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# **A Service-based Model for Customer Intelligence in the Age of Big Data**

*Completed Research*

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## **Abstract**

The dominance of the service sector in today's economy gives prominence to customer intelligence as a means for enterprises to provide optimal service. In fact, the revolution of big data has generated a vast amount of customer data and reshaped the dimensions of science, management, and engineering within enterprises. The big data era also acknowledges the role of customers as value co-creators. Therefore, the objective of this paper is to propose a service-based customer intelligence model, hereafter called **SBCI (Service-based Customer Intelligence)** model, to guide the development and application of customer intelligence. Laid the groundwork upon the service science, the model is proposed with three levels: i) the network of service systems level for customer value co-creation, ii) the service system level for the science, management, and engineering dimensions, and iii) the service level for customer intelligence services.

## **Keywords**

Customer intelligence, service-based model, big data, service science.

## **Introduction**

In the big data age, customers create a significant amount of data through different online platforms, which stimulates the emergence of big data-driven customer intelligence (France and Ghose 2019; Ramaswamy and Ozcan 2019). The role of customers has gone beyond regular consumers; instead, customers become co-creators from the process of product/service development to consumption (Burrell 2018). Through the value co-creation, enterprises can take advantage of customer intelligence, which is considered as the ability to acquire customer insights to gain competitive advantages (Burrell 2018; Nambisan 2010).

The era of big data witnesses the dominance of the service sector (Anshari et al. 2019); however, enterprises find it challenging to build customer-oriented service through a network of customer value co-creation (Anshari et al. 2019; Ramaswamy and Ozcan 2019). Most enterprises struggle with upgrading technologies and systems to keep up with the big data, which are described in terms of the “four V’s”: volume, velocity, variety, and veracity (Sivarajah et al. 2017). Accordingly, they have to deal with changes in strategies and organizational structure due to the revolution of technology (Bansal 2019; Tabrizi et al. 2019). In fact, the majority of enterprises overemphasize the importance of technological changes and lack the mindset of restructuring the organizational and strategic viewpoints to better offer service for customers (Yohn 2018). To sum up, the big data era has reshaped the viewpoints of organization, strategy, and technology (Davenport and Spanyi 2019; Tabrizi et al. 2019); therefore, there is an urgent need for an approach that confronts the challenges related to all the viewpoints coherently.

To address those challenges of developing and applying customer intelligence, the objective of the paper is to propose a service-based model for customer intelligence, which facilitates the transformations from the organizational, strategic, and technological viewpoints due to big data. The proposed model, hereafter called **SBCI (Service-based Customer Intelligence)** model, aims at promoting the development and

application of customer intelligence in the age of big data in a coherent manner. Laid the groundwork upon the service-dominant logic and service science approach (Maglio and Spohrer 2013; Spohrer et al. 2007), the SBCI model is developed with a detailed discussion on science, management, and engineering dimensions (Le Dinh and Pham 2012). The science dimension focuses on the organizational viewpoint whereas the management dimension covers the strategic viewpoint. The engineering dimension touches upon the technological viewpoint.

The remaining structure of the paper continues with the theoretical background relevant to the service science approach. Thus, the paper proposes the service-based model for customer intelligence. The next section of the paper discusses the three levels of the SBCI model based on the perspective of service science (Le Dinh and Pham 2012): i) Network of service systems level for customer value co-creation; ii) Service system level for the customer intelligence system, including the science, management, and engineering dimensions; and iii) Service level for customer intelligence services. An illustrative example extracted from a case study is also demonstrated to validate the SBCI model. The last section of this paper indicates an in-depth discussion of contributions, limitations, and future directions as the conclusion.

## Theoretical Background

This paper relies on the service science as it covers the three principal dimensions within an enterprise: science, management, and engineering (Maglio and Spohrer 2013; Spohrer et al. 2007). It is argued that the service science approach can be used to fortify the significance of customer intelligence. In light of the *science dimension*, customer intelligence deals with the organizational structure and the process to create, communicate, and deliver values to customers, clients, partners, and society. Regarding the *management dimension*, marketing intelligence is applied to marketing decisions and strategies. The final dimension of the service science approach: the *engineering dimension* clarifies how to transform data into information, knowledge, and wisdom to offer innovation and service (Le Dinh et al. 2014).

Laid the foundation upon the service science approach, customer intelligence may be implemented as service or service-based products. The study of Vargo and Lusch (2004) defined *service* as the “application of competencies such as knowledge as skills to offer values to other entities and the entity itself”. Accordingly, customer intelligence is the application of knowledge and skills from customers and enterprises for mutual benefits. The science, management, and engineering dimensions set a robust foundation for the service system (Maglio and Spohrer 2013). A *service system* is defined as the “value-co-creation configurations of people, technology, value propositions connecting internal and external service systems, and shared information” (Spohrer et al. 2007). A service system is facilitated by a *network of the service system*, also called a value-creation network, which emphasizes the role of customers as the resource for knowledge and skills (Vargo and Lusch 2004).

## Service-based Customer Intelligence Model

This section presents the SBCI model, which is defined as a set of statements expressing the relationships among key concepts (Hevner et al. 2004). As illustrated in **Figure 1**, the SBCI model consists of three levels: i) the customer value co-creation for the network of service systems level, ii) the dimensions of management, science, and engineering for the service system level, and iii) the customer intelligence for the service level.

The hierarchy of each level of the SBCI model indicates the relationships among key concepts (Le Dinh and Pham 2012). At first, the network of service systems defines the role of each service system such as Co-ideators, Co-designers, Co-marketers, Co-experiencers, and Co-partners. Thus, the service system has a direct impact on customer intelligence as the service level by providing different tools, techniques and processes. A short description of key concepts in each level of the SBCI model is demonstrated in **Table 1**. These keys concepts are comprehensive and complete as they are developed from the concept-centric literature reviews that have been recently published by the authors (Dam et al. 2019a; Dam et al. 2019b).

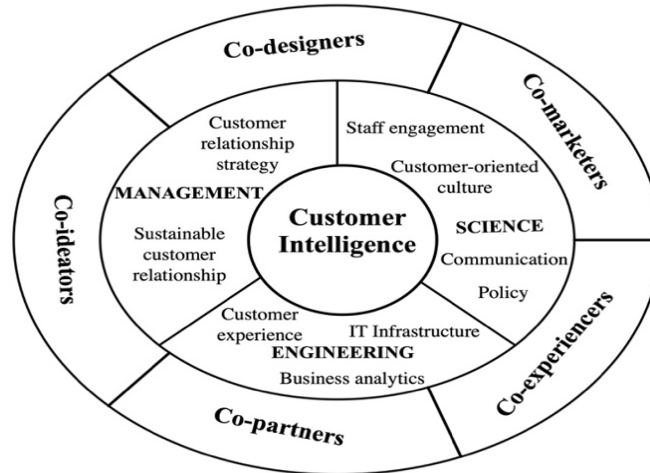


Figure 1. Service-based Customer Intelligence Model

Key Concepts	Descriptions
Customer intelligence	The ability to acquire knowledge and skills from big data and analytics and apply to the process of creating, communicating, delivering, and co-creating offerings that have value for actual or prospective customers of products or service <sup>1</sup> .
Customer relationship strategy	Techniques and processes to understand customers and maximize their values for enterprises (France and Ghose 2019; Zhang et al. 2018).
Sustainable customer relationship	Connected strategies between enterprises and customers due to the application of technologies (Siggelkow and Terwiesch 2019).
Staff engagement	An alignment between leaders and employees with a customer-oriented mindset (Burrell 2018; Tabrizi et al. 2019).
Customer-oriented culture	Beliefs and values of enterprises that benefit customers (Tabrizi et al. 2019).
Communication	The process to share the importance of customer intelligence among employees (Tabrizi et al. 2019; Yohn 2018).
Policy	An incentive system for employees (Rawson et al. 2013).
Customer experience	A customer interaction journey from pre-purchases to post-purchases (Rawson et al. 2013; Tabrizi et al. 2019).
IT infrastructures	A data warehouse, intranets, cloud-based platforms, storage area networks, software, etc. (Chen et al. 2012; Wamba et al. 2017).
Business analytics	Analytic techniques involve descriptive, predictive, and prescriptive to transform data into information, knowledge, and intelligence (Chen et al. 2012).
Co-ideators	Customers participate in the process of idea generation for product conceptualization and improvement (Russo-Spena and Mele 2012).
Co-designers	Customers design prototypes on provided engagement platforms (Frow et al. 2015; Nambisan 2010).
Co-marketers	Customers evaluate products/service and optimize customer experience (Russo-Spena and Mele 2012).
Co-experiencers	Customers exchange their role with employees and vice versa (Ramawamy and Ozcan 2018).
Co-partners	Customers offer their knowledge and intelligence and receive benefits in return (Libert et al. 2015).

Table 1. Descriptions of Key Concepts of the SBCI Model

<sup>1</sup> Adapted from American Marketing Association and Oxford Dictionary.

### ***SBCI Model at the Service level***

The service level emphasizes the application of customer intelligence in offering innovative and smart service to customers in the age of big data. However, literature hardly recognizes an official definition of customer intelligence, especially a definition that can comprehensively cover the three dimensions of the service science approach (Chen et al. 2012; Liang and Liu 2018). This forms the rationale for reshaping the definition of customer intelligence.

### **Reshaping the Definition of Customer Intelligence in the Age of Big Data**

As customer intelligence is the core of the service level in the SBCI model, it is important to define what customer intelligence is, considering the context of big data. According to the Oxford dictionary, intelligence is the “ability to acquire and apply knowledge and skills” (Dictionary 2014). On the other hand, the American Association of Marketing (AMA) defines a customer as the “actual or prospective purchaser of products or service” (Association 2015). The AMA also clarifies the role of marketing as “the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large”. In the digital age, the emergence of big data along with analytic techniques has made a significant impact on the definition of marketing and customer. Building on these reflections, this paper proposes the updated definition as follows:

*Customer intelligence is the ability to acquire knowledge and skills from big data and business analytics and to apply to the process of creating, communicating, delivering, and co-creating in order to offer more values to actual or prospective customers of products or service.*

Compared to other definitions of customer intelligence (Anshari et al. 2019; Sivarajah et al. 2017; Zerbino et al. 2018), the proposed definition seems to be more appropriate and complete, which considers all the three dimensions of the service science approach: science, management, and engineering (Maglio and Spohrer 2013; Spohrer et al. 2007). The science dimension focuses on the process of creating, communicating, delivering, and co-creating offerings. The management dimension intensifies the values for customers. The engineering dimension demystifies knowledge and skills from big data and business analytics. The pre-eminence of the proposed definition is the emphasis on the value co-creation with customers. The word “exchanging” in the original definition of marketing is replaced by the word “co-creating” to highlight the importance of customers with various roles in the age of big data. The next section continues with the discussion on the importance of customer intelligence as service.

### **Importance of Customer Intelligence in the Big Data Era**

The intelligence-based era has opened up incredible opportunities for enterprises in taking advantage of customer intelligence from big data (Sivarajah et al. 2017). Nowadays, customer intelligence relies on big data and analytic techniques to gather information on markets and customers in a more efficient way (Chen et al. 2012; Liang and Liu 2018). Customer intelligence can be acquired from web intelligence by mining Internet Protocol searches, cookies and server logs (Chen et al. 2012). Through web pages and e-commerce sites, data on potential customers can be acquired through their reviews or feedback to uncover customers' needs. Other types of customer data from web intelligence are clickstream data logs that record customers' activities on visit frequency, viewed items, and visit time on a website (Chen et al. 2012; Park et al. 2012). In the age of big data, customer intelligence strongly reflects in the form of social intelligence through sentiment analysis and opinion mining on numerous customers' comments on social media and e-commerce sites. Social intelligence extracted from user-contributed data on social media can help enterprises in designing new service, implementing marketing strategies, managing customer relationships, improving service quality (Stone et al. 2017; Zerbino et al. 2018). The real-time property of social intelligence along with its subjectivity in a specific context is significantly believed to be more trustworthy, updated, and reliable. Consequently, customer intelligence from social media is strongly believed to help enterprises gain competitive advantages (Liang and Liu 2018).

### ***SBCI Model at the Service System level***

The service system level concerning the three dimensions – management, science, and engineering – involves the system configuration (Le Dinh and Pham 2012). This level collects and interprets data from

the network of service systems to support the service level in creating and applying customer intelligence. It also takes advantage of the input from the network to restructure the service system.

### **Management Dimension**

The management dimension aims at applying and co-creating customer intelligence to offer innovations and service. This dimension supports the service level in the reflection of customer intelligence applications, including customer relationship strategy and sustainable customer relationship (France and Ghose 2019; Siggelkow and Terwiesch 2019).

**Customer relationship strategy.** Customer intelligence is applied to the process of customer relationship management (CRM) to understand customers and maximize their values for enterprises (Anshari et al. 2019; Dam et al. 2019a). The management dimension highlights the prominence of CRM as a strategy in the age of big data. Accordingly, customer intelligence is applied to the four key processes in marketing strategies: i) *Customer identification* – how to target a customer segment that yields the most profit; ii) *Customer attraction* – how to attract the target segment by satisfying their needs; iii) *Customer retention* – how to develop and maintain a long-term relationship with customers; and iv) *Customer development* – how to maximize customer values for enterprises (France and Ghose 2019; Ngai et al. 2009).

**Sustainable customer relationships.** Sustainable customer relationship is defined as connected strategies in which enterprises are interconnected with customers 24/7 due to the application of technologies in the age of big data (Siggelkow and Terwiesch 2019). Maintaining a continuous connection with customers helps enterprises improve service quality as well as customer experience. Instead of waiting for customers to come, enterprises applied customer intelligence in simulating customer experience to anticipate customer concerns (Anshari et al. 2019; Zerbino et al. 2018). With the support of customer intelligence, sustainable customer relationship is also developed through the application of customer lifetime values in allocating resources and investment in building relationships relevant to each stage of the customer lifetime (Zerbino et al. 2018; Zhang et al. 2018).

### **Science Dimension**

The science dimension examines the different aspects of the organization of a customer intelligence system, including culture, staff engagement, communication, and policy.

**Customer-oriented culture.** Customer-oriented culture is considered as the most significant factor in the science dimension as it has such a significant impact on the business process, functions, people, leadership, and strategies (Dam et al. 2019b; Yohn 2018). It is defined as the beliefs and values of enterprises, which benefit customers (Tabrizi et al. 2019). To instill a customer-oriented culture as a universal value, enterprises can start with leaders who need to establish a clear vision and leadership so that every employee is aware of their job responsibility and missions of enterprises (Ramaswamy 2009).

**Staff engagement.** It is important to align leaders and employees with a customer-oriented mindset, especially employees who interact directly with customers (Tabrizi et al. 2019). Enterprises can consider hiring employees with customer orientation as a clear priority. Without a customer-oriented mindset, it is challenging for employees to understand customer needs, identifying the motive behind their needs, and providing advantageous solutions (Zerbino et al. 2018; Zhang et al. 2018). It also poses threats for them in engaging with a customer-oriented enterprise (Burrell 2018).

**Communication.** To promote communication, enterprises should allow every employee to access customer intelligence. Sharing customer intelligence across departments helps employees understand customers and gets updated on customer experience (Yohn 2018). Therefore, a flat hierarchy will facilitate the communication process as it eliminates the power distance among employees (Tabrizi et al. 2019).

**Policy.** To support the customer-oriented culture, enterprises should consider developing an appropriate incentive system (Rawson et al. 2013). It is important to take into account the discrepancy in the incentive policy between front-office and back-office employees. As back-office employees are not rewarded for the number of ticket sales, they are more likely to process sales data with mistakes (Burrell 2018; Yohn 2018).

## **Engineering Dimension**

The engineering dimension discusses the role of technologies in analyzing and storing data. Accordingly, enterprises have to adapt to state-of-the-art data analytics and information technology (IT) infrastructures in the age of big data, especially on how to enable access and make good use of stored customer intelligence not only for employees but also for customers in terms of value co-creation.

**Customer experience.** Customer experience catches the attention of researchers and practitioners in the application of customer intelligence as it reflects the extent of how customers engage with products (Hollebeek et al. 2019). Analyzing data to understand customer context is significant to manage customer experience and to reinvent customer journeys from pre-purchases to post-purchases (Rawson et al. 2013). Integrating and interpreting different sources of customer data help enterprises identify and prioritize key customer journeys (Dam et al. 2019b; Tabrizi et al. 2019).

**Business analytics.** Analytic techniques that involve descriptive, predictive, and prescriptive are implemented to uncover information, knowledge, and intelligence behind data (Bansal 2019; Sivarajah et al. 2017). Descriptive analytics is ideal to explore historical data and transforms them into insights through different techniques such as business reporting, descriptive statistics, and visualization (Sivarajah et al. 2017). As the characteristics of predictive analytics are to forecast future possibilities, it would make information more actionable (Janssen et al. 2017). Whereas, prescriptive analytics proposes the most optimal solutions for specific practical scenarios through simulation and optimization (Chen et al. 2012).

**IT infrastructure.** A repository supported by a data warehouse may be required to store customer data from different databases or servers to improve customer experience (Wamba et al. 2017). MySQL – an open-source relational database – is a popular choice for many enterprises to store customer data for executing SQL queries with low latency (Rao et al. 2018). In the age of big data, NoSQL or non-relational databases provide a great mechanism for handling extremely large data sets in volume, velocity, variety, and veracity (Chen et al. 2012). Other database infrastructures may include intranets, software, or cloud-based platforms (Chen et al. 2012; Wamba et al. 2017).

## ***SBCI Model at the Network of Service Systems Level***

The network of service systems functions as a chain of value co-creation in which customers can co-create to offer values to the service system (Spohrer et al. 2007). Customers are considered as an important resource with the significant impact on the service system. This level has the functionality as an input, which facilitates the restructure of the dimensions of science, management, and engineering of the service system. The next part of the paper discusses in detail the SBCI model at the network of service systems level, which clarifies the five key roles of customers as co-partners, co-ideators, co-designers, co-marketers, and co-experiencers (Frow et al. 2015; Ramaswamy and Ozcan 2018).

**Co-partners.** Customers can become co-partners in the network of service systems by offering their knowledge and intelligence and receiving benefits from enterprises. As customers develop skills and knowledge through experiencing products and service, their partnership yields positive outcomes for enterprises. For example, customers of a customer relationship management (CRM) software can become experts, who can create and sell add-on apps for the user community (Libert et al. 2015). Therefore, other customers can enjoy additional service offered by enterprises' customers. When customers can prove that they can offer values to enterprises as co-partners, they do not only receive profits but also have a chance to be recruited as experts or become business partners for the service system.

**Co-ideators.** As co-ideators, customers with product/service interests and passions often participate in the process of idea generation for the product/service conceptualization and improvement (Russo-Spena and Mele 2012). The interaction between an enterprise and customers facilitates improvement for existing products/service and gradually stimulates ideas for innovation. Besides, customers can evaluate ideas of others. For example, M&Ms customers can personalize their candies with different colors, text, and images (Libert et al. 2015). Starbucks launched the project called “My Starbucks Idea” allowing customers to express their ideas and discuss ideas from other customers (Russo-Spena and Mele 2012).

**Co-designers.** At a higher level, customers can involve more as co-designers in product/service development (Ramaswamy and Ozcan 2019). For the co-designing practice, customers are required to have a certain level of knowledge and skills (Russo-Spena and Mele 2012). To facilitate the customer co-

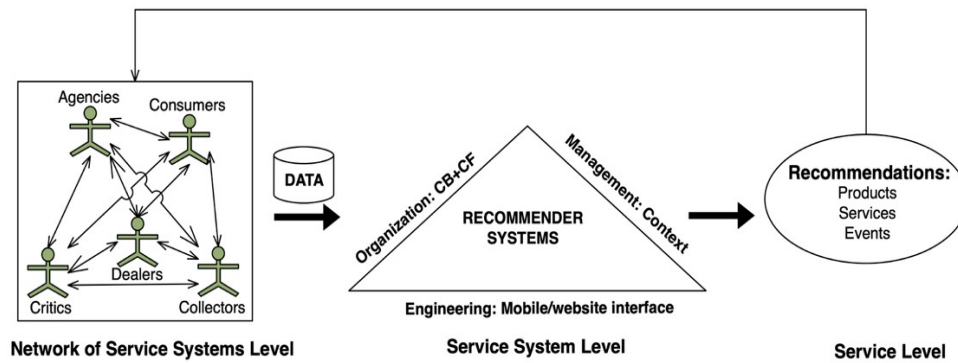
designing process, enterprises provide engagement platforms, which can be a website, user design tool kits, virtual prototyping tools, or a joint process (Frow et al. 2015; Nambisan 2010). Nikes exploits customers as co-designers by allowing them to design their running shoes through the website (Libert et al. 2015).

**Co-marketers.** Customers can involve as co-marketers in participating in activities related to testing and sharing experience with products/service (Frow et al. 2015). The primary goal of the co-marketing practice is to evaluate products/service and optimize customer experience (Russo-Spena and Mele 2012). Customers can also discover new ways or shortcuts for consumption; thus, product/service values can be leveraged (Nambisan 2010). Microsoft has created different online communities in which users share their experiences and support other users (Gibbert et al. 2002). From this co-creation approach, each Microsoft customer becomes a marketer through their participation in the online customer support service.

**Co-experiencers.** Customer co-experience aims at building the organizational structure and culture in which customers can experience as employees whereas employees can experience as customers (Leticia Santos-Vijande et al. 2013). From the customer-to-employee co-experience practice, customers have a chance to experience as real employees. In reality, Airbnb turns their customers into employees by providing the online database and service to support their customers to offer their housing for lease (Libert et al. 2015). Regarding the employee-to-customer co-experience practice, the first step to build a co-creation culture is to treat employees as customers by letting them complain about their job, their customers, and their colleagues (Burrell 2018). Listening to employees' complaints will enhance the engagement and cohesiveness with their enterprise. It also aligns each employee with a shared vision so that the value co-creation process can initially start among employees (Ramaswamy and Ozcan 2018).

## Illustrative Example

This section continues with an illustrative example extracted from a case study to demonstrate the SBCI model. Currently, we are working on the project developing a recommender system as a customer intelligence application for the cultural sector in Quebec, Canada. According to **Figure 2**, the SBCI model is applied to design the recommender system regarding the three levels: i) Service level: recommendations as services, ii) Service system level: the recommender system as a service system, and iii) Network of the service system: customers as co-experiencers and co-marketers.



**Figure 2. The Application of SBCI Model for the Cultural Sector**

### Service Level

At the service level, customer intelligence is applied in providing recommendation services on relevant cultural products, services, or events. The recommendation system collects and analyzes customer data to predict customer preferences and recommend customers with related choices. According to the *Canadian Framework for Culture Statistics*<sup>2</sup>, there are six main domains of cultural products/service: heritage and libraries, live performance, visual and applied arts, written and published works, audio-visual and interactive media, and sound recording. Considering different domains in the cultural sector, the system

<sup>2</sup> [www.stat.gouv.qc.ca/statistiques/culture/guide-cadre-culture\\_an.pdf](http://www.stat.gouv.qc.ca/statistiques/culture/guide-cadre-culture_an.pdf)



not only recommends relevant cultural contents in the same domain. The system also recommends related content in other domains. Cultural enterprises can improve their profits as the number of cultural products/service consumption increases. In addition, the mobile interface helps the system continuously connect with customers. Consequently, the quality of recommendations can also be improved through the constant collection and upgrade of customer data (for example: context-related data) into the system.

### ***Service System Level***

As illustrated in **Figure 2**, historical and current data from the network of service systems are interpreted and applied to the dimensions of science, management, and engineering of the recommender system for the cultural sector. The science dimension deals with the structure of the recommender system. Accordingly, the hybrid structure integrating the content-based (CB) and collaborating-filtering (CF) approach is chosen to develop the recommender system (Chen et al. 2012; Park et al. 2012). On the other hand, the management dimension provides more accurate recommendation services by considering the context of users. A user's context is a very broad concept and can be either physical (e.g.: a real location), social (e.g.: a social network such as Facebook), or emotional (an emotion, mood, or feeling of users). A context-aware recommender system will provide more personalized recommendations for users. In the dimension of engineering, the recommender system applies information technologies - for example, a mobile platform or a website - to support on-site recommendations while users are at cultural sites.

### ***Network of Service Systems Level***

The network of service systems level of the recommender system consists of customers. In the cultural sector, customers consist of a variety of actors, including cultural consumers (end-users), critics, dealers, culture agencies, merchandisers, and collectors (Colbert 2014). The wide range of customers forms the network of service systems with a vast amount of data. Various roles of customers as consumers, critics, and dealers, and so on co-create values for the service system. To be specific, the primary roles of customers in the network of service systems level, for the time being, can be labeled as co-experiencers and co-marketers for the recommender system. As co-experiencers, cultural consumers or end-users experience the system and contribute a significant amount of data through their comments, ratings, and interactions. On the other hand, critics and collectors take the lead as co-marketers, who are responsible for shaping the public taste and recommending cultural contents. For example, recommendations by well-known critics or collectors are likely to convince other customers to make a purchase.

## **Conclusion and Future Work**

The dominance of the service sector in the age of big data stimulates the need to take advantage of customer intelligence to offer optimal service to customers. Furthermore, the emergence of big data and business analytics has generated a vast amount of customer data and restructured the dimensions of science, management, and engineering within enterprises. This paper addresses those changes and the need for a new approach, which takes into account all the viewpoints of a customer intelligence application in order to co-create values with customers. Therefore, its objective is to propose a service-based model for customer intelligence, called Service-based Customer Intelligence (SBCI) model.

The result of the paper indicates the state-of-the-arts model, which is capable of creating, managing and amplifying values of customer intelligence in a coherent manner based on the service science perspective. The service level of the SBCI model offers the opportunities for enterprises to take advantages of customer intelligence from big data and business analytics. The service system level helps enterprises deal with different dimensions of science, management, and engineering. From the science dimension, enterprises will be able to adjust organizational structure, culture, business process, and people for sharing customer intelligence. The management dimension leverages values of customer intelligence to the service level. The engineering dimension examines the role of technologies as a means to exploit customer data. Finally, the network of service systems level facilitates the value co-creation process of customers as co-partners, co-ideators, co-designers, co-marketers, and co-experiencers.

In comparison with the related work, the majority of the customer co-creation process just focuses on the product/service development which is peripheral to the core business of enterprises (Libert et al. 2015). Through the SBCI model, customer intelligence from the network of co-creators will recur into the

dimensions of science, management, and engineering instead of producing one-off products/service. Furthermore, the SBCI model identifies various key concepts supporting the development and application of customer intelligence in the age of big data. Each concept can be a promising future research direction. Scholars can also modify these concepts to improve the SBCI model.

In terms of theoretical implications, the SBCI model can be a great source of reference for both researchers and practitioners. This is one of the first models that comprehensively covers the three dimensions of science, management, and engineering while coupling with customer value co-creation. The significant theoretical contribution is that customer intelligence generated from the network of value co-creation is applied to the service system level and the service level.

With regard to practical implications, the SBCI model can make important contributions for enterprises as customer intelligence may offer them certain competitive advantages to overcome the challenge in understanding consumer behaviors, estimating customer lifetime values, and optimizing customer experiences. Customer intelligence as the service level in the SBCI model is also fortified with innovations and strategies from the management dimension in the service system level. In addition, customer intelligence from the SBCI model is adjusted with changes from the revolution of big data. Therefore, it will help enterprises thrive in today's fierce competition. Furthermore, the SBCI model can serve as the starting point for enterprises to restructure and adapt to changes from the dimensions of science, management, and engineering in the age of big data. Through the model, enterprises will be able to co-create values with customers by transforming customer data into customer intelligence.

Being aware of further validation of the SBCI model as the limitation of the paper, we are currently working on experimenting with the model in other business sectors besides the cultural sector. The service system level of the SBCI model will also be tested with other smart service systems such as smart data platforms and conversational agents. Moreover, interrelationships in the network of service systems will be examined in future research. Researchers can follow up with other roles of customers in the network of service systems. Another research direction is a maturity model for implementing the SBCI model.

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