

# The customer knowledge management lifecycle in PSS value networks : towards process characterization

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# The Customer Knowledge Management Lifecycle in PSS Value Networks: Towards Process Characterization

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**Abstract:** Following a service orientation paradigm, value is no longer restricted to product functionalities. Value is in particular based on co-creation with customers, making use of their experiences and leading to so-called integrated solutions. The longitudinal view on relationships with customers requires networked collaboration of multiple partners with their mutual customers within the context of a product-service system (PSS) value network. A customer-centric view on solution offerings motivates PSS value networks to enhance their understanding of customers' needs. To achieve a shared understanding of customers' needs across a network, customer knowledge can be seen as a prerequisite. Prior research has been primarily focused on an intra-organizational perspective on customer knowledge management (CKM), in which customer knowledge (CK) is obtained in a one-to-one relationship. In the context of PSS value networks, besides the individual CK of each partner, CK is also co-created through the interaction of several partners with customers during solution processes. However, this asks for a broader conceptualization of CKM. Moreover, a long term relationship with customers demonstrates new opportunities for CKM. Hence, a firm-centric approach is inadequate for managing the network-level processes of CK creation, storage / retrieval, transfer, and application across a PSS value network. Based on a systematic literature review on both CKM within a PSS value network, and collaborative knowledge management, we present in this paper a conceptual framework of the value network customer knowledge management (VN-CKM) lifecycle. We will characterize its four main processes based on the novel characteristics of a PSS value network.

**Keywords:** customer knowledge management, co-creation, integrated solution, PSS value network

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## 1. Introduction

To respond to customers' unique and rapidly changing needs, many companies transcend from manufacturing products to co-creating Product-Service Systems (PSS) or integrated solutions. Apart from bundles of products and services, PSS refers to longitudinal relational processes among multiple partners and their mutual customers, aimed at meeting customer's needs and providing an outstanding customer experience (Grönroos 2011; Hakanen 2014; Tuli et al. 2007). Therefore, firms together with their partners and customers co-create value in the context of a PSS value network (Lusch & Webster 2011). Customers expect solutions which include processes such as understanding their requirements, customizing and integrating products and services, deploying them, and supporting them on an ongoing basis (Tuli et al. 2007). Co-creation of value embraces the idea that value is no longer based on determined output. Value is considered as a jointly created phenomenon that emerges in interaction among multiple partners and customers (Tax et al. 2013). For that reason, the PSS literature emphasizes a deep understanding of customers' needs, experiences, and contexts (Frow & Payne 2007). This is regarded as a first step in offering solutions in which customer knowledge (CK) is considered as a prerequisite.

Although there is considerable research on customer knowledge management (CKM), and co-creation integrated solutions, surprisingly little is known about the characteristics of CKM processes that support co-creation in the context of a PSS value network. In fact, jointly managing the CK distributed across a network is a complex task involving multiple partners and customers. We aim to contribute to this research gap by defining the CKM lifecycle of a PSS value network, called a Value Network CKM (VN-CKM). By applying a standard process characterisation model, i.e. input process output (IPO), and Nonaka knowledge model (Nonaka 1994), we characterize the four processes of a VN-CKM lifecycle. The proposed conceptual framework can help integrated solution partners and customers to collaboratively manage CK more effectively.

In this paper we will answer the following research question:

What are main characteristics of the VN-CKM processes within the context of a PSS value network?

This study contributes to CKM literature in twofold: First, extending the scope of analysis from a firm-level to a network-level; second, characterizing the VN-CKM lifecycle in accordance with the novel characteristics of a PSS value network environment.

The outline of the paper is as follows. Current work is discussed in section two. Section three describes the research methodology. Section four analyses and discusses the results from a systematic literature review, while section five defines the VN-CKM lifecycle and characterizes each process of the VN-CKM lifecycle. The final section presents conclusions and indicates directions for further research.

## **2. Current work**

Customer knowledge management (CKM), which is rooted in Knowledge-based theory, considers customer knowledge as one of the strategic sources of firm competitive advantage (Gibbert et al. 2002). CKM have been introduced as an ongoing process of CK creation, storage / retrieval, transfer, and application with an emphasis on interaction between firms and customers (Belkahlia & Triki 2011; Gibbert et al. 2002). CKM changes the role of customers from passive recipients of products or services to active knowledge partners (Gibbert et al. 2002). By managing CK, organizations can better understand customers' characteristics, needs, and preferences (Weng et al. 2012). Recently the CK flows between a firm and its customers has been transcended from a unilateral direction from a firm to a customer (e.g. knowledge about product), or a customer to a firm (e.g. feedback), into a bi-directional relationship which is called knowledge co-creation "with" a customer. "With" refers to productive dialogue and cooperation of a company with its customers in order to create new CK for joint value creation,(Buchnowska 2011; Smith & McKeen 2005).

Many studies have focused on defining CKM concepts and processes, (e.g. Buchnowska 2011; Y. Lin et al. 2006; Salomann et al. 2006), in which a general knowledge management (KM) lifecycle has been used. The general KM lifecycle consists of four main processes of knowledge creation, storage / retrieval, transfer, and application (Alavi & Leidner 2001; Sedera & Gable 2010).

We focus at CKM in the PSS value network literature. In this context, the focus of KM in general and CK in particular, has shifted from improving product innovation and operational efficiency towards improving customer experience of integrated solutions (Salonen 2011; Raja et al. 2013). Payne et al. (2008) propose to build KM practices around customers' processes and experiences rather than products. A customer has an active role in the integrated solution processes of identification, development, deployment and post-deployment support (Aarikka-Stenroos & Jaakkola 2012; Tuli et al. 2007). This indicates the necessity of managing CK throughout the solution processes within the PSS value network environment (Bagheri et al. 2015). The importance of knowledge as a most fundamental resource, and customer as a knowledge provider in co-creating value, also regard as main premises of service-dominant (S-D) logic (Vargo & Lusch 2006). Lusch et al. (2007) advise that knowledge usage and collaboration should be the key drivers for firms to more successfully enhanced customer experience.

Although knowledge emerged as the most frequently mentioned attribute in this field (Lusch et al. 2007; Raja et al. 2013; Vargo & Lusch 2006), this research stream has some limitations. First, it makes generic comments on the role of customer knowledge in providing integrated solutions (Aarikka-Stenroos & Jaakkola 2012; Payne et al. 2008) rather than describing the CKM lifecycle explicitly. Second, while integrated solutions are inherently co-created by a firm and its network of partners and customers, many studies are still limited to a customer-firm dyad (Aarikka-Stenroos & Jaakkola 2012; Tuli et al. 2007). As a consequence, the opportunity of involving all the network partners and customers in CKM processes across the PSS value network has mostly remained under-explored.

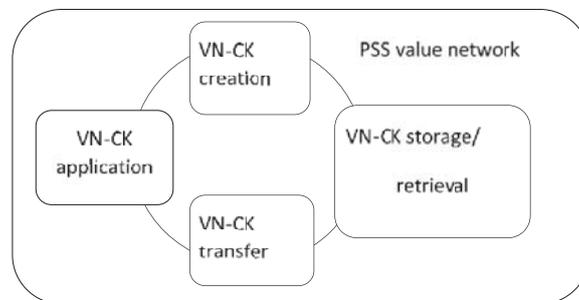
Since research on CKM at a network level is still in its nascent phase, we also searched within the wider literature on related field of the collaborative KM lifecycle, to find relevant information that can be used in our research. Collaborative KM refers to the collective activities that partners engage into manage knowledge across firms boundaries, to enhance the cooperative performance (Li et al. 2012; Samuel et al. 2011; Shang et al. 2009). Li et al. (2012) examine the effect of four main processes of collaborative KM on knowledge quality and supply chain integration. Samuel et al. (2011) contend that collaborative KM is about knowledge acquisition and transfer between partners, innovation and improved performance. Harryson et al. (2008) and Valkokari et al. (2012) examine the role of knowledge creation and transfer within networked innovation. Feller et al. (2009) identify

how the relationship between the partners affects the effectiveness of inter-firm knowledge transfer in promoting innovation and continuous improvement. This research stream still has limitations. First, scholars primarily discuss the management of knowledge with partners and not jointly with both customers and partners. Second, even though the KM processes transcend from firm boundaries the focus of KM is still to improve product innovation and operational efficiency, and less emphasis is given to co-creating customer experience (Valkokari et al. 2012; Harryson et al. 2008).

By taking into account the above limitations of both research fields (i.e. CKM within PSS value network, collaborative KM), we look at the potential synergies of connecting them. Therefore, this study aims to enhance the existing literature on the VN-CKM lifecycle by using relevant information from the collaborative KM literature. Consequently, we develop a conceptual framework of the VN-CKM lifecycle.

### 3. Research methodology

The goal of this study is to develop a VN-CKM lifecycle framework that facilitates the co-creation of integrated solutions. We used terms proposed by Alavi & Leidner (2001) in developing the VN-CKM lifecycle that involves iterative and continuous processes of value networked customer knowledge (VN-CK) creation, VN-CK storage/retrieval, VN-CK transfer, and VN-CK application, within the context of PSS value networks (figure 1). We systematically characterised those processes through the following steps:



**Figure 1:** VN-CKM lifecycle- a research framework

1. Identifying, characterizing, and classifying the existing literature on VN-CKM processes.
2. Identifying, characterizing, and classifying the existing literature on collaborative KM processes.
3. Analyzing and discussing the results from both research areas.
4. Defining the VN-CKM lifecycle and developing its conceptual framework to characterize its processes.

In step one, direct information on the VN-CKM lifecycle has been investigated. However, since this research area is still under progress, in step two we also obtained indirect information from a relevant related research area.

In both steps one and two a systematic literature review, based on the guidelines proposed by Kitchenham (2004), has been conducted in order to summarize the existing insights and to identify the eventual research gaps.

In general the systematic review embraces the following stages (Kitchenham 2004):

Developing a review protocol (e.g. research questions, search strategy and process), identification of research studies, selection of papers, quality assessment, data extraction, summary and synthesis of study results.

In fact we conducted two systematic reviews to identify research on the VN-CKM processes in PSS value networks and KM processes in collaborative networks. A number of keywords including a number of synonyms were identified and used in the search process. The different combinations of the search terms 'customer knowledge', 'creation', 'storage', 'retrieval', 'transfer', 'application'; 'co-creating value', 'integrated solution', 'value network' were used in the search process for primary studies in literature since 2005 in step one. The following search terms were used in step two: 'knowledge'; 'creation', 'storage', 'retrieval', 'transfer', 'application'; 'inter-firm collaboration', 'supply chain', 'supply network', 'strategic alliance', 'collaborative network'. The selected papers should address the CK or KM processes (also by explicitly considering the concept of collaboration) and should be published in an academic journal or conference proceedings. After reviewing

titles and abstracts, the selection processes led to an in-depth evaluation of the full text of 9 (step one) and 16 papers (step 2).

Since the results were mixed and researchers define and describe (VN-CKM) KM processes from different perspectives, we decided to identify and characterize them in a structured way. Hence, in the data extraction phase we coded the text, using three instruments as guidelines. These are respectively the KM lifecycle approach, the IPO and the Nonaka model (c.f. figure 2). Applying the KM lifecycle approach enabled us to identify different processes and to put them into the four main processes of creation, storage, retrieval, transfer, and application. The main characteristics of a process (i.e. input, resource, control, activities, output, and objective) were identified by using the IPO model. Input and output refer to explicit or tacit knowledge. Resource refers to both actors and tools required for processing input into output. Regarding the control aspect, we made a distinction between formal and informal control. Formal control relies on criteria such as contractual agreements, rules, procedures, regulations, reports, incentive system, and also performance monitoring. Informal (social) control is realized through shared norms and values, trust, meetings, open communication, and interaction (Fang et al. 2013; Hoetker & Mellewig 2009; Langfield-Smith & D. Smith 2003; Dekker 2004). The organizational knowledge creation model of Nonaka explains how new knowledge is created through a continuous interplay between tacit and explicit knowledge. By using this widely accepted model we looked in the selected literature at how knowledge is dealt with.



Figure 2: The IPO and Nonaka models

Subsequently, in group discussions, we incorporated the results, removed duplications and summarized the findings. This part resulted in the development of two classification frameworks, one for step one and one for step two (c.f. tables 1 and 2).

In step three, the analysis of the results was conducted in a structured way to identify the gaps and weaknesses of the current literature on VN-CKM and to discuss about our suggestions to provide a more completed view on VN-CKM lifecycle. In doing so, table 1 was considered as a starting point. Its content was compared with table 2 by identifying and discussing the following issues:

- Weakness: regarding the identified limitations of existing literature on VN-CKM we modified the content whenever it was needed (weakness-modification). The modification was done with regard to the characteristics of a PSS value network, i.e. collaboration with both partners and customers as well as the customer experience view on providing integrated solutions.
- Confirmation: the content of table 1 was supported by table 2. No change was made.
- Enrichment: something missing in table 1 could be completed by using table 2.
- Gap: in the case of empty spaces in table 1, we made a decision: to keep it empty similar to table 2 (empty-confirmation) or fill it by using relevant information from table 2 after modification based on the characteristics of a PSS value network (gap-completion).

In step four, since there was no common definition on VN-CKM lifecycle in the existing literature, we modified the basic definition of the CKM lifecycle (from section 2) in accordance with the characteristics of a PSS value network and proposed our definition. We then developed the conceptual framework of a VN-CKM lifecycle based on the results of the analysis.

#### 4. Classification frameworks, analysis and discussion of the results

The result of the systematic literature review of on the one hand VN-CKM and on the other hand the collaborative KM lifecycle literature is provided in tables 1 and 2.

**Table 1:** Classification framework of VN-CKM lifecycle from the literature review

P	I/O	Main activities	Control	Resource	Objective	source	
			Formal	Informal			
Creation	T/T	Ideations, identifying the business customer’s problem, customers explain their challenges, obtaining deep customer insight and contextual understanding of customer experience (CE) and emotions through brainstorming, empathic methods, and ethnographic research techniques besides traditional market research.		Briefing session, frequent and reciprocal interaction , trust, dialogue.	Network of solution partners and customers	Mutual understanding of the customer problem, directing and evaluating solution, providing user-centered perspectives on solution offerings.	Edvardsson et al. (2012);Zomerdijk & Voss (2011);Tax et al. (2013);Aarikka-Stenroos & Jaakkola (2012);Hakanen (2014); Payne et al. (2008);Frow & Payne (2007);Wetter-Edman et al. (2014); Tuli et al. (2007)
	T/E	Analyzing and interpreting the customer preference, explicitly describing customer knowledge and service offerings, Storytelling and visualizing, mapping out the service encounters (firm-customer touch points)from the customer’s perspective by utilizing mapping tools (e.g. process mapping, service-blueprinting, and customer-firm touch point analysis),formalization of all the solution processes, clarify roles and responsibilities, reporting structure.	Rules and guidelines.	Workshop, forum.	Network of solution partners and customers.	Create common understanding of the content of the solution, elicit customer experiences, to ensure that customer requirements define, meet, and support accurately.	Hakanen (2014); Wetter-Edman et al. (2014); Tuli et al. (2007); Payne et al. (2008);Frow & Payne (2007)
	E/E						
	E/T	Providing knowledge for customer at deployment phase.		Training.	Solution provider and customer.	Enhance the value they derive from solution.	Tuli et al. (2007)
Storage /							

P	I/O	Main activities	Control	Resource	Objective	source	
			Formal	Informal			
Transfer	T/T	Sharing knowledge of the customer's problem, needs, and value expectations, identifying the customer's preference for centralized or decentralized knowledge flows between partners and customers.			Network of solution partners and customers.		Hakanen (2014)
	E/E						
Application	E/E	Providing integrated solution from identification to post-deployment support are based on using CK.			Network of solution partners and customers.	provide outstanding customer experience, enhance the customer's business	Hakanen (2014); Tuli et al. (2007); Aarikka-Stenroos & Jaakkola (2012)

P: process, I/O: input/output, T: tacit, E: explicit

**Table 2:** Classification framework of collaborative KM lifecycle from the literature review

P	I/O	Main activities	Control		Resource	Objective	Source
			Formal	Informal			
Creation	T/T	Collaboratively involve in exploring, leveraging, and pursuing potential synergy by integrating knowledge, sharing idea and experience.		Face to face communication, frequent interaction, feedback, formal/informal meeting, shared interests and value, trust, dialogue.	Partners.	Joint exploration of new opportunity, Develop network specific knowledge.	Samuel et al. (2011); Li et al. (2012); Valkokari et al. (2012); Pak et al. (2015); Fang & Zou (2010); Mahr et al. (2014)
	T/E	Codification and articulation the knowledge, giving clear expression, documenting their experience, institutionalizing new knowledge	Defining a joint contract, Archiving document, rules, routines, procedures, and directives.	Formal meeting, metaphors, analogies, stories, workshop.	Partners.	shared interpretation.	Samuel et al. (2011); Li et al. (2012); Fang & Zou (2010)
	E/E	Reconfiguring the existing knowledge - by sorting, combining, and categorizing from scatters sources, Integrating information system (IS).	Developing common tools, establishing communication routines, guideline and standards.		IS.	Find new pattern.	Samuel et al. (2011); Li et al. (2012); Shang et al. (2009)
	E/T	Learning by doing.	Routines.	Training.	Partners.		Samuel et al. (2011)

Storage and retrieval	E/E	Linking multiple knowledge repositories, storing integrated knowledge of different partners in knowledge database, Coordinating data format, and storage location between partners, defining a unified access for retrieval.	Formal knowledge representations, standards, organizational routines.		network's collective memory	Ensuring the efficient knowledge preservation and access to the stored knowledge across a network	Li et al. (2012);Shih et al. (2012);Parent et al. (2014)
	T/E	Documenting and organizing both effective and ineffective experiences of networked activities.	Documentation.	Interview.	Tacit knowledge Inventory chart or map, partners.		
Transfer	E/E	Documenting, Transferring present explicit knowledge in a transaction network.	Formal contract, common platform, standards, organizational routines, document, network's institutional agreement		IT tools.	Provide timely, accurate, reliable access to the required knowledge across a network.  Reciprocal learning, recognize the value of partner knowledge.	Li et al. (2012);Feller et al. (2009); Valkokari et al. (2012);Gupta & Polonsky (2014);Easterby-Smith et al. (2008); Fang & Zou (2010); Pak et al. (2015)
	T/T	Sharing a common knowledge base, knowledge adaptation to the new context, publicizing the existence of knowledge.		Face-to-face communication, discussion, and dialogue, shared value, mutual norm, trust, Joint training program.	Partners.		
application	E/E	Utilizing the collaboratively acquired, stored, and shared knowledge created in a network.	Organizational routines, directives, contractual agreement		Partners.	Collective decision making, coordinated response.	Li et al. (2012);Pak et al. (2015); Tai Tsou (2012)

In the following the main findings of the analysis of table 1 against table 2, based on the process defined in section 3, are discussed.

Similar to the collaborative KM creation process, the informal control in tacit to tacit CK conversion and both informal and formal controls in tacit to explicit CK conversion have been regarded as appropriate mechanisms within the VN-CK creation process. This can be considered as a confirmation.

Regarding creation new explicit CK from tacit CK, both a gap-completion and a weakness-modification can be recognized. While the former is related to the formal control, the latter is related to the resources. Similar to table 2, we suggest using formal control such as developing network routines facilitate this type of VN-CK creation process. We also recommend considering the network of partners and customers as resources. Because providing integrated solutions principally require network collaboration of multiple partners with customers in

response to evolving customer needs during solution experience. Creation new explicit CK from explicit CK regards can be considered as a gap-completion. To fill the gap and in line with collaborative KM literature, we propose that solution partners and customers jointly reconfigure their existing explicit CK -that are resulted from analysing transactional information- by sorting, combining and categorizing scatters sources. We also suggest that they integrate their CK data warehouses, and define routines, standards, and guidelines across a value network. These activities can lead to identify the new pattern of fit between customer needs and solution offerings.

VN-CK storage/retrieval process can be considered as a gap-completion. To fill the gap and comparable to collaborative KM literature, we suggest that KM storage/retrieval process explicit CK should be recorded and stored in the value network collective CK memory. To ensure that the explicit CK preserve efficiently across the value network, we propose to link CK repositories of all partners and customers, and to coordinate data format and location among partners and customers. For documenting and organizing tacit CK, we propose that solution partners and customers should collaboratively develop a tacit CK inventory chart or CK maps. Such a tacit CK inventory can be created by interviewing customers about their experience and needs. Likewise solution partners can be interviewed about their past experiences in developing solutions for multiple customers. Then set of scenarios can be developed and documented to describe a typical solution-related situation and check whether providers' customer-related experiences are matched with a new customer's requirements. The documentation ensures that they access to codified CK within solution processes from identification to post deployment support. For CK retrieval from stored CK, it is proposed to define a unified access to the CK repositories across a PSS value network through technical interfaces, standard routines, or formal CK representations.

Regarding tacit VN-CK transfer process, formal control and activities can be regarded as an empty-confirmation and enrichment respectively. Both informal control and objective can be considered as a gap-completion. Co-creation integrated solution take place at a network level in which customers engage in dialog with solution partners during each stage of solution processes. We propose to consider solution processes as a reciprocal learning process through which solution partners share and transfer their knowledge of the customers' needs and expectation with other. Through such processes customers can also share their knowledge, manifested in their idea, and value experience with solution partners. So, they can publicize their CK across a network through discussion, dialogue, trust, face-to-face communication, or joint training program provided by partners and customers. These informal control mechanisms can facilitate the discussion on recognizing the value of CK.

Explicit VN-CK transfer process can be regard as gap-completion. The explicit CK treats similarly as explicit knowledge. Therefore, we fill table 1 by using the characteristics of transfer explicit collaborative knowledge (table2).

Regarding VN-CK application process, formal and informal control can be considered as a gap-completion empty-confirmation respectively. Similar to collaborative knowledge application process, we advise partners and customers develop a routines and contractual agreement to coordinate tasks in using CK during all stages of solution processes.

## **5. Define VN-CKM lifecycle and develop the framework**

In this section we define the VN-CKM lifecycle and subsequently the conceptual framework is presented in table 3. Within the context of a PSS value network, the VN-CKM lifecycle refers to ongoing collaborative processes of CK creation, storage/retrieval, transfer, and application, pertaining to the solution processes with emphasis on multilateral interaction of partners and customers, and to the benefits of all partners and customers. The VN-CKM lifecycle facilitates a shared understanding of customers' needs among partners which results in the creation of superior integrated solutions. Comparing this with the aforementioned definition of CKM the novel aspects of our definition are:

- Collaborative efforts of all partners and customers in the VN-CKM processes take place across the network.
- We highlight the multilateral interaction which goes beyond the two-actor focus to a multi-actor focus through the customer experience of integrated solution processes.

- Put emphasis on the solution processes, because customers are actively involved in identifying, designing, developing, deployment and post-deployment processes of integrated solutions. These processes offer ample opportunities for managing CK across the PSS value network.

The discussions on analysis the results in the previous section enable us to develop a more comprehensive framework on VN-CKM lifecycle in comparison with what is available in table1. The proposed VN-CKM lifecycle framework is presented in table3. The four types of analysis and the origin of the used data are mentioned in the brackets in table3.

**Table 3:** VN-CKM lifecycle- a conceptual framework

P	I/O	Main activities	Control		Resource	Objective
			Formal	Informal		
	T/T	Ideations, identifying the business customer’s problem, customers explain their challenges, obtaining deep customer insight and contextual understanding of customer experience (CE) and emotions through brainstorming, empathic methods, and ethnographic research techniques besides traditional market research. (From table 1)	(empty-confirmation)	briefing session, frequent, collective and reciprocal interaction, trust, dialogue (confirmation)	Network of solution partners and customers. (From table 1)	Mutual understanding of the customer problem, directing and evaluating solution, providing user-centered perspectives on solution offerings. (From table 1)
Creation	T/E	Analyzing and interpreting the customer preference, explicitly describing customer knowledge and service offerings, Storytelling and visualizing, mapping out the service encounters (firm-customer touch points)from the customer’s perspective by utilizing mapping tools (e.g. process mapping, service-blueprinting, and customer-firm touch point analysis),formalization of all the solution processes, clarify roles and responsibilities, reporting structure. (From table 1)	Rules and guidelines. (confirmation)	Workshop, forum. (confirmation)	Network of solution partners and customers. (From table 1)	Create common understanding of the content of the solution, elicit customer experiences, ensure that customer requirements define, meet, and support accurately. (From table 1)

P	I/O	Main activities	Control		Resource	Objective
			Formal	Informal		
	E/E	Reconfiguring the existing CK - by sorting, combining, and categorizing, integrating CK data warehouses. (gap-completion)	Developing common tools, establishing communication routines, guideline and standards. (gap-completion)	(empty-confirmation)	IS. (gap-completion)	Find new patterns of fit between customer needs and solution offerings. (gap-completion)
	E/T	Providing knowledge for customer at deployment phase. (From table 1)	Network routines (gap-completion)	Training (confirmation)	Network of solution partners and customers. (weakness-modification)	Enhance the value customers derive from solution. (From table 1)
Storage/ retrieval	E/E	Integrating CK repositories, defining a unified access to the CK repositories, coordinating data formats and storage locations, making access to the stored CK. (gap-completion)	Formal CK representations, standards, routines. (gap-completion)	(empty-confirmation)	Network collective CK memory. (gap-completion)	Ensuring the efficient CK preservation and access to the stored knowledge across a value network. (gap-completion)
	T/E	Documenting and organizing past experiences of both solution providers and customers. (gap-completion)	Documentation (gap-completion)	Interview (gap-completion)	CK inventory map, network of solution partners and customers. (gap-completion)	
Transfer	E/E	Documenting, transferring present explicit CK in a transaction network. (gap-completion)	Formal contract, common platform, standards, organizational routines, document, network's institutional agreement. (gap-completion)	(empty-confirmation)	IT tools. (gap-completion)	Provide timely, accurate, reliable access to the required CK across a PSS value network. (gap-completion)
	T/T	Sharing knowledge of the customer's problem, needs, and value expectations, identifying the customer's preference for centralized or decentralized knowledge flows between partners and customers. (enrichment)	(empty-confirmation)	Face-to-face communication , discussion, and dialogue, shared value, mutual norm, trust, Joint training program. (gap-completion)	Network of solution partners and customers. (From table 1)	Reciprocal learning during solution processes. (gap-completion)

P	I/O	Main activities	Control		Resource	Objective
			Formal	Informal		
Application	E/E	Integrated solution proposes from identification to post-deployment support are based on using CK. (From table 1)	Network routines, directives, contractual agreement. (gap-completion)	(empty-confirmation)	Network of solution partners and customers. (From table 1)	Provide outstanding customer experience, Enhance the customer's business. (From table 1)

## 6. Conclusion

Although customer knowledge emerged as the most frequently mentioned attribute of PSS value network environments, little is known about CKM processes in such contexts. These CKM processes differ from CKM processes in more traditional settings in two ways. First, there is a move from single organizations to collaborative networks of partners and customers. Second, there is a focus on co-creation customer experience during integrated solution processes. These novel aspects strongly affect CKM processes and offer new opportunities for collaboration. This research has presented a conceptual framework to characterize the four processes of VN-CKM lifecycle. In doing so, we conducted a systematic literature review on both the VN-CKM lifecycle and the collaborative KM lifecycle approach, by using the IPO and Nonaka knowledge models as guidelines. The proposed VN-CKM lifecycle can serve as a descriptive mechanism that aims to generate in-depth insight into how partners work together and with customers, to more effectively manage customer knowledge across a PSS value network.

In future research we will conduct case studies to assess the usability of the proposed VN-CKM lifecycle framework in practice. Moreover, we suggest investigating the applications of information systems in facilitating VN-CKM lifecycle in future research.

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