42][43][44][45][46][47][48][49][50]
Prior Knowledge (10 articles)	[51][52][53][54][55][56][12][57][43][44]
Relationship (OCB) (17 articles)	[58][39] [59][40][60] [55][12] [41][61][62][44][63][45] [64][46][48][49]
Environmental Conditions	[65][53][56][12][43][3]
PACAP	[51][58][12][62][46][66][67][68][69]
RACAP	[51][58][12][62][66][67][68] [69]
Acquire	[54][39] [59][57][44][63][64][47] [50] [3]
Assimilate	[52][10][58] [54] [39][59][60] [57][43][62][44][63] [64][47][48] [50] [3]
Transform	[39][59][44][63] [64][47] [50] [3]
Apply/ Exploit	[52][54][59][60][44][63] [64][47][70] [50] [3]
Organizational Strategies/ Management	[35][71][54][59][47]
Organizational Structures/ Process perspective	[34][37][58][54][60][13][56][70]
Innovation	[35][51][72][73][65][38][53][71][54][39][59][59] [40][74][41][61][75][64][46][66][70]
Innovative Performance	[35][76][36] [49]
Knowledge Output	[10][71][43][45][67][67]
Exploitation/ Exploration	[39][59][74][77][56][48] [3][69][78]
Performance	[73][10][79][71][54][60][74][12][43][44][64][47][70]
Competitive Advantage	[10][58] [77][12]
Social Interaction / transfer/ share (OCB)	[36][10][79][53][39][59][66][60][13][77][12][41][61][75][42][62][44][63][45][46][67][50]
Individual Creativity/ Individual Development (OCB)	[51][10][39][40][12][61][62][45][66][49] [44][63] [64][46][48]
Initiative	[58][40] [63]
R&D/ Basic Research	[76][73][52][36][71][13][12][80][78]
Dynamic Process/ Dynamic Capability	[34][74][77][44][63][64][48]
Intrinsic Motivation (OCB)	[51][61][49]
Agility (1 article)	[63]

3.2. Sample selection

Inclusion and exclusion criteria were used to assess the relevance of each study found to determine whether the study actually answered the review question [31]. Therefore, the articles selected to be part of this study met specific inclusion criteria: published in English; categorized as articles; come from the following fields of study: Information Systems. The initial search returned 588 of all Journals. After applying the inclusion and exclusion criteria, 51 articles were obtained which will be used for further analysis. Table 1 shows the stages of data collection and summarizes how the articles were obtained. Although a small number of articles were found that met the inclusion criteria, it is relevant to continue the following steps of the SLR to describe the pathways by which this emerging topic is evolving and to provide insights for future research. Furthermore, the publication systematization for each article includes information on the constructs used in the study. The mapping of similarities and differences in constructs was carried out to determine the development of the use of AC in recent studies. The comparison of the pattern of AC evolution in previous studies is used as an initial reference for AC evolution. The selected articles, Table 2 and Table 3, will then be analyzed by grouping them based on the components that make up the AC. The components that have the same domain will be grouped into 1, for example, the OCB domain. The OCB domain refers to the literature review in the previous chapter.

4. Findings

The mapping of the articles shows the development of the construct and the relationship between AC and other activities in the organization. Absorption is a relevant driver for acquiring external knowledge and transferring it

within the firm. As stated by Cohen and Levinthal (1990) [4], AC gives firms the ability to recognize the value of new information, assimilate it and apply it to commercial purposes. On the other hand, in terms of finding external knowledge from cross-sectoral partnerships, alliances or collaborations, the importance of knowledge sharing and participatory decision-making must be considered in the success of collaborative efforts. AC has developed since it was introduced. There are several changes to the construct based on the different perspectives of each researcher. However, if it is observed that there are similarities in constructs that have been maintained since the beginning of the introduction of AC, namely assimilation [1]-[4], [12]. In the previous chapter, it was also explained that the absorption of knowledge is related to the behavior that underlies learning and knowledge [4]. This can be seen in the process of assimilation. Informal networks and communication as part of behavior are among the driving factors of AC [12]. In addition to its knowledge base, companies need to develop structures and processes that facilitate the absorption of knowledge [10]. Previous research has found that two types of organizational capacity have an impact on AC: coordination ability and socialization ability [56][81]. Socialization skills contribute to the development of broad implicit rules for appropriate organizational behavior [82]. As a result, socialization skills increase the application of new knowledge to products, services, and other organizational activities [81]. The behavior referred to in this study is positive behavior outside of work obligations, which willingly absorbs IS capacity and coordinates and socializes it [83], without getting rewarded. Organizational citizenship behavior (OCB) is defined as behavior that is freely chosen by individuals where the behavior is not directly or explicitly recognized by the formal reward system and contributes to the effectiveness and efficiency of organizational functioning [84][85][86]. This adds information about the existence of other factors related to AC, namely individual behavior in the organization itself. The involvement of OCB in AC research has not been very popular. However, referring to the concept of AC which involves behavior, this study proposes the addition of the OCB construct to measure the success of AC in organizations. In its development, there are groups of components that come from the OCB domain, Fig. 1. There are similar components in the development of AC, namely Knowledge Source, Prior Knowledge, Assimilate, Apply/Exploit. While in more than 50 articles collected from reputable journals, Scientific Journal Ranking (SJR) Q1 the majority placed OCB on the AC component, Fig. 2. In addition to the similarity of 4 components (Fig. 1) that drive the success of AC (Fig. 1), there are several other components that support the success of AC as presented in Fig. s 1 and 2. There are groups of components that are clearly part of the manifestation of OCB. There are components in Fig. 2 that consistently appear among 50 articles (see method section) are part of OCB. They are Individual creativity [28], social interaction [87][24], and Individual development [28]. These show that OCB can not be separated from AC both directly and indirectly. OCB manifestations in AC components include: Social Interaction. OCB affiliates "lubricate the social engine of the organization" [87] by enhancing cooperation and strengthening relationships between workers [24], which increases the efficiency and effectiveness of routines that support learning abilities; Power Relationship. The strength of a relationship is reflected on how individuals help each other. Strengthening relationships between workers, increasing knowledge transfer, increasing the rate of learning by new employees and encouraging the diffusion of the best practices among workers, which increases the efficiency and effectiveness of learning routines [22]; Self Development. "Refers to the improvement of one's own knowledge or work skills" [28]. Acquiring valuable skills through self-development, including individual creativity, increases employees' ability to more competently carry out assigned routines and, possibly, increases the types of routines they understand and can participate in [28]. Intrinsic motivation strengthens OCB in general [51][61][49] including individual creativity.

5. Discussion

The development of AC since its introduction until now has undergone changes based on various perspectives. However, the idea underlying the AC concept has consistently featured a domain of individual behavior called Organizational Citizenship Behavior. This is based on the grouping of AC components that consistently appear in the 50 selected papers that have been described previously in the findings (Fig. 2). Certain types of individual-level behavior contribute to the development of enterprise-level absorbcency. As far as behavioral involvement in AC increases, the proposed managerial implication is that organizations should seek to hire employees who are more likely to engage in OCB. OCB personality traits as drivers of AC success need to be further disclosed to facilitate identification of applicants or promoted employees who have higher OCB engagement than others. Several OCB

personalities are already provided in the finding section. As a preliminary study, this research opens up opportunities for future research in revealing the success of AC.

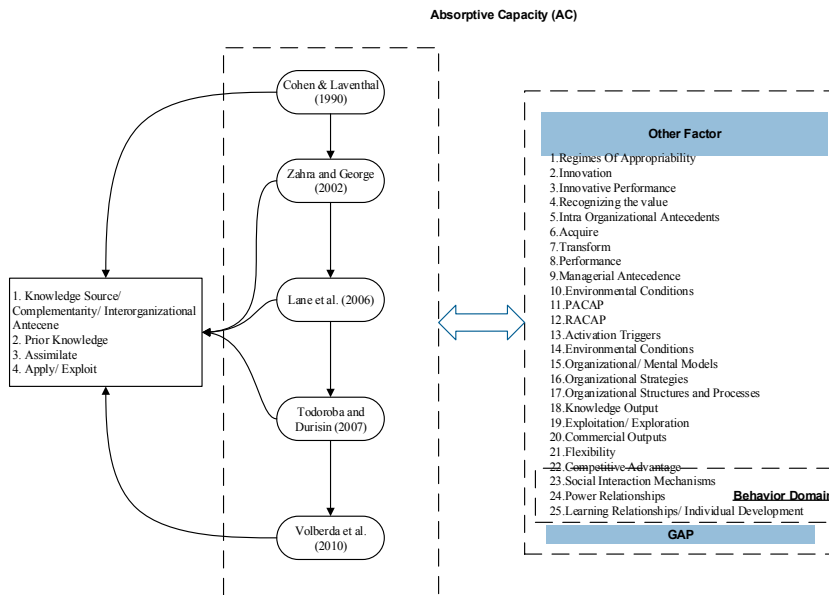


Fig. 1. AC components.

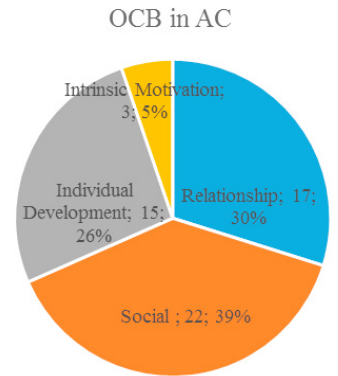


Fig. 2. OCB in AC.

There are many interesting potentials that can be investigated further by extending this research. One way is to reveal the manifestation of each dimension of OCB that is directly related to AC by considering environmental factors. The findings of this study support previous research on the relationship between behavioral components in the implementation of AC. A total of 51 articles from reputable journals indicate that there are at least 3 behavioral components consistently involved in AC research. The behavioral components include Social Interaction, Power Relationship and Self Development. In addition to these three behavioral components, there is other behavioral component, namely intrinsic motivation. In addition, other components that drive the success of AC provide opportunities for future studies.

6. Conclusion

The development of AC allows the emergence new variety of new component. From the literature analysis and findings, it is clear how the behavior cannot be separated in the AC. Several types of components are manifestations of behavior. In general, the behavior in this study is part of OCB. This study opens up future research opportunities in exploring the AC components. Because OCB has a close relationship with where the location and culture of the company is located, research on the topic of AC has a greater opportunity for synergies and to learn from each other in a world that increasingly demands intercultural collaboration.

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