



Exploring the role of customer relationship management (CRM) systems in customer knowledge creation



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ABSTRACT

This study explores how customer relationship management (CRM) systems support customer knowledge creation processes [48], including socialization, externalization, combination and internalization. CRM systems are categorized as collaborative, operational and analytical. An analysis of CRM applications in three organizations reveals that analytical systems strongly support the combination process. Collaborative systems provide the greatest support for externalization. Operational systems facilitate socialization with customers, while collaborative systems are used for socialization within an organization. Collaborative and analytical systems both support the internalization process by providing learning opportunities. Three-way interactions among CRM systems, types of customer knowledge, and knowledge creation processes are explored.

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1. Introduction

Customer knowledge is a critical asset, and gathering, managing, and sharing customer knowledge can be a valuable competitive activity for organizations [21,72]. However, within the broad domain of knowledge management, customer knowledge has received relatively little attention. Customer knowledge can be broadly categorized as knowledge for customers (i.e., knowledge provided to customers to satisfy their needs), knowledge about customers, and knowledge from customers, which is the knowledge that customers possess that organizations can obtain by interacting with them.

An organization's ability to create knowledge depends on its capability to convert and combine knowledge from various sources. Organizational knowledge creation theory explains how knowledge is created and expanded through a four-stage process: (1) socialization (sharing tacit² knowledge among individuals through social interactions); (2) externalization (formulating tacit knowledge into explicit knowledge that can be shared

within an organization); (3) combination (integrating different sources of explicit knowledge to create new knowledge); and (4) internalization (understanding explicit knowledge and integrating it into business practices). Successful customer knowledge creation depends on organizational structures, processes and personal skills [16,19], but it also requires appropriate information systems that can speed up and support knowledge creation processes [2,33,50,53]. Customer relationship management (CRM) systems are a group of information systems that enable organizations to contact customers and collect, store and analyze customer data to provide a comprehensive view of their customers. CRM systems mainly fall into three categories: operational systems (used for automation and increased efficiency of CRM processes), analytical systems (used for the analysis of customer data and knowledge), and collaborative systems (used to manage and integrate communication channels and customer interaction touch points) [7,23,28,29,74].

CRM systems help organizations acquire and continuously generate customer knowledge. The level of support that these systems provide for knowledge creation processes, as well as the type of customer knowledge (knowledge for/from/about customers) that they are well suited to create, vary based on the systems' features and functionality. Previous scholars have examined 2-way interactions³ among knowledge management (KM) initiatives, customer relationship management (CRM)

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² Tacit knowledge is highly personal and difficult to capture, codify, adopt, and share among people, while explicit knowledge is easy to capture, formalize, and distribute within an organization.

³ We use the term "interaction" not in a precise, mathematical sense but loosely to refer to connections and relations.

systems and customer knowledge. An important contribution of this research, however, is the exploration of specific, 3-way interactions. As an area of study matures (e.g., research on the support provided by information systems for knowledge creation processes), it is appropriate to conduct fine-grained, precise examinations.

To complete a comprehensive literature review, top journals in the field of MIS⁴ and knowledge management⁵ were identified and examined using the following keyword phrases: customer knowledge, knowledge management, CRM, customer relationship management system, and knowledge creation. Because the topic of interest is interdisciplinary, marketing and management journals were also reviewed using the above keywords. The papers that discussed these topics, explored interactions among the topics of interest, and were published in the time span of 2000–2012, were carefully investigated and classified (see Appendix A).

Many studies have focused on comparing CRM and KM concepts and practices with the aim of integrating the two concepts (e.g., [38,51,63,70]) and introducing the new concept of customer knowledge management (CKM) (e.g., [11,21,22,60]). However, most of these studies discussed the topics conceptually without emphasizing the CRM technological requirements.

Conversely, other studies have explored the contributions of CRM systems or information systems in general to knowledge creation. In a conceptual article, Carvalho and Ferreira [10] presented a typology of KM systems, discussing their applicability for integrating tacit and explicit knowledge through socialization, externalization, combination and internalization processes [48]. Another study by Shang et al. [63] focused specifically on Web 2.0 application sites – classified into four service models – and their support for the four knowledge creation processes [48].

Other papers have discussed the interaction of CRM systems and customer knowledge, focusing on how to gain customer knowledge through CRM systems; however, those studies did not elaborate on the knowledge creation processes involved (see [29,35,59,74]). For example, Xu and Walton [74] examined one category of CRM systems, namely, analytical CRM. Based on an analytical CRM model, they described how such systems were used to acquire customer knowledge internally-about existing customers- and externally-about prospective customers. Karakostas et al. [32] discussed the application of CRM tools at the strategic and process levels, and how those tools support communication and business-to-customer interactions.

Finally, a few studies have discussed the interaction between knowledge management and customer knowledge [4,11,21]. For example, Belbay et al. [4] showed how knowledge from customers was captured through knowledge creation processes [48] in the context of new product development.

As outlined, there are many studies on 2-way interactions among CRM systems (or CRM processes), knowledge creation and customer knowledge. However, the 3-way interactions between CRM systems, the types of customer knowledge and knowledge creation processes have rarely been considered, or the discussion has been restricted to only one type of CRM system (primarily analytical systems) or one type of customer knowledge (e.g., [64]).

This study draws on and extends knowledge creation theory by proposing and investigating the nature of precise, 3-way interactions between CRM systems, customer knowledge and knowledge

creation processes. Specifically, we address the following research question:

- How useful are operational/analytical/collaborative CRM systems in providing support for socialization/externalization/combination/internalization processes that create knowledge for/from/about customers?

More simply, the research question can be expressed as follows: How useful are different types of CRM systems in providing support for different knowledge processes that create different types of customer knowledge? We answer this question theoretically and then empirically.

Looking at 3-way interactions provides deeper insight into the capabilities of various CRM systems. For instance, using 3-way interactions helps us explore whether a particular type of system is more or less capable of producing a certain type of customer knowledge and determine which knowledge creation process is facilitated by a particular type of application. A simple illustration can demonstrate the importance of 3-way interactions. Sales associates who have direct contact with customers are not usually asked to externalize the knowledge they gain from customers. In many organizations, the sales associates' main responsibility is to provide knowledge for customers (e.g., help customers with technical issues) or knowledge about customers (e.g., identify the specific product features that customers spend the most time examining). However, through communication with customers, these employees gain extensive knowledge from customers (e.g., what they think about a similar product offered by competitors and suggestions for improving product/service quality). An organization may be satisfied with its current information systems that focus on creating knowledge for/about customers, but if executives realize that their systems do not capture the knowledge obtained from customers, they can invest in additional systems or modify their use of existing systems to improve their ability to capture and use knowledge from customers and their overall knowledge creation capabilities.

Given the exploratory nature of our study, a multiple case study approach was used. In three organizations, knowledge creation processes, customer knowledge types and CRM systems used to support customer knowledge creation were studied through a series of semi-structured interviews. The results were coded and analyzed to determine the level of support that each group of CRM systems provided for each knowledge creation process and type of customer knowledge created. In addition to this research contribution, this study offers managers a “dashboard” that provides important insights into specific “customer data gaps” where there is a lack of customer knowledge. The study also identifies some of the practical challenges that organizations face in using CRM systems for the purpose of customer knowledge creation.

The remainder of paper is organized as follows: first, the theoretical background and research model are discussed. Next, the research method and case study findings are outlined. Finally, research implications, limitations and future research opportunities are presented.

2. Theoretical background

Knowledge represents a critical asset for organizations in today's economy. Successful organizations need dynamic capabilities to create, acquire, integrate and use knowledge [1,40,57,61,73]. However, knowledge is a broad concept that is difficult to define and identify [26]. Within the domain of the IS literature, a common definition of knowledge distinguishes knowledge from data and information. Data refer to observations or raw facts. Information is classified and analyzed data that

⁴ The top MIS journals were selected based on the Association for Information Systems (AIS) MIS Journal Ranking available at <http://ais.affiniscap.com/display-common.cfm?an=1&subarticlenbr=432>. Specifically, we examined MISQ, ISR, JMIS, CACM, EJIS, DSS and I&M.

⁵ The top KM journals were identified from the Serenko and Bontis [62] study: “Global ranking of knowledge management and intellectual capital academic journals”.

Table 1
Research model: CRM systems' support for customer knowledge creation.

Type of CRM system	Level of support the system provides for:				The extent to which this system is capable of supporting the creation of the following types of customer knowledge:		
	Socialization	Externalization	Combination	Internalization	Knowledge <u>for</u> customers	Knowledge <u>about</u> customers	Knowledge <u>from</u> customers
Operational CRM	Medium/high	Low/medium	Low	Low	Low/medium	Medium	Medium
Analytical CRM	Low	Low	High	Medium	Low	High	Low
Collaborative CRM	Medium/high	High	Medium	High	High	Low	High

“inform”. Knowledge is defined as “meaningful and organized accumulation of information through experience, communication or inference” [30]. Knowledge has the highest value; it involves human expertise, experiences and “justified beliefs” [26,30,48].

Although the definitions of knowledge and information are different, it is difficult to define a clear line between the two concepts. Grover and Davenport [26] acknowledged that in practice, “what companies actually manage under the banner of knowledge management is a mix of knowledge, information and undefined data – in short, whatever that is useful” [26]. Thus, in this study, both concepts are considered. However, we recognize that knowledge has a higher level of complexity, and its generation requires more insight and analysis.

Organizations constantly search for knowledge resources and create new knowledge to stay competitive [1,11]. Knowledge creation is defined as “the process of making available and amplifying knowledge created by individuals as well as crystallizing and connecting it to an organization’s knowledge system” [45]. The creation of knowledge involves the interaction between tacit and explicit knowledge. Explicit knowledge is easy to capture, formalize, and distribute within an organization, while tacit knowledge is highly personal and difficult to capture, codify, adopt, and share among people [8,11,47]. An organization’s ability to create knowledge depends on its capability to convert and combine tacit and explicit knowledge from various sources. Organizational knowledge creation theory explains knowledge creation processes [48] and is outlined below.

2.1. Organizational knowledge creation theory

Organizational knowledge creation theory explains how the interaction between tacit and explicit knowledge leads to the creation of new knowledge. Knowledge is created and expands through a four-stage process (Fig. 1): (1) socialization aims to

share tacit knowledge among individuals through social interactions; (2) externalization aims to formulate tacit knowledge into explicit knowledge that can be shared within the organization; (3) combination aims to integrate different sources of explicit knowledge to create new knowledge; and (4) Internalization aims to transform explicit knowledge into tacit knowledge through individual learning from explicit knowledge resources. The main purpose of organizational knowledge creation theory (captured in Nonaka’s socialization, externalization, combination and internalization model or SECI model) is to identify the conditions that support knowledge creation in organizations to improve innovation and learning [45–48]. The present study focuses on the creation of customer knowledge in organizations.

2.2. Customer knowledge

Within the broad domain of information systems literature, customer knowledge has received relatively little attention; however, gathering, managing, and sharing customer information and knowledge can be a valuable competitive activity for organizations [21]. Many scholars (e.g., [21,23,66]) classify customer knowledge into three categories: Knowledge **for** customers, which is provided to customers to satisfy their need for knowledge about products, services and other relevant items; knowledge **about** customers, which refers to knowledge about customers’ backgrounds, motivations and preferences; and knowledge **from** customers, which is knowledge about products, services and competitors that customers possess. Organizations can obtain this knowledge by interacting with their customers.

Knowledge about and from customers is required for continuous improvement in many organizational processes, such as new product development and customer service. Knowledge for customers is required to support customer relations and satisfy customers’ knowledge needs [64,66]. Customer knowledge can be obtained from different sources within and outside an organization. A broad range of information systems known as customer relationship management (CRM) systems are used to gather and integrate customer knowledge sources and facilitate the creation of new knowledge. CRM systems are discussed in the following section.

2.3. Customer relationship management (CRM) systems

Customer relationship management has been widely regarded as a set of methodologies and organizational processes to attract and retain customers through their increased satisfaction and loyalty [13,24]. The main CRM processes involve “acquiring customers, knowing them well, providing services and anticipating their needs” [69]. From a technological perspective, CRM systems are information systems that enable organizations to contact customers, provide services for them, collect and store customer information and analyze that information to provide a comprehensive view of the customers [32,34,69]. CRM systems mainly fall into three categories [7,23,28,29,42,74]:

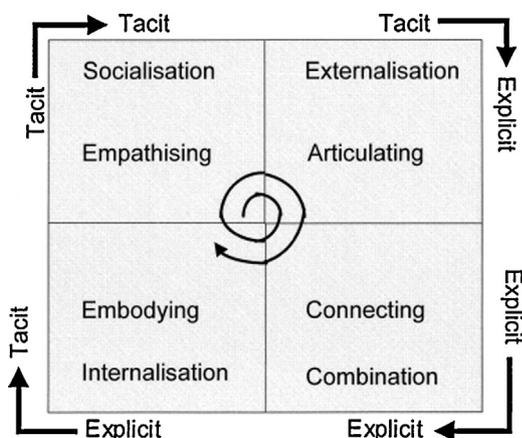


Fig. 1. SECI model for knowledge creation. Adapted from: Nonaka et al. [46].

- *Operational CRM systems* aim to automate CRM processes to improve their efficiency and productivity. Customer service and support systems (e.g., call centers), sales force automation (e.g., point of sale (POS) systems) and marketing automation belong to this category.
- *Analytical CRM systems* provide a better understanding of individual customers' behaviors and needs. They facilitate customer behavior predictive modeling and purchase pattern recognition. This category incorporates various analytical tools such as data mining,⁶ data warehouses and online analytical processing (OLAP).⁷
- *Collaborative CRM systems* manage and integrate communication channels and customer interaction touch points. Company websites, e-mail, customer portals and video/web conferencing are examples of collaborative systems.

CRM systems help to acquire and continuously generate customer knowledge. The level of support that these systems provide for each knowledge creation process varies based on the systems' features and functionality. The research model section, which follows, discusses these variations.

3. Research model

3.1. Theory development

This study explores how CRM systems support customer knowledge creation. As discussed above, knowledge is created and expands through a four-stage process: (1) socialization, (2) externalization, (3) combination, and (4) internalization. Each class of CRM system (operational, analytical, and collaborative) provides a range of applications that facilitate different knowledge creation processes. The level of support that CRM systems provide for each process varies because of differences in the nature of the applications embodied in each type of system and differences in the nature of the processes. We illustrate these relationships below.

In organizations, socialization mostly occurs through social interactions involving individuals and groups [45]. Therefore, collaborative systems that enable real-time communication provide a high level of support for socialization. For instance, in an e-meeting facilitated by collaborative technologies such as web conferencing, team members can share their experiences and discuss new ideas [39,49]. In addition, some specific operational CRM systems such as call center systems are used by organizations for real-time communication with customers and facilitate socialization between customers and company agents. In these examples, we see that the level of support that operational and collaborative systems provide for socialization is medium to high. Through these socialization processes, company agents can provide product information and advisory services for customers (i.e., knowledge for customers), collect information from them (i.e., knowledge from customers), and learn about their specific needs and expectations (i.e., knowledge about customers).

In the externalization process, tacit knowledge is converted to comprehensible, explicit forms that are easier to share. Information systems are employed to express ideas or experiences as words, concepts, figures or reports [3]. Collaborative systems facilitate externalization by enabling individuals to codify tacit

knowledge and share documents and knowledge sources. Intranets, online discussion forums, news groups and e-mail are examples of collaborative systems that facilitate externalization [10,36,39]. Externalization through CRM systems can lead to the creation of knowledge for customers (e.g., tutorials and product information on websites), knowledge about customers (e.g., online forums) and knowledge from customers (e.g., customer surveys and feedback). Operational CRM systems can capture knowledge about customers and make that knowledge accessible throughout the organization. However, the level of new knowledge creation through these operational systems is typically not very high.

The combination knowledge creation process involves the conversion of explicit information and knowledge into more complex and comprehensive sets of explicit knowledge [63]. Customer information and knowledge are gathered through several resources and are stored in knowledge repositories such as databases. However, other opportunities exist to enrich the collected information and knowledge through aggregation and analysis to create a new form of explicit knowledge. Analytical CRM systems support combination processes to a great extent. Data mining, web mining, data warehouses and OLAP are examples of analytical systems that facilitate combination processes by allowing employees to categorize, structure and analyze large amounts of data to discover implicit behavioral patterns, improve sales predictions, and gain useful knowledge about customers [6,10,64]. Some scholars (e.g., [10,39]) believe that collaborative systems such as intranets and search tools facilitate combination processes by allowing employees to systematize and aggregate the knowledge resources that are spread through departments. No study that we reviewed discussed the role of operational systems in combination processes. In fact, operational systems mainly gather customer information that can later be used as input for combination processes.

Finally, internalization involves the conversion of explicit knowledge into internalized knowledge, i.e., individual or organizational learning. Internalization requires that individuals identify explicit knowledge that is personally relevant and create their own tacit knowledge based on it [3]. Collaborative systems such as intranets support the internalization process by providing access to various documents and materials. Customers can also learn about a company's products and services by searching and reading materials provided on a company's website, blogs, forums and online communities (i.e., knowledge for customers). Another important category of collaborative systems that facilitate internalization is e-learning systems. These "distance learning" systems provide both "instructor-led learning" and "self-directed learning" opportunities for employees [39]. Analytical CRM systems also support internalization processes to some extent. For instance, employees can gain knowledge about customers by reading reports and analyses prepared using analytical systems.

As we described above, previous studies have examined ways in which CRM systems facilitate knowledge creation processes. However, few studies have investigated the interaction between CRM systems and customer knowledge types. The studies tend to focus on one specific type of CRM system (e.g., analytical CRM) or one specific type of customer knowledge (e.g., knowledge about customers) (e.g., [32,35,59,74]), or they discuss customer knowledge at a general level without further elaboration on the type of customer knowledge (e.g., [29]). In this study, we develop a model to explain how CRM systems support the creation of different types of customer knowledge.

Knowledge for customers (e.g., product and service information, information about companies, and product reviews and recommendations) is mostly available to customers through

⁶ Data mining is the process of searching and analyzing data to find implicit, previously unknown patterns and information [64].

⁷ OLAP tools provide multidimensional views of large amounts of data to help users explore complex patterns of relationships among variables and answer multidimensional analytical queries quickly [10].

Table 2
Criteria for evaluation of IS case study research.

Criteria	Implementation in the current research
Research design	
Clear research question	Initial research question “How useful are operational/analytical/collaborative CRM systems in providing support for socialization/externalization/combination/internalization processes that create knowledge for/from/about customers?” is clearly defined in Section 1
A priori specification of constructs and clean theoretical slate	Constructs (knowledge creation processes, knowledge types and CRM systems) are defined a priori. Nonaka’s organizational knowledge creation processes Model is applied as a theoretical foundation for this study and predictions from theory are presented in Table 1
Theory of interest, predictions from theory and rival theories	
Multiple-case design	Multiple cases are studied to have a more robust design
Pilot case	Due to the limited number of available cases, a full pilot case was not possible; however, two individuals from a local organization agreed to review interview questions and comment on the suitability and clarity of the questions. Input from several academics was also received and used to finetune the questions
Context of case study	Information about the context of the study (organizational structure and size, CRM systems used in each organization, nature of data, examples of knowledge creation processes, etc.) are presented to increase the credibility of results
Data collection	
Elucidation of the data collection process	A description of the interviews (sampling, number of interviews and profile of interviews, etc.) are presented in the paper and summarized at Tables 3 and 4
Multiple data collection methods and a mix of qualitative and quantitative data	Interviewing was used as the primary data collection method, although website data and company documents were also gathered and analyzed. Some of the interviews were conducted in the field which allowed us to observe systems in their actual settings as well. Both quantitative and qualitative data were presented
Case study database	A case study database was developed prior to, and during, data collection and was used for coding transcripts
Data analysis	
Elucidation of the data analysis process	Data were analyzed using the case study database. Some examples of knowledge creation processes that were extracted during the coding process are presented in Table 5. These examples were presented to make the data analysis process clear
Field notes, coding and data display	Field notes were taken during interviews. All interviews were recorded and transcribed. The case study database was used for the coding of transcripts. Data are displayed both qualitatively and quantitatively
Empirical testing and explanation building	Dubé and Paré [17] recommend that a “positivist case researcher must be more explicit about how data is analyzed. The adoption of an explicit and appropriate mode of analysis is likely to increase the validity of findings” (p. 624). Tables 6 and 7 were developed in an attempt to provide empirical results which are comparable
Cross-case patterns	Cross-case comparison is presented in Section 6
Quotes	Several quotes from interviewees are presented
Project reviews	To each interview participant, we e-mailed a copy of the overall study results (keeping other organizations’ identities hidden), a report describing the systems and knowledge creation processes in their specific organizations, and a discussion of recommendations for change/improvement in their organizations. We asked participants to review our findings and provide us with feedback on our comments and correct any inaccuracies
Comparison with extant literature	Findings of study were compared with the original research model which is based on the existing literature. The case study results are generally in line with the original research model. A detailed discussion is presented in Section 6.2

collaborative systems such as company websites, online discussion forums and communities, blogs and e-mail. In addition, some knowledge can be transferred to customers through operational systems (e.g., call centers). Analytical systems are used internally and therefore in general do not provide knowledge for customers. In contrast, analytical systems provide the highest level of support in creating knowledge about customers. Data warehouses, data mining and OLAP are analytical systems that are capable of creating extensive knowledge about customer behavior, purchasing trends, and preferences [6,64]. Operational systems such as call centers, databases, and POS systems can collect and record large amounts of information on customers’ contact details, demographics, and purchasing history. Reports and analyses produced by such systems can be considered explicit knowledge about customers, even though these types of knowledge are not as extensive as knowledge developed through analytical systems. Knowledge from customers is mainly obtained through operational and collaborative systems. Call centers help company agents gain knowledge from customers through socialization. However, collaborative systems provide a higher level of knowledge from customers because this knowledge can be collected through several systems, e.g., customers’ feedback on online customer surveys, comments on blogs and forums, and e-mails.

3.2. Theory refinement via expert survey

To gain more insight and refine the research model presented below, a small survey was conducted of IS and CRM experts at the authors’ business schools. Nine IS and Marketing professors and six PhD students⁸ provided their insights and views regarding:

- The extent to which each type of CRM system (operational/analytical/collaborative) facilitates each knowledge creation process in Nonaka’s SECI model [48].
- The extent to which each type of CRM system (operational/analytical/collaborative) facilitates the creation of each type of customer knowledge (knowledge for/about/from customers).

The experts were asked to express their views by ranking the level of support that CRM systems provide, in each instance, as low, medium, or high. The results of this survey were used to confirm and refine the authors’ conclusions from their literature review and as a guide in the development of the research model presented in Table 1. The experts were also asked to evaluate the functionalities

⁸ All faculty and doctoral students were familiar with Nonaka’s knowledge creation theory [45,48], and almost all had several years of practical business and/or information systems experience.

Table 3
Profile of participants.

Job category	Expert ID	Job title	Male/female	Case ^a
IT	A	IT manager	M	B
	B	Manager of customer interaction center	F	A
	C	Associate director of IT	M	C
Marketing/CRM	D	Marketing manager	M	B
	E	Vice president of CRM	M	A
	F	Marketing analyst	M	B
	G	Marketing analyst	M	B
Administration (system users)	H	Regional director and manager of local center	F	B
	I	Operations manager	M	B
	J	Manager of local retail store	M	A
	K	Center administrator and manager	F	C
	N	Director of operations	M	C

^a Case A is the electronics organization; Case B is the health organization; Case C is the education organization.

(i.e., levels of operational, analytical, and collaborative features) of a variety of CRM systems. Their views helped to more precisely identify the operational, analytical or collaborative nature of CRM systems. The results from the survey⁹ were combined with the insights gleaned from the literature to develop our research propositions, which are summarized in Table 1.¹⁰ Examples of the 21 specific propositions displayed in Table 1 include the following:

We propose that operational CRM systems provide low support for the knowledge combination process.

We propose that analytical CRM systems are highly capable of producing knowledge about customers.

The propositions summarized in Table 1 represent an important theoretical contribution of this study and were used to guide the development of our interview questions and our analysis of the results.

4. Research method

Given the exploratory nature of this study, a qualitative research approach was utilized. The case study method was a suitable approach because it allowed the researchers to learn about CRM systems in their natural settings and to explore the structure and complexity of knowledge creation processes [5,14,31,43,75]. The case methodology utilized was rigorous, satisfying criteria that Dubé and Paré recommended for a good IS positivist case study [17]. Table 2 describes how these criteria were implemented in our study.

We contacted a number of local organizations from different industries to invite them to participate in the study. We wished to conduct face-to-face interviews and examine the information systems firsthand. Several organizations responded positively; however, further investigation revealed that they were using only a few CRM systems. An example was a local newspaper organization with approximately 10 employees who mostly used phone/e-mail for communication, conducted very few data analyses, used Excel to record data, and used no computer-based systems to support socialization (i.e., most interactions were face-to-face). We believed that studying small organizations such as that one, with limited CRM systems and processes, would provide very limited insight regarding the use of CRM systems for customer

knowledge creation. Therefore, we excluded such organizations from our data gathering and analysis. The three Canadian organizations selected for the study varied by industry sector (electronics, education and health), number of employees and customers, organizational structure and level of CRM system development. All three organizations used a variety of CRM systems that made them appropriate case studies.

We used interviews as the main technique for data collection, although data were also gathered from company websites and company brochures and documents. This method facilitated data triangulation. Several semi-structured interviews were conducted using a pre-defined set of questions (see Appendix B) while allowing for conversational and open-ended answers [75]. Prior to the study, interview questions were developed and pretested with faculty and graduate students. A pilot test was also conducted with a local organization that did not participate in the case research. Two employees from this organization were asked to review the interview questions and provide comments and suggestions. After revising and finalizing the questions, interviews were conducted with the three case organizations with a total of 12 participants (3 female, 9 male) from various departments (primarily IT, Marketing, and Sales) who were experts on the organizations' systems and customers. Three interviewees were IT managers with responsibility for system development. Four marketing department interviewees (marketing/CRM managers and senior analysts) were engaged in the development of marketing and CRM strategies. The other interviewees were managers of departments or regional stores who were users of CRM systems. They provided valuable information on the actual usage of CRM systems in their organizations. The range of interviewees (system developers/CRM experts/system users/marketing managers) allowed the researchers to explore the development and use of CRM systems and customer knowledge in the organizations. A profile of the participants is presented in Table 3.

As recommended by Dubé and Paré [17], to assist with data analysis and the formulation of arguments, a case study database was developed. Using this database, the interviews were coded using the NVivo program. The main knowledge creation processes and related CRM systems discussed in each interview were identified and coded. For each process, the type of knowledge created was also coded. The case study results are discussed in the next section.

5. Data analysis and results

5.1. Case study findings

The applications of CRM systems for customer knowledge creation were explored in the studied organizations. The studied electronics organization (Case A) is a large corporation with several

⁹ These results are available from the researchers on request. They have not been provided here for simplicity and because of space constraints.

¹⁰ Wherever there was general agreement among experts, we relied on their responses, which were in line with our predictions. Wherever there was less agreement among the experts, we refrained from making firm predictions about systems' applicability and ranked systems' support levels as High/Medium or Medium/Low to reflect variation in the experts' views and the research evidence. Please see Table 1.

Table 4
CRM systems.

CRM Category	CRM systems	Case A [*]	Case B [*]	Case C [*]
Operational	Customer service and support (e.g., call center)	✓	✓	✓
	Sales force automation (e.g., POS)	✓	✓	×
	Marketing automation (e.g., e-mail campaign)	✓		✓
	Database management system	✓		
Analytical	Data warehouse	✓	✓	
	Data/web mining	✓		
	Excel	✓		✓
Collaborative	Departmental portals	✓	✓	✓
	Social media (e.g., website, virtual communities, Facebook fan page)	✓	✓	✓
	Communication support (e.g., e-mail, text messaging)	✓	✓	✓
	Tele/video/web conferencing	✓	✓	✓

^{*} Case A is the electronics organization; Case B is the health organization; Case C is the education organization

well-known brands. It sells electronics products all across Canada through its website and local stores. The organization uses the latest version of the SAP CRM¹¹ system. It also has a call center from which customers obtain information about new and existing products and receive repair and maintenance recommendations. The organization has an e-support website that offers online services. Inside the organization, several portals, including a “Voice of Customer” portal, facilitate the communication and sharing of customer knowledge. POS and customer databases are used as operational CRM systems. Data warehouses and data mining facilitate analyses of customer and sales data in this organization.

The health organization (Case B) has stores all across Canada. This organization offers customized weight loss plans and individual training and consultancy sessions for its clients. It also sells specific lines of nutrition and health supplements. The health organization has a call center, internal portals, and POS and customer databases. To perform analyses, employees rely primarily on Excel macros and computations. This organization recently launched a collaborative online system that connects all of its stores to the company's head quarters, allowing all employees to share knowledge readily. Customers also can use this system to access their weight loss progress reports and other valuable reports and knowledge resources. This system was developed internally to address the specific needs of the organization.

The education organization (Case C) is a university department that has fewer employees compared with the other two organizations, but it has offices in several Canadian cities and customers (student groups) who reside across Canada and internationally. It is independently run and managed within the university. This organization uses a CRM system that was bought a couple of years ago from a large CRM vendor. Since the system's implementation, the employees have largely used it as a contact management system. Many of the system's operational and analytical capabilities have rarely been utilized. The education organization also has an intranet and several portals that facilitate communication and knowledge sharing within the organization and with customers.

All three of the organizations have websites and extensively use social media tools (e.g., Facebook, Twitter, online discussion forums and blogs). A list of the systems that are used in these organizations is presented in Table 4. Brief descriptions of the systems are provided in Appendix C.

5.2. CRM applications for knowledge creation

Several applications of CRM systems to support customer knowledge creation processes were analyzed in these organizations. Some of the systems such as call centers, intranets, and customer databases were used in all three of the organizations, while others

(e.g., an e-support website) were used in only one organization. Interviewees were asked to describe the CRM processes in their departments and organizations and the applications of the CRM systems for these processes. They were specifically asked to elaborate on the application of systems for knowledge creation purposes and to describe the types of customer knowledge created as a result of each process. Table 5 provides examples of the knowledge creation (SECI) processes that were identified through the interviews. The types of CRM systems that facilitated each process as well as the types of customer knowledge created through each process are also presented in the table.

5.3. Detailed results

The researchers counted the number of times that each CRM system was referred to by the interviewees as they discussed how specific knowledge creation processes were facilitated. Detailed results are presented in Table 6. The numbers in the table indicate the number of times the interviewees discussed system applications to support a knowledge creation activity and to facilitate the creation of a type of customer knowledge.¹² Table 7 summarizes the interactions between the CRM systems, knowledge creation processes and customer knowledge types.

Once the knowledge creation processes were identified and coded for each case, the results were used to find general patterns across the organizations based on the frequency of the codes. The case studies showed that CRM analytical systems strongly support the organizations' combination processes and provide a great deal of knowledge about customers that helps the organizations better understand their customers' behaviors and needs. However, the interviewees indicated that to effectively support the combination processes, the analytical capabilities of the systems needed to match both the volume of customer data and the employees' expertise and IT skills. For instance, the education organization uses a CRM system that has powerful analytical capabilities. However, these capabilities “scare” people because many employees do not have the required data analysis and IT skills. Therefore, they do not utilize these capabilities and mostly rely on Excel to perform low-level analyses of customer data.

The study confirmed that operational CRM systems such as POS and customer databases can help organizations capture and externalize knowledge about customers. Operational systems such as call centers, which are widely used in these organizations, strongly support socialization with customers. Through the socialization process, organizations provide information and knowledge for customers (e.g., product information and

¹¹ See <http://www.sap.com/solutions/bp/customer-relationship-management/index.epx>.

¹² To avoid unnecessary subjective judgments, we did not rate or weigh interviewees' references to knowledge, processes, or systems. Each unprompted reference was simply noted and counted.

Table 5
Examples of knowledge creation processes facilitated by CRM systems.

Knowledge creation processes	CRM systems	Category of system	Customer knowledge types
Socialization processes			
<i>Socialization within the company</i>			
Web and call conferences between store managers and the district manager to share best practices, customer experiences, etc. as well as conference calls between the members of various committees to make decisions and share ideas	Tele/video/web conferencing	Collaborative	ABOUT
<i>Socialization with customers</i>			
Customers call to get information about products and services, get recommendations on problems with products, request services, etc.	Customer service and support	Operational	ABOUT/FOR
Externalization processes			
<i>Externalization within the company</i>			
Knowledge exchange (sharing information, reports, experiences, etc.) with e-mail and through internal portals	Communication support/departmental portals	Collaborative	ABOUT/FROM
Proposing suggestions, solutions, ideas through electronic suggestion box and/or instant messaging tools	Communication support/departmental portals	Collaborative	ABOUT/FROM
Customers' purchase information is externalized and accessible through CRM systems	Sales force automation	Operational	ABOUT
Publishing customer experience survey results, customers suggestions and feedback	Departmental portals	Collaborative	ABOUT/FROM
<i>Externalization outside the company (for/from customers)</i>			
Externalization of product information, manuals, tutorials for products repair through the organization's websites (e.g., e-support website)	Social media	Collaborative	FOR
E-mail campaigns and loyalty-based communication with customers (promotions, rewards, exclusive discounts, etc.)	Communication support	Collaborative	FOR
Combination processes			
Analysis on the leads' and customers' information for reporting, tracking customers' activities and offering complementary products that match each customer's purchase pattern	Excel/data warehouse	Analytical	ABOUT
Customer lifetime value analysis, customer segmentation, etc.	Excel/data warehouse	Analytics	ABOUT
Analysis of customer experience survey results and feedback	Communication support/departmental portals	Collaborative	ABOUT/FROM
Internalization processes			
<i>Internalization for employees</i>			
Online courses for various organizational and technological topics	Departmental portals	Collaborative	FOR/ABOUT
Learning from reports and materials on intranet (product information, tutorials, customers' feedback, best practices, etc.)	Communication support/departmental portals	Collaborative	ABOUT
<i>Internalization for customers</i>			
Customers learning about products, services and repair solutions (product and service information, tutorials, FAQ, manuals, videos, etc.)	Social media	Collaborative	FOR

recommendations), collect knowledge about customers and gain knowledge from customers (e.g., customer feedback).

The studied collaborative CRM systems facilitate communication with customers as well as communication within the organization. Collaborative systems that are used as communication channels with customers (e.g., company websites, e-mail, and social media) can facilitate the externalization of knowledge for customers and help them learn more about products and services.

Customers can also share their feedback and opinions with the organization through these systems. The electronics organization makes very good use of collaborative systems to generate knowledge from customers. At the end of each day, customer experience surveys are e-mailed to randomly selected customers who have called during the day. These customers are asked to provide feedback and rate the call center agents' performance. The responses are analyzed and the summary results are accessible to

Table 6

Aggregated results – references made by interviewees to knowledge types.

	Knowledge creation processes	Knowledge FOR customers	Knowledge ABOUT customers	Knowledge FROM customers	Total for each system and process	Total for each system
Operational CRM	Socialization	8	6	5	19	52
	Externalization	3	9	1	13	
	Combination	2	9	0	11	
	Internalization	2	7	0	9	
Total for each system and knowledge type		15	31	6		
Analytical CRM	Socialization	0	0	0	0	48
	Externalization	0	0	0	0	
	Combination	0	31	0	31	
	Internalization	1	15	1	17	
Total for each system and knowledge type		1	46	1		
Collaborative CRM	Socialization	1	11	1	13	93
	Externalization	17	24	6	47	
	Combination	0	3	0	3	
	Internalization	11	14	5	30	
Total for each system and knowledge type		29	52	12		
Total for each Process		45	129	19		

all employees through the organization's "Voice of Customer" portal. Another set of collaborative CRM systems are used to facilitate collaboration inside the organizations. This group of systems helps employees externalize their knowledge about customers, collectively make decisions and find solutions to business problems (e.g., an electronic suggestion box). Furthermore, some collaborative systems provide learning opportunities (knowledge sources, online courses, etc.) and therefore facilitate knowledge internalization for individual employees.

6. Discussion

6.1. Cross-case comparisons

All three of the organizations were generally satisfied with the operational CRM systems' capabilities in terms of their work efficiency and their impact on business performance. However, some interviewees in the health and education organizations noted that the operational systems were mainly used to collect and organize customer information and were not capable of generating high-level customer knowledge.

Regarding the analytical capabilities of CRM systems, different patterns were found in the organizations. The electronics

organization had systems with high analytical capabilities that employees used to carry out various analyses of customer information. However, the other two organizations largely relied on Excel programs and simple spreadsheets to support the knowledge combination process. The health organization did not have any specific analytical systems, and Excel seemed to provide sufficient analytical support given the organization's current market. However, the interviewees indicated that as the business grows, the organization will likely need a more powerful analytical system to manage and analyze larger amounts of customer data. The educational organization's CRM system had high analytical capabilities that were not utilized. Due to the complexity of the analytical applications and the lack of IT expertise, employees were not willing to use these applications.

The electronics organization and the health organization made good use of collaborative system capabilities to support knowledge externalization and internalization processes. However, in the education organization, the independence of the systems within internal departments and the low motivation for knowledge sharing led to the limited use of collaborative systems for knowledge externalization.

The different characteristics of these organizations may explain several differences identified in the application of the CRM

Table 7

Interaction of CRM systems, knowledge creation processes and customer knowledge.

CRM system	Number of references			
	Socialization	Externalization	Combination	Internalization
Interaction of CRM systems and knowledge creation processes				
Operational	19	13	11	9
Analytical	0	0	31	17
Collaborative	13	47	3	30
CRM system	Number of references			Knowledge FROM customers
	Knowledge FOR customers	Knowledge ABOUT customers	Knowledge FROM customers	
Interaction of CRM systems and customer knowledge				
Operational	15	31	6	
Analytical	1	46	1	
Collaborative	29	52	12	
Customer knowledge	Number of references			
	Socialization	Externalization	Combination	Internalization
Interaction of customer knowledge and knowledge creation processes				
Knowledge FOR customers	9	20	2	14
Knowledge ABOUT customers	17	33	43	36
Knowledge FROM customers	6	7	0	6

Table 8
Three-way interaction of knowledge creation process/CRM system/customer knowledge.

Knowledge type	Socialization			Knowledge type	Total				
		Opr	Analyt		Coll		Opr	Analyt	Coll
	For	8	0		1	For	15	1	29
	About	6	0		11	About	31	46	52
	From	5	0		1	From	6	1	12
	Externalization								
		Opr	Analyt		Coll				
	For	8	0		17				
	About	9	0		24				
	From	1	0		6				
	Combination								
		Opr	Analyt		Coll				
	For	2	0		0				
	About	9	31		3				
	From	0	0		0				
Internalization									
	Opr	Analyt	Coll						
For	2	1	11						
About	7	15	14						
From	0	1	5						

CRM systems	Knowledge FOR customers				CRM System	Total					
		Soc	Ext	Com		Int		Soc	Ext	Com	Int
	Operational	8	3	2		2	Operational	19	13	11	9
	Analytical	0	0	0		1	Analytical	0	0	31	17
	Collaborative	1	17	0		11	Collaborative	13	47	3	30
	Knowledge ABOUT customers										
		Soc	Ext	Com		Int					
	Operational	6	9	9		7					
	Analytical	0	0	31		15					
	Collaborative	11	24	3		14					
	Knowledge FROM customers										
		Soc	Ext	Com		Int					
	Operational	5	1	0		0					
	Analytical	0	0	0		1					
	Collaborative	1	6	0		5					

Knowledge type	Operational CRM				Knowledge type	Total					
		Soc	Ext	Com		Int		Soc	Ext	Com	Int
	For	8	3	2		2	For	9	20	2	14
	About	6	9	9		7	About	17	33	43	36
	From	5	1	0		0	From	6	7	0	6
	Analytical CRM										
		Soc	Ext	Com		Int					
	For	0	0	0		1					
	About	0	0	31		15					
	From	0	0	0		1					
	Collaborative CRM										
		Soc	Ext	Com		Int					
	For	1	17	0		11					
	About	11	24	3		14					
	From	1	6	0		5					

No. of references Low Med Med/High High



Opr: operational; Analyt: analytical; Coll: collaborative; Soc: socialization; Ext: externalization; Com: combination; Int: internalization.

systems. For instance, the electronics organization operates in a dynamic and highly competitive industry. In such industries, customer retention is particularly challenging, and organizations need to build strong relationships with customers to stay competitive in their markets [21]. As a result, this organization has implemented the latest CRM technologies to provide strong support for customer knowledge creation activities. Compared with the other two organizations, the electronics organization has much higher analytical capabilities, and its employees make very good use of these capabilities to gain useful knowledge about their customers' behaviors and requirements. In contrast, the education organization operates in a less competitive environment, and its employees make limited use of its primary CRM system. The system is mostly used as an operational tool to manage contact lists and track customers' activities. Many analytical and collaborative capabilities of the system have not been utilized.

6.2. Comparison of findings with the proposed model

The case study results are generally in line with the original research model (compare Tables 1 and 7). Regarding the socialization process, operational and collaborative systems provided medium support, while no interviewees talked about the support of analytical systems for socialization. Regarding the externalization process, the operational systems provided medium support and the collaborative systems provided a high level of support, as predicted by the model. Again, no interviewees commented on the support of analytical systems for externalization processes. As expected for the combination process, operational systems provided fairly low support, while analytical systems demonstrated very high support. However, there were few comments about the support of collaborative systems for the combination process. For the internalization process, the operational systems provided the lowest support, the analytical systems provided medium support, and the collaborative systems provided the highest level of support. These findings are consistent with the research model.

Regarding the type of knowledge produced through each class of CRM system, the results were consistent with the proposed model for knowledge about customers (low support from analytical systems, medium support from operational systems, and high support from collaborative systems). All three classes of CRM systems provided a high level of support for the creation of knowledge about customers. However, this knowledge was not always high-level knowledge, specifically in the case of operational systems that mainly gathered transactional data and demographic information about customers.¹³ There were relatively few interviewee comments concerning knowledge from customers. The studied organizations did not make full use of their CRM systems' capabilities to obtain valuable knowledge through communication with their customers; the organizations focused on other forms of customer knowledge.

6.3. CRM systems' benefits and challenges

The interviewees were asked to discuss the benefits of their CRM systems and to evaluate the systems' capabilities and their level of satisfaction with these capabilities. All the interviewees expressed the view that the systems have improved their business capabilities to a great extent and have helped them know their customers better and make more effective decisions by acquiring

and creating more precise and detailed customer knowledge. For example, one interviewee stated:

It's very important to note that a year ago we were at zero. We had no data. We were starting to test things in the media and did not have any clue about what worked.

(Expert D)

The interviewees believed that the CRM systems help them work more productively because they spend less time acquiring and aggregating all the information they need to perform analyses. For example:

I discovered so many things about that center that weren't right just by looking at the compliance report that would have taken me hours and hours of manual labor to find out... It was all right before me.

(Expert H)

Another important benefit of the systems is that they support internalization processes, providing learning and awareness opportunities. An example is offered by a senior marketing analyst:

At an aggregate level, it helps us understand on average how long people are with us and what point they start leaving us, and then it helps us to operationalize if there's anything that we can do to extend the client's life with us.

(Expert G)

In addition, support for externalization processes helps the same company provide employees with the information they require for daily operations and makes them aware of plans and events that are scheduled:

[A portal] should be checked at least once a day to see what's going on. Because you can see everything. It tells you about updates on any products, any conference calls, any promos... It just gives you everything that you need to know.

(Expert J)

Finally, CRM systems help to improve products and services in several ways. For instance, customer purchase trends can be analyzed to allow an organization to help its customers make new purchases and assist the organization in offering customers new products that closely match their needs and expectations.

It allows us to be able to call them or find ways to offer them more service beyond the service they've already received in order to complement their experience with [the company].

(Expert E)

There are also several challenges that negatively affect the support of CRM systems for customer knowledge creation. From a technological perspective, system integration is one of the most important challenges. Integrated CRM systems enable knowledge sharing and ensure that employees have access to the right customer information to make appropriate decisions [59]. The interviewees noted that a lack of integration led to work redundancy and ineffective use of systems.

Currently there are a lot of people spending a lot of hours continually manipulating Excel spreadsheets to put them into one format or another for one party or another, almost on a daily basis.

(Expert I)

In addition, in the education organization, employees did not follow standard formats for developing databases, which in turn

¹³ For the purpose of this study, we documented the frequency of comments in interviews and did not assess the quality or importance of the knowledge produced. Future studies may wish to examine the importance and impact of the created customer knowledge.

made the integration of databases more challenging [58] and negatively affected combination processes because the employees could not easily aggregate information from various sources to provide analyses and reports.

The amount of flexibility is incredible, almost too flexible. It allows us to keep creating these separate databases as often as we can without relating any information between them. It's a high level of customization, low level of standardization in my opinion. And that's what the biggest challenge is.

(Expert C)

However, the study also reveals that having integrated CRM systems is not enough to ensure the creation of superior customer knowledge. Organizations need to change business processes and shape their organizational culture and routines to utilize the potential of CRM systems to generate customer knowledge and optimize their benefits [12,25,71]. For example:

Each of the departments has a different meaning for marketing and sales and this problem has never been dealt with. This is one of my challenges with these types of products - it's not flexible in nomenclatures, in the language. So I would like to be able to customize some of this language.

(Expert N)

The existence of a CRM strategy is an important organizational factor that affects customer knowledge creation efforts. To effectively manage and leverage customer knowledge, a customer-centric CRM strategy is required to synchronize the CRM processes within an organization [27,69]. The lack of a CRM strategy was a challenge for the education organization, for example. This organization was re-evaluating its CRM system, but the managers realized that before deciding what new systems were needed, they had to develop a centralized CRM strategy and identify their technological needs based on this strategy. Internal departments were operating independently, and collaboration among departments was limited. Therefore, many potential benefits of the CRM system had not been utilized.

We've always gotten the question why do we continue using this product? We felt that [the CRM system] can meet the needs. But we only explored 10% of the money spent on the product, 90% of it goes away.

(Expert C)

This study suggests that there should be a supportive culture for knowledge creation in organizations. An appropriate evaluation and reward structure can increase the motivation of employees to take part in customer knowledge creation activities [9,41]. CRM systems' effectiveness in supporting knowledge creation processes, and specifically externalization processes, was highly dependent on the employees' willingness to externalize their knowledge and actively engage in knowledge creation activities.

We have tried a few times in the past to share best practices between departments. There were positive meetings generating lots of discussion but we never really got past the preliminary stages.

(Expert K)

As another example, personal consultants in the health organization had very close interactions with individual clients. Through socialization with each client, they gained helpful knowledge about customer needs, their feedback on services, and their suggestions for service improvement. This knowledge was helpful for decision making and planning at the managerial level. However, the consultants were not encouraged to externalize their knowledge and share it with the whole organization.

Finally, the study shows that appropriate training is required to make sure that employees have enough IT skills and expertise to effectively utilize systems' capabilities. As described above, this was very evident in the case of the education organization.

7. Research and management implications

Many organizations invest in costly CRM systems but do not fully utilize the potential of such systems to acquire customer knowledge. This study has important research implications. We applied organizational knowledge creation theory to systematically generate propositions examining the role of various CRM systems in facilitating knowledge creation processes in organizations. Thus, our study extends the theory on customer knowledge creation by drawing attention to specific 3-way interactions among CRM systems, types of customer knowledge, and knowledge creation processes. To our knowledge, no prior study has investigated these precise interactions or highlighted their importance.

The case study findings generally confirm the research propositions. As predicted, analytical CRM systems provided the highest level of support for combination processes and were very capable of producing useful knowledge about customers. Some operational systems (e.g., call centers) supported socialization, and others (e.g., databases and POS systems) provided moderate support for externalization. Collaborative systems had the highest capabilities to support knowledge creation processes. Various collaborative tools were used in organizations to support CRM processes. Most of these systems facilitated externalization and internalization processes, provided knowledge for customers, and provided organizations with opportunities to learn from their customers. More research is needed to confirm these exploratory findings.

Our research also has important management implications. Many organizations are investing in sophisticated CRM systems, but the effectiveness of these systems within specific organizational contexts is a major question for managers. For example, global expenditures on CRM systems grew from \$8 billion in 2008 to more than \$13 billion in 2012.¹⁴ However, AMR Research, Inc. indicates that "fewer than 50 percent of CRM projects fully meet expectations" [18]. These findings are in line with what was observed in this case study when the interviewees noted that they were under-utilizing the capabilities of several of their CRM systems. This study's findings can help organizations better understand the strengths and weaknesses of their CRM systems, specifically in regard to customer knowledge creation activities.

To make the results of the study readily understandable, we have summarized our findings visually in Table 8, in which different colors represent various levels of applicability of the systems as they are used in the studied organizations. Red cells indicate the highest level of support provided, orange cells show moderate support, and yellow cells very limited support. These 3-way interaction findings are of particular interest to managers. They show precisely what customer data companies are able to obtain and analyze well (e.g., the specific types of customer data they can "mine"). The results also show where customer data are lacking in the studied organizations, and where new technologies, processes or approaches to support the creation of customer knowledge may be needed. For instance, the results suggest that "collaborative externalization" can be well supported by CRM systems with respect to knowledge for and about customers. In the studied organizations, current software and processes received high scores for their support in this area.

However, as Table 8 reveals, there are not many red areas. Many more areas are yellow, indicating poor scores and minimal support for customer knowledge creation processes. These are the areas where

¹⁴ Gartner, Inc., <http://www.gartner.com/technology/home.jsp>.

organizations may benefit from new systems, processes or innovations that gather and use customer data. The yellow areas show stark “data gaps” where there is a lack of potentially valuable customer data. For instance, one table is “all yellow”. This table indicates that very little data, relatively speaking, are captured “from” customers in the studied organizations. This result represents the entire customer knowledge creation cycle and shows a major, potentially limiting weakness of current CRM systems and processes. These red, orange and yellow indicators may be viewed as a “dashboard”, providing important insights for managers and researchers into customer data availability and an organization’s needs.

In summary, the case studies reveal that organizations often do not make good use of their CRM systems’ capabilities to obtain knowledge from their customers. Customers are a very valuable knowledge resource for organizations, “yet only a few companies are actually managing well their perhaps most precious resource: the knowledge residing in their customers” [24]. Knowledge from customers can be effectively integrated into the knowledge bases of organizations. The feedback and innovative recommendations that customers provide can improve many organizational processes and marketing practices [66].

Three groups of practitioners can benefit from this study: (1) IT managers/developers who are engaged in managing and developing CRM systems should know the weaknesses of these systems and support system users in exploiting system capabilities; (2) marketing/CRM managers and analysts who rely on customer knowledge to make decisions and develop marketing strategies; and (3) users of CRM systems who need to know the capabilities of the systems and receive appropriate training to properly utilize these capabilities. Several challenges that negatively affect the support for knowledge creation provided by CRM systems are identified in this study, and recommendations for dealing with these difficulties are outlined. The study helps managers to understand the potential benefits and challenges in the knowledge creation cycle and to evaluate their current use of CRM systems to support knowledge creation.

8. Limitations and suggestions for future research

Our study extends the theory on customer knowledge creation, highlighting the importance of 3-way interactions among

customer knowledge types, knowledge creation processes, and CRM systems. However, some limitations apply.

The number of organizations studied (three) restricts the generalizability of our results. However, the study’s propositions and findings can serve as a starting point for researchers seeking to further explore opportunities for customer knowledge creation through CRM systems. Our goal has been to encourage other researchers to investigate customer knowledge creation (e.g., the 3-way interactions we have highlighted) with more rigor and specificity. In addition, we encourage researchers to consider similar investigations with other types of organizational knowledge (e.g., to explore 3-way interactions among supply chain systems, types of supplier knowledge, and knowledge creation processes).

We also recognize that the analysis of interview data in case study research can be affected by researchers’ characteristics and their interpretations [15,20]. We have done our best to maximize the robustness of our case data and analyses, as outlined in our discussion of the research methods. However, further triangulation of the qualitative findings of this study with quantitative data from a survey involving a larger sample of organizations would be helpful. Survey-based data could also be used to statistically test the significance of the 3-way interactions we have explored in our research.

Finally, we invite other researchers to investigate the patterns of CRM systems and their uses across industries and countries to see how characteristics of the business environment (national culture, level of competitiveness, industry turbulence, etc.) affect the application and support of CRM systems for customer knowledge creation processes.

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Appendix A. Review of similar studies

Paper	Topics discussed		
	CRM	Knowledge creation	Customer knowledge
Belbaly et al. [4]	N/A	Knowledge creation theory	Knowledge for/about/from customers
Bose and Sugumaran [7]	Analytical systems	KM processes	N/A
Carvalho and Ferreira [10]	KM systems	Knowledge creation theory	N/A
Chen and Su [11]	CRM processes	CKM processes	Knowledge for/about/from customers
García-Murillo and Annabi [21]	N/A	CKM processes	Knowledge from customers
Gebert et al. [22]	CRM processes	KM processes	Knowledge for/about/from customers
Iriana and Buttle [29]	Strategic/operational/analytical	N/A	General knowledge
Karakostas et al. [32]	CRM as a strategic tool/tool to support communication channels/tools for supporting the B2 C interaction	N/A	Knowledge about customers
Kong et al. [35]	Analytical systems	N/A	General knowledge
Liew [38]	KM systems/CRM in general	KM processes	N/A
Plessis and Boon [51]	CRM processes	KM processes	N/A
Ranjan and Bhatnagar [55]	Mobile CRM and data mining	N/A	General knowledge
Ranjan and Bhatnagar, [54]	Analytical systems	KM process	Knowledge for/about/from customers
Ryals and Payne [59]	Operational systems	N/A	Knowledge about customers
Salomann et al. [60]	CRM processes	CKM processes	Knowledge for/about/from customers
Shang et al. [63]	Collaborative (Web 2 services)	Knowledge creation theory	N/A
Shaw et al. [64]	Analytical (data mining)	KM processes	General knowledge
Smith and McKeen [66]	CKM solutions (not just systems)	N/A	Knowledge for/about/from customers
Su and Lin [67]	N/A	KM processes	General knowledge
Toriani and Angeloni [70]	CRM processes	Knowledge creation theory	N/A
Xu and Walton [74]	Analytical systems	N/A	Knowledge about/from customers

Appendix B. Interview questions

On a daily basis, how often do you use CRM systems? Which tools do you use? For what purposes do you use each system? Could you give some examples?

B.1. Knowledge creation process: socialization

How do you use CRM systems to interact with customers/other employees in your organization?

Do you think these communications are helpful to you (e.g., you learn about customers, exchange knowledge, etc. through these communications)?

Do you think these communications help you exchange your knowledge with others (employees, customers)?

B.2. Knowledge creation process: externalization

What types of information (reports, documents, etc.) do you share with customers/other employees through the systems? Could you give some examples?

When you come up with new ideas and suggestions, do you share them with others? How? Are there any systems or applications (e.g., discussion forum on the intranet) available for that purpose?

Do you share your customer experiences with others? How? Are there any systems or applications (e.g., discussion forum on intranet) available for that purpose?

B.3. Knowledge creation process: combination

What types of analyses do you do on customer data?

What type of analytical tools do you use? (e.g., data warehouse, data mining, and OLAP)

Does the CRM system in your company have a knowledge base (about customers, competitors, products, markets, etc.) or repositories/databases of customer data and information?

Do you use it? Do you provide input to this knowledge base?

Do these applications allow you gather and combine different types of knowledge?

B.4. Knowledge creation process: internalization

What types of learning materials do the systems provide for employees and for customers? (examples are online tutorials, FAQs, databases, search engines, websites, articles, demos).

Are there best practices and lessons-learned documents? Do you read them? Do you find them effective and helpful for your work?

How often do you read others' notes and suggestions on the company's portal?

Do you find them helpful for your work? How do you use this information? Can you share some examples?

B.5. Evaluation of CRM systems

What benefits do CRM systems provide for you and your organization?

To what extent do CRM systems successfully and effectively support knowledge creation activities within your department or

in the whole organization? Specifically, could you please give examples for each of the following questions:

- Do CRM systems help you gather information and create knowledge that you did not previously have about your customers?
- Do they give you any information from your customers that you previously did not receive?
- Do they provide new knowledge that you can share with customers (i.e., knowledge for customers) that you could not previously share with them?

In your opinion, what are the strengths and weaknesses of your organization's current CRM systems in regard to customer knowledge creation opportunities, analytical capabilities, collaborative capabilities and operational capabilities?

In general, are you satisfied with your organization's CRM systems capabilities?

What are your suggestions for improving CRM systems to match your requirements for knowledge creation?

B.6. Organizational support

Are there any barriers to more effective use of the systems (e.g., technical barriers, cultural barriers, lack of skills)?

What are your plans to encourage employees to create more knowledge through the use of CRM systems? Are there any incentives and rewards?

What support does the IT department provide for CRM users? Examples of support from the IT department are: technical support, providing tutorials, demos, individual/group learning and recommendations, plans for encouraging employees to utilize applications, etc.

Appendix C. Description of systems

C.1. Customer service and support systems

Customer service and support systems are applied to manage customer inquiries and feedback through multiple communication channels. By automating the processes, these systems help organizations increase the speed and quality of customer service and therefore increase customer satisfaction [29].

C.2. Sales force automation system (SFA)

Sales force automation (SFA) systems facilitate the management of selling activities. These systems improve the efficiency and quality of selling processes by automating selling activities. Contact and activity management, account management, order and contract management, sales forecasting, etc. are some of the main features of SFA systems [29,65].

C.3. Marketing automation

Marketing automation systems are applied to improve the efficiency and effectiveness of marketing plans and processes. They include features that help organizations track customer contact efforts across all communication channels, generate leads and manage internal marketing workflows [29,68].

C.4. Database management system (DBMS)

DBMS is a complex software program that is capable of managing and organizing a large amount of datasets. It enables users to interact efficiently with databases. DBMS allows the users to define the structure of databases and manipulate and use the data [52].

C.5. Data mining and web mining

Data mining is “the process of searching and analyzing data in order to find implicit, but potentially useful, information. It involves selecting, exploring and modeling large amounts of data to uncover previously unknown patterns, and ultimately comprehensible information, from large databases” [44,64]. Different methods are used for arranging data into groups and extracting the patterns of relationships between variables. These methods include “statistical analysis, decision trees, rule induction and refinement, and graphic visualization” [64].

Web mining involves the application of data mining techniques to “the content, structure, and usage of Web resources” [37].

C.6. Data warehouse

A data warehouse collects data from several systems such as call centers, POS systems, and marketing and customer support systems. The data warehouse combines and integrates the data collected from different sources and facilitates data retrieval and analysis [59].

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