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Customer Knowledge Management In the Cloud Ecosystem

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Customer Knowledge Management in the Cloud Ecosystem

INTRODUCTION

The economic order of the twenty-first century is driven by knowledge based on the value of relationships (Galbreath, 2002) throughout the extended enterprise. Knowledge management (KM) and customer relationship management (CRM) have become cornerstones of value creation strategies in a market saturated with product offerings. CKM arises from synthesizing the knowledge management and customer relationship management processes, where customer knowledge is acquired through CRM operations and transformed into actionable knowledge insights through the KM process to enhance operations.

Alongside the advances in KM and CRM is the emergence of such business technologies as Big Data and Cloud Computing. Big Data refers to datasets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyse (McKinsey Global Institute, 2011), and is characterized by the datasets' high volume, velocity, variety, veracity and value. Big Data sources for customer knowledge include high volume CRM transactions, machine-to-machine communications, the Internet of Things (IoT), geospatial applications, social media, and the Web. Big Data utilizes massive scalable computing platforms that can handle the associated volume and speed, such as the Hadoop Distributed File System and MapReduce.

Depeige and Doyencourt (2015) describe the deployment of knowledge that involves a pull model based on consumer needs as well as real-time knowledge analytics and the on-demand delivery of knowledge as a service (KaaS). Cloud computing emerges as a model for on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction (Mell & Grance, 2011). Grolinger, Higashino, Tiwari, and Capretz (2013) noted the synergy between Big Data processing requirements and the availability and scalability of the cloud platform.

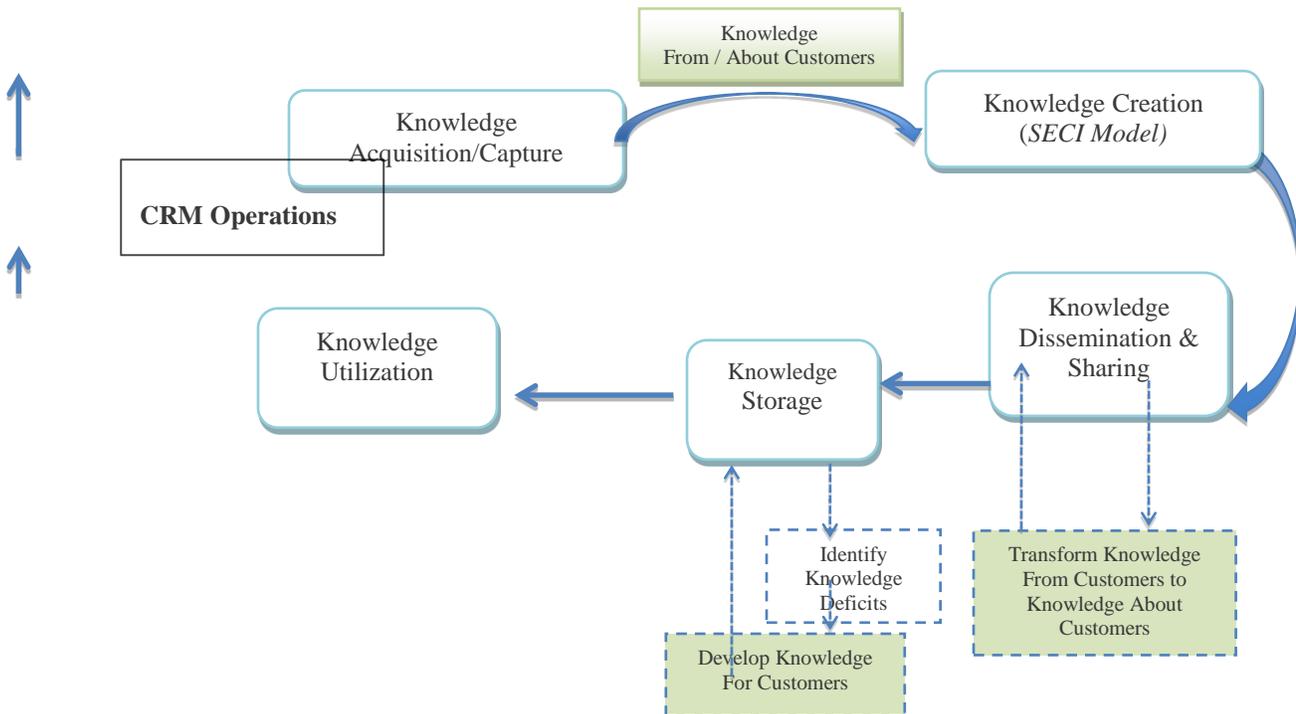
Research in each of the areas of CKM, Big Data and Cloud Computing has mostly taken place independently, and there is a lack of integration of these ideas addressing contemporary issues of customer knowledge management leveraging the advances in these technologies. This paper builds upon the work done in the areas of CRM, KM, Big Data and Cloud Computing. A conceptual framework that integrates the Big Data and Cloud platforms is presented to create actionable knowledge in support of the CKM processes of knowledge acquisition, creation, dissemination and sharing, storage, and utilization of customer knowledge across the extended enterprise, where knowledge is deployed as a service based on user demands anywhere, anytime, around the globe.

CUSTOMER KNOWLEDGE MANAGEMENT

Customer knowledge management refers to KM models in which customer knowledge is applied to support CRM processes (Gebert, Geib, Kolbe, and Riempp, 2002; Gebert, Geib, Kolbe, and

Brenner, 2003). Categories of customer knowledge include knowledge from customers, knowledge about customers, and knowledge for customers (Gibbert et al., 2002). Knowledge from customers is created through their experiences with the firm in product and service offerings and captured through their interactions across various touch points in CRM operations. Knowledge about customers acquired through customer interactions with the firm and external sources may include customer demographics, past purchasing patterns, and other behavioral characteristics. Knowledge for customers is created based on the needs of customers to know about the firm's products, services, and alliance partners. The CKM process consists of knowledge acquisition, creation, sharing, storage, and utilization. Knowledge from and about customers is captured from knowledge sources that include CRM operations, third parties and Big Data sources such as social media and the IoT. The acquired knowledge goes through the socialization, externalization, combination, and internalization (SECI) knowledge creation cycle (Nonaka & Takeuchi, 1995) where tacit and explicit knowledge are created and transformed in an organization. Knowledge is disseminated and shared in the organization. The firm identifies the knowledge deficits, which measure what customers should know verses what customers do know, and then creates the knowledge for customers. Customer knowledge is represented and stored. It is utilized to enhance CRM operations. Figure 1 illustrates the CKM process.

Figure 1: The CKM Process.



BIG DATA KNOWLEDGE MANAGEMENT

Big Data refers to datasets whose size is beyond the storage and processing capability of prevalent technology of the time. The Big Data phenomenon is facilitated by the trends of data growth in volume and variety, growth in processing power, and the availability of open source technology and commodity hardware (Minelli, Chambers, and Dhiraj, 2013). Big Data is characterized by its volume, velocity, variety, veracity, and value. It has become a new knowledge source for CKM, which includes high volume CRM transactions, Web data, call center transcripts, online apps, software as a service (SaaS) applications, as well as recent trends in social media, the IoT, and geospatial data.

Social media has become a source of customer knowledge as customer interactions proliferated via social networks such as Facebook, Twitter, Google+, LinkedIn, and others. Social media contributes to Big Data in volume, velocity and variety. According to Internet Live Stats (2018), around 6,000 tweets are sent every second, which corresponds to 500 million tweets per day. As of the first quarter of 2018, Facebook had 2.19 billion monthly active users (Statista, 2018a). CRM has evolved from a strategy focused on customer transactions to social CRM, which is a strategy based on creating engagements between customers and the company (Faase, Helms, and Spruit, 2011). Social customers are described by their use of social software characterized by permanent connectivity, mobility, being multichannel, and the progress of the IoT (Orenga-Roglá & Chalmeta, 2016). CRM operations in marketing, sales, and service are utilizing social media as channels for monitoring, communication, engagement, listening, and providing responses. Knowledge from customers can be captured via social media where customers express their experiences about a firm's product and service offerings. Customer profiles in social media provide knowledge about customers. Knowledge for customers can be disseminated via social engagements with customers.

Another Big Data source for customer knowledge is machine-to-machine (M2M) communication between devices. The IoT is a type of device communication using IP networks where data delivery is relayed through a middle layer hosted in the cloud or a middleware platform (Hassel, 2017; Polsonetti, 2014). Polsonetti (2014) contended that integration of device and sensor data with Big Data, analytics, and other enterprise applications is a core concept behind the emerging IoT. Gartner (2014) described the IoT as the fifth driver of CRM after social, mobile, Big Data, and the cloud. According to Statista (2018b), the installed base of IoT devices is forecast to grow to almost 31 billion worldwide in 2020.

M2M and IoT applications include real-time location tracking, built-in diagnostics for automobiles, real-time surveillance, process monitoring and control in manufacturing, and telemedical real-time monitoring of patients. Real-time patient monitoring devices that include implants and wearable devices are used to collect a wide range of patient data, which are transmitted to medical providers. Knowledge for patients such as diagnosis and alerts can be created and disseminated. Marketers are engaging customers in real-time location-based services. Knowledge from and about customers such as buying patterns can be captured and knowledge for customers such as price comparisons can be provided while customers are shopping.

Spatial or geospatial data describe locations of boundaries and features of the earth via coordinates and topologies. Through GPS, satellites, cell towers and the IoT, geospatial technologies can now track locations of people and objects in very precise ways that were not possible before (Woodie, 2015). OGC (2013) described that geospatial data such as Big Data is enabled by real-time sensor observations, fast geometric processing of vector geodata, and big processing through cloud computing and analytics. Advances in imagery and remote sensing technologies find many applications in terrestrial, hydrological, and atmospheric environments in tracking, monitoring, and real-time event detection (Aina, 2012), and have become significant sources of big knowledge. Geospatial applications in CRM include real-time comparison-shopping, real-time location-based service, and marketing. Knowledge from and about customers may include travel time, location, and associated activities such as purchases and entertainment choices. Tully (2013) described the potential use of advanced robots moving cargo across the globe and the delivery of packages to customers' doorsteps in autonomous aircraft. Recent advances in self-driving cars further demonstrate the viability of geospatial technologies in combination with machine vision and learning, sensors, and robotics, in providing value-added service to customers. Knowledge for customers can be provided in real time, such as control guidance of traffic and emergency situations in autonomous driving.

CLOUD COMPUTING

Cloud computing emerged in the last decade as a computing platform that uses advances in information and communication technologies (ICT) such as virtualization and grid computing (Sultan, 2013), delivering services through software and virtual hardware provisioned by cloud providers according to user demands and requirements. Cloud services include SaaS, infrastructure as a service (IaaS) and platform as a service (PaaS). Cloud computing provides huge economic benefits to organizations by minimizing the need for expensive software and hardware, upgrades, and maintenance. Sharif (2010) argued that ICT consumption behaviors are the main factors that will drive the cloud-computing environment. The cloud platform allows KM to deliver knowledge resources whenever users need them, shifting from a push-based delivery model to a pull-based service model. KaaS can be conceived as an on-demand knowledge store, capable of searching, analyzing, and restructuring its knowledge sources (Rustam & Van der Weide, 2014). Low, Chen, and Wu (2011) suggested that the essence of the cloud-computing paradigm is the idea that users will be able to access any application on demand, wherever the users are located in the world. Depeige and Doyencourt (2015) described deployment of KaaS involving the monitoring of the knowledge pushed to the market as well as the market itself so that the creation of new knowledge can be adequately aligned with the knowledge needs of customers. Cloud computing offers tangible benefits in terms of knowledge services delivery such as the continuous and personalized delivery of knowledge assets over the Web, offering flexibility and scalability through a "pay-as-you-go" service orientation (Sultan, 2013). Collaboration as a means of knowledge creation can leverage the cloud platform. Delic and Riley (2009) envisioned that the cloud-computing environment was first an opportunity for massive collaboration among people, while the future of cloud computing may involve the operation of intelligent virtual objects and devices that would collaborate with people. The authors described how the cloud infrastructure delivers the potential of having a gigantic number of devices that are interconnected, fostering the emergence of brand-new applications that could stimulate the development and availability of innovative solutions and

applications. Depeige and Doyencourt (2015) further described that the fast rise of cloud computing solutions has certain implications in terms of knowledge lifecycle, the creation of knowledge, the sharing of knowledge to internal and external audiences, and its reusability to meet the needs of organizations and beneficiaries of new KM services.

BIG DATA CKM IN THE CLOUD ECOSYSTEM

Big Data processing requires a massive scalable computing platform that can handle the associated volume and speed. The costs of building on-premise data centers to meet the growth needs of Big Data could be prohibitive. Minelli et al. (2013) described the driving need for a new value proposition that is manifesting in the cloud model. Thiagarajan (2016) described the compelling reasons for Big Data analytics to be deployed in the cloud. They include the shifting of IT spending to line-of-business functions, increasing organization comfort with the cloud, particularly with data integration and security, delivering business insights quickly, and addressing the skills shortages in Big Data. Agrawal (2013) suggested that building an M2M analytics solution using Big Data will be more of an on-demand and flexible capacity-provisioning requirement, where the cloud becomes the natural choice. Cloud computing provides a highly scalable and on-demand platform for Big Data CKM.

The cloud model for CKM provides a real-time, on-demand, knowledge service platform that supports the CKM process. During knowledge capture, knowledge from and about customers is identified. It goes through the knowledge creation activities of the SECI cycle within the knowledge user community that includes internal and external people and machines. Customer knowledge is disseminated and shared within the knowledge user community. Disseminated and shared knowledge may feed back to the SECI cycle in the creation of new knowledge. Knowledge for customers is created based on identified knowledge deficits to satisfy customer needs. Knowledge services provide solutions to knowledge issues that utilize reusable knowledge from the knowledge base, which stores knowledge created from the knowledge creation cycle and knowledge analytics. The cloud provides the platform for sharing, connectivity, communication, collaboration, and visualization for the knowledge user community. Actionable knowledge is utilized to enhance customer operations.

A Conceptual Model for CKM Utilizing Big Data and the Cloud

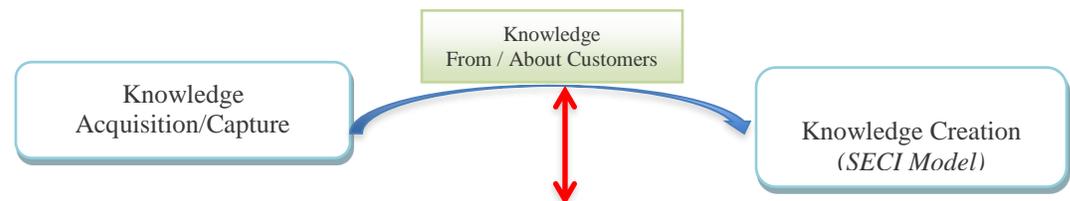
Figure 2 provides a conceptual framework for Big Data customer knowledge management in the cloud ecosystem. It illustrates the knowledge transformation of Big Data into actionable insight through the cloud. Knowledge sources include traditional transactional data and Big Data sources. Traditional data sources are extracted, transformed, and loaded into a data warehouse where BI analytical processing can be performed. An implication of this paper is the addition of knowledge sources to traditional operational transaction data to include Big Data that has high volume, velocity, and variety. The growth of Big Data can be attributed to the IoT, geospatial data, social media, and Web data. Big Data requires a parallel processing platform that is highly scalable. Big Data is captured, stored, and processed in platforms such as Apache Hadoop, and NoSQL databases such as Hbase. Big Data goes through contextualized knowledge analytics using technologies such as semantic Web, machine learning, and data and text mining techniques, which allow knowledge discovery and identification to draw insights on knowledge domains (Depeige

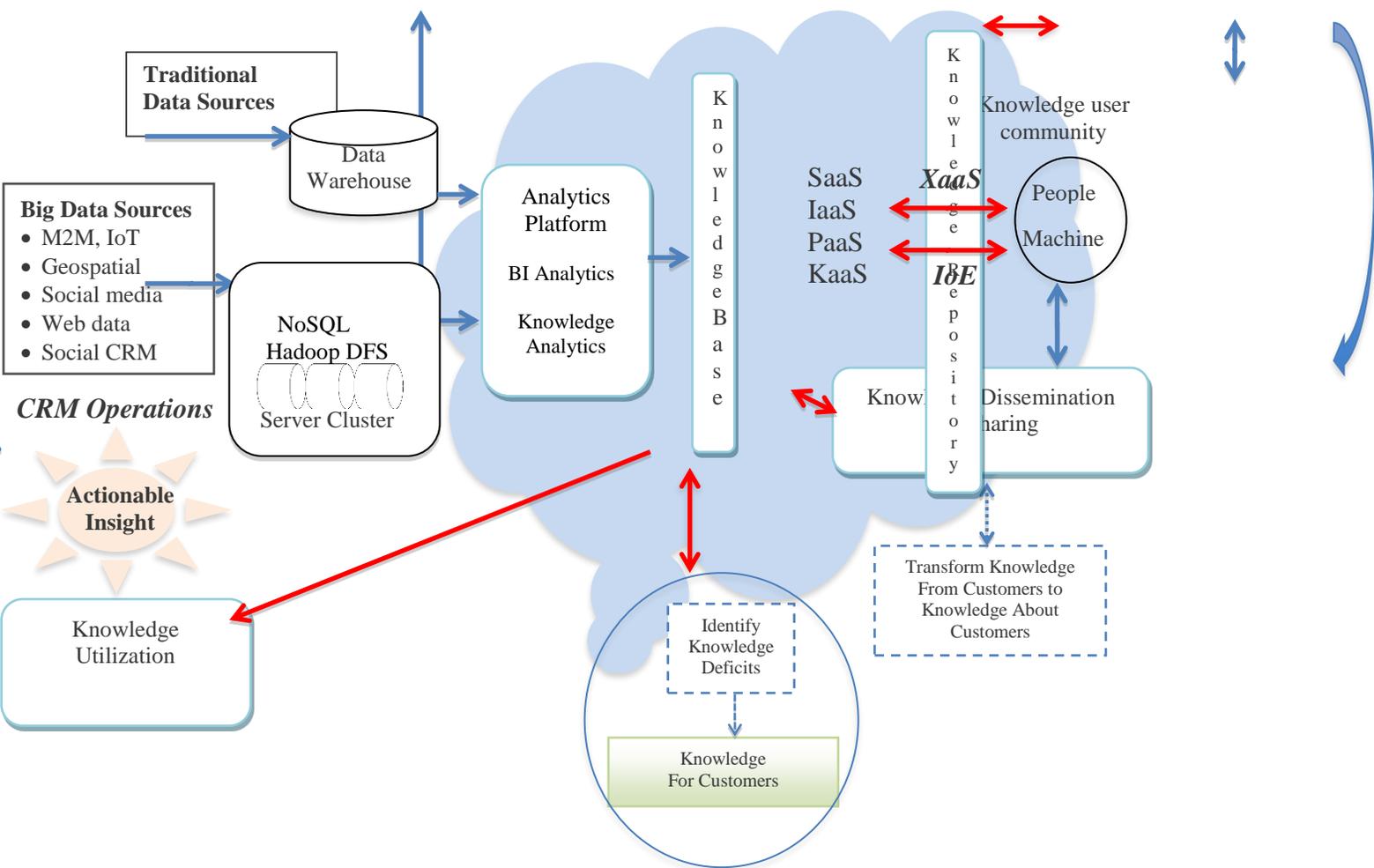
& Doyencourt, 2015). Knowledge analytics is business analytics applied to the domain of organizational knowledge. It combines multiple data sources to create a richer picture of how knowledge can affect a business process to improve performance and human productivity.

The cloud provides the platform connecting Big Data sources to different components of CKM in acquisition, creation, dissemination, storage, and utilization of knowledge. Acquired knowledge goes through the SECI cycle (Nonaka and Takeuchi, 1995), and then knowledge is disseminated and shared within the knowledge user community of people and machines, which may be further processed for new knowledge creation in the SECI model. Knowledge can be stored in machine-readable and human-readable formats in knowledge bases and knowledge repositories, respectively. A knowledge base consists of facts and rules (Turban, Sharda, and Delen, 2011) and can be used with artificial intelligence systems such as expert systems where an inference engine is used for reasoning about information in the knowledge base. Knowledge can also be stored in human-readable formats in online computer-based storehouses of expertise, knowledge, experiences, and documentation about a particular domain of expertise (Liebowitz and Beckman, 1998). Technologies supporting knowledge capture, creation, and sharing include intelligent agents, tools for knowledge discovery and collaboration, groupware, enterprise knowledge portals, electronic document and content management systems, knowledge harvesting tools, search engines, and knowledge management suites (Turban et al., 2011). Knowledge is utilized through knowledge retrieval systems for human processing and artificial intelligence software for machine processing to support decision making in CKM operations. Through SaaS, IaaS and PaaS the cloud provides KaaS, thus supporting the CKM knowledge cycle.

The CKM model (Figure 2) describes the knowledge user community of people and machines in the knowledge cycle. Interaction within the community is facilitated by the emerging technology of the IoE. IoE expands on the concept of the “Internet of Things” in that it connects not just physical devices but literally everything by placing them all on the network, leading to automation and advanced “smart” applications (Pickett, 2015). It provides the connectivity platform for knowledge creation, dissemination, and sharing for CKM in the knowledge user community.

Figure 2: Big Data CKM in the Cloud Ecosystem.





BUSINESS CASES: THE DEMISE OF SEARS AND THE RISE OF WALMART

The Downfall of Sears

On October 15, 2018, Rachel Siegel reported “Sears, the one-time titan of American retail, filed for bankruptcy.” (*The Washington Post*). Long before Kmart and Sears merged to form Sears Holdings Corporation in 2004, Kmart suffered from supply chain issues, could not execute innovative IT efforts, and failed to deliver a quality customer service experience (*Information Week*, 2002; Lewis, 2003). These problems were not resolved by the merger with Sears. The demise of Sears could be attributed to many factors that include failed strategies in branding, expansion outside its core, controversial leadership, outdated stores, heavy debts, and online competition. A major contributor to Sears’ failure was a disconnection from its customer base. Sears lacked personalized experience and connectivity with its customers, failed to understand consumers, did not successfully engage customers, and failed to adapt to changing consumer tastes (Billups, 2011; Mourdoukoutas, 2015; Ritter, 2017; Milke, 2017). Sears could have benefited from a pull-based, on-demand, cloud-based Big Data customer knowledge management model proposed in this paper to better sense and predict customer needs and to provide actionable responses. The model provides a platform for connectivity, communication, and collaboration that encourage customer engagement, which was apparently lacking at Sears.

The Rise of Walmart

In contrast to Sears’ downfall, Walmart’s success leverages a customer-focused, technology-driven strategy. Walmart’s world-class supply chain management has been cited in many studies as an attribute of its success. Appticity (2013) described Walmart’s focus on controlling costs by mastering its supply chain in innovative ways. These included sophisticated, pioneering use of product offerings, monitoring consumer behavior, employing sales performance tracking technology, and the wide use of customer behavior data that the company effectively collects and analyzes. Walmart uses its powerful tracking data analysis tools to ensure that it buys just the right amount of merchandise to meet accurately forecasted demand. Walmart’s Retail Link® is a comprehensive tool used to pull point-of-sale (POS) data (Eighteen Knowledge Group, 2017). Suppliers receive real-time POS data that detect depletion of inventory at Walmart and can continuously replenish based on actual customer demand, increasing customer satisfaction.

Walmart Innovates with Big Data and Analytics. Econocom (2016) described Walmart as a pioneer in Big Data that has been developing a number of tools at its @WalmartLabs and recently set up a Data Café (“Collaborative Analytics Facilities for Enterprise”). Walmart uses Big Data to identify customers’ expectations. With over 2.5 petabytes of data analyzed an hour, it anticipates the needs of its 250 million weekly customers (Econocom, 2016). Walmart is using Big Data to get a real-time view of workflow in its pharmacies, distribution centers, and through its network of stores and e-commerce businesses (Souza, 2017). Walmart has been using technologies such as RFID in tracking its merchandise and expediting checkout. With the emergence of the IoT as a source for Big Data and a driver for CRM, Walmart is expanding its investment in M2M technologies such as biometric sensors in shopping carts. In February 2018, Walmart filed a patent application for a biometric feedback cart handle, which, based on biometric data received, can alert

store employees that a customer may need assistance (Vasgaard et al., 2018). Walmart is employing social media to engage customers and provide insight into how customers from individual markets are responding to specific promotions and developing the ability to create localized messages that seize on that insight (Cantor, 2011). It integrated a "My Local Walmart" function into its Facebook presence, which helped put the individual establishments, not just the overall brand, in the direct line of sight of its 9.5 million Facebook followers (Cantor, 2011). Walmart employs artificial intelligence to advance its analytics and enhance customer relationships. It is launching an Intelligent Retail Lab inside one of its stores in Levittown, New York, to test both associate and customer experiences and to better identify when stock is running low on particular items so that it can proactively replenish the stock (Dickey, 2018).

Walmart Goes to the Cloud. Looking to bolster its anytime, anywhere online shopping experience for customers, Walmart has picked up two startups in the cloud computing realm, cloud computing newcomer OneOps and the software development shop Tasty Labs, acquisitions which enable it to "significantly accelerate" its PaaS and Private Cloud Infrastructure as a Service (IaaS) strategies and create a best-in-class global e-commerce platform to power "anytime, anywhere" shopping for its customers (Burke, 2013). Walmart is building its own internal cloud network to grab a bigger slice of online shopping, leveraging the use of cloud-powered Big Data to drive digital sales (Bose, 2018). On another front for cloud computing, Walmart is establishing a strategic partnership with Microsoft that allows Walmart to offer a full range of Microsoft cloud solutions to further accelerate its digital transformation in retail, empower its associates worldwide, and make shopping faster and easier for millions of customers around the world (Walmart, 2018).

Knowledge Management and Customer Relationship Management at Walmart. Knowledge management is deeply rooted in Walmart's business culture, particularly in the arena of human resource management. Seo-Kisumu (2011) described the effective knowledge management program at Walmart that has enabled it to retain its competitive advantage, to focus its strategic business operations on cutting operational costs, and to build up value for its shareholders. The chain's effective and reliable knowledge management skills have enhanced efficiency in service delivery and customer care and promoted success in market competition (Seo-Kisumu, 2011). The customer relationship is ingrained in Walmart's corporate culture. Everything Walmart does, including store design, bar coding, lighting, and employing greeters, is implemented only after carefully considering the impact on the customer (Shetty, 2011); nothing is done without the guarantee that it benefits the customer in some way. Walmart has been able to build loyalty and trust among its customers, unparalleled among other retail giants (Shetty, 2011).

Lessons Learned

The demise of Sears was attributed to many factors. Among the contributors: the inability to know and predict customer needs, the failure to connect to its customers, and a failure in its attempt to leverage state-of-the-art technologies in its operations. Walmart, on the other hand, was able to exploit critical success factors such as innovating with Big Data and analytics, cloud computing, and knowledge and customer relationship management in its business strategy. Walmart successfully exploits the model presented in this paper of CKM driven by Big Data and Cloud Computing.

CONCLUSIONS

The present-day economy is characterized by knowledge and relationships that are critical ingredients for the value creation of competitive business strategies. Customer knowledge management, which synthesizes KM and CRM, exploits the knowledge and relationships assets in an organization. Traditional KM systems tend to be standalone and internally focused. Recent developments in social networks, Big Data, and Cloud Computing are changing the dynamics of KM to a demand driven service platform for internal and external user communities across the extended enterprise.

This paper examines the converging theme of CKM in the era of Big Data and Cloud Computing. Big Data has emerged as a new knowledge source for CKM. The Big Data platform consists of massively parallel, distributed storage and processing capability such as Apache Hadoop. Big Data is transformed via knowledge analytics and through the knowledge creation cycle into knowledge, represented and stored in a knowledge base to be reused in support of the CKM process. The cloud provides an on-demand platform to deliver software, infrastructure, platform, and knowledge as services. It provides the capability for sharing, connectivity, communication, collaboration and visualization for the knowledge user community. A conceptual model for CKM utilizing the Big Data and Cloud platforms is presented. The model provides a roadmap for the changing paradigm of CKM to an external, dynamic, and collaborative focus by exploiting the wealth of Big Data knowledge sources and the delivery of KaaS based on user demands through the cloud, accessible anywhere and anytime around the globe.

Previous research in CKM focused on traditional knowledge sources and on-premise computing resources to support the knowledge cycle, utilizing a push delivery model. The contribution of this paper is twofold. First, it creates new knowledge of CKM utilizing the Big Data and Cloud platforms. It expands the knowledge user community to include machines and devices through the connectivity provided by the Internet of Things. Second, it demonstrates significant industrial implications as illustrated by the business cases of Sears and Walmart, relating the success and failure of modern enterprises to the ability to leverage customer knowledge, customer relationships, and the advances in Big Data and Cloud Computing.

From a management perspective, companies should adopt a pull-based customer relationship and knowledge management strategy driven by customer needs, which may have significant implications to its organizational culture, structure, and process. As an outsourcing model, managing the public cloud deployment requires effective management of service level agreements with cloud providers. Other management issues involve managing the relationship, including finance, security, and trust with a third party who now has control of a firm's important information asset.

It is not the intent of this paper to promote any vendor specific offerings. Suffice it to say that many products and services are available and the market is expanding to support Big Data analytics, cloud-based knowledge management, customer relationship management, and knowledge analytics. This paper provides the framework for adopting suitable technologies in the deployment of CKM. Future research can focus on implementation issues, such as creating an integrated platform utilizing available and emerging technologies supporting cloud-based CKM, migration from on-premise to cloud-based platforms, integration of on-premise and multi-clouds, security, and the further exploitation of IoT to the IoE and everything as a service (XaaS) in cloud computing.

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