Knowledge Management and the Pandemic

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Abstract

The Covid-19 pandemic has called for an effective mechanism for the creation and dissemination of knowledge. Accurate and trustworthy knowledge is needed for government, business and institutions to formulate strategies and implement solutions in containing the spread of the disease and fighting problems that confront the society caused by the pandemic. This paper explores the impact of the pandemic in business, society, and technology. It points out the dark side of social media in the spread of mis/dis-information. It emphasizes an efficacious remedy via a credible knowledge management system. A conceptual model of knowledge management is presented that leverages technologies in Big Data and cloud computing, addressing the problems arising from the Covid-19 pandemic. It posits a pathway of digital transformation for organizations to cope with the current situations and beyond.

Keywords: Covid-19, pandemic, Big Data, cloud computing, digital transformation

1. Introduction

The World Health Organization in early 2020 identified SARS-CoV-2 as a new type of coronavirus. COVID-19is a disease caused by SARS-CoV-2 that can trigger a respiratory tract infection. It was first detected in Wuhan, China in late 2019 and has set off a global pandemic (Bhargava 2020, Pathak 2020). According to Johns Hopkins (2020), as of December 30, 2020, there are over 82 million global cases with 1.8 million global deaths; United States accounts for closed to 20 million cases with over 338 thousand deaths. On December 14, 2020, the first vaccine was administered to a critical care nurse in the United States (Levenson 2020). However, it will be months before the general public will be inoculated. In the meantime, new infections and deaths surge to record highs. To add to the uncertainty of an imminent end to the pandemic, a new strain of the virus was discovered in the UK with a first confirmed case in the US reported by the Associated Press (2020) on December 29.

This paper examines the critical role of technology via knowledge management, Big Data, cloud computing and digital transformation in handling the pandemic. A conceptual model of knowledge management utilizing Big Data and cloud computing is presented. The paper is organized as followed. Section 2 discusses the impact of the pandemic to business, society and technology. Section 3 examines the role of knowledge management during the pandemic. Section 4 presents a conceptual model tying the elements of cloud computing, Big Data, knowledge management and digital transformation in the approach to address the COVID-19 pandemic.

2. Impact of the Pandemic

2.1. Business Impact

For a little less than a year, the pandemic has brought significant impacts to society, many of which have permanent effects to our way of life. The pandemic affects businesses in multiple dimensions in no small ways; some with irreversible damages. Diminished revenue forces many industries to close or reduce operations, lay-off employees, or completely change their business models in order to survive. These industries include but not limited to retail, restaurants, travel, childcare, gyms, cruise ships, hotels and convention halls. The US suffered significant employment loss during the pandemic. Unemployment claims peaked in late March 2020 to nearly 7 million and remained higher than in any previous recession. Cambon (2020) reported on November 25, 2020 that "Jobless claims rose for the second straight week, to 778,000, a sign the nationwide surge in virus cases was starting to weigh on the labor-market recovery."

Companies are shifting to remote work; many schools and universities have migrated to online learning. Travel bans have prohibited the movements of people across the world. Urbanites are moving to the suburbs in search of more spacious living quarters to accommodate remote work and online learning. Aging people are moving away from nursing home to find other forms of age-segregated housing. Remote work is also trending in healthcare as many medical appointments are moving online. Telemedicine helps provide the necessary care to patients while minimizing the transmission risk of COVID-19.

2.2. Social Impact

Society as a whole has adjusted to new norms including mask wearing and social distancing. The social divide is exacerbated in many ways between the haves and have-nots in wealth, technology, healthcare, information and digital access. According to USAFacts (2020), 4.4 million households with students still lack consistent access to a computer and 3.7 million lack internet access for online learning during the pandemic. East & Marcus (2020) discussed the disparities in access to healthcare during a pandemic including COVID-19. It pointed out that immigrants, especially non-citizens, are less likely to be insured than natives; and that the gap in insurance can lead to worse health among non-citizens, It can create negative public health consequences for the general population in the setting such as COVID-19.

The pandemic has overwhelmed the medical capacity due to insufficiency of medical staff, hospital beds, intensive care units and equipment. Non-urgent surgeries are delayed. A regular visit to the doctors' office may not occur or may take place online. There are rising mental problems among the overstressed healthcare professionals and people in isolation. According to CDC(2020), "During June 24–30, 2020, U.S. adults reported considerably elevated adverse mental health conditions associated with COVID-19. Younger adults, racial/ethnic minorities, essential workers, and unpaid adult caregivers reported having experienced disproportionately worse mental health outcomes, increased substance use, and elevated suicidal ideation."

Another social impact of the pandemic is hunger, a rare phenomenon in the wealthiest nation in the world. Reported in Llobrera (2020), according to the Center on Budget and Policy Priorities from Census Bureau's Household Pulse Survey, "As Thanksgiving approaches amidst a pandemic-driven economic crisis, just 44 percent of households with children are "very confident" that they can afford needed food over the next four weeks - and about 10 percent, or 3.5 million households, are "not at all confident." This represents 5.6 million households with children struggling to put enough food on the table in the past seven days. Bowden (2020) reported that Americans are lining up in historic numbers at food banks across the country ahead of Thanksgiving this year as the COVID-19 pandemic exacerbates levels of food insecurity for millions of people.

2.3. Technology Impact

The pandemic has accelerated the march to a digital world "as retailers learn to operate without stores, business travelers without airplanes, and workers without offices; much of what started out as a temporary expedient is likely to become permanent" (Ip 2020). It articulates that "In many ways, digitization is simply the next chapter of a process under way for a century: the dematerialization of the economy."Old business models are adapting, and new ones emerge. The e-commerce platform is becoming an enabler for the digital transformation in many industries. Technology enabled the virtual experience for consumers without physical interactions. Virtual tours allow the showing of houses by sellers leading to the online closing activities. Online car sales create a virtual experience where customers can view a 3-D demo and complete the transaction online, and have the car shipped to a home or a vending machine for pickup (Ip 2020).

For many businesses like retailers and restaurants, the capability to migrate to e-commerce is critical to survival during the pandemic. Mobile devices also emerge as essential to business operations, like allowing customers order food with smartphones. With limited family visits during the pandemic, technology enables the older population to engage with tablets and smartphones, and communication platform like Zoom. Tilley (2020) reported that Zoom has grown to more than 300 million daily active participants from around 10 million before the pandemic; Microsoft's Teams, grew from 32 million daily active users at the beginning of the pandemic in March to more than 115 million in October 2020.

Sadly, many COVID patients died in isolation in the hospital and their last connection to the loved ones are through video conferencing via technologies such as Facetime and Zoom. Collaborative communication platforms proliferate during the pandemic to accommodate remote work and online education. Telehealth, including telemedicine, is becoming an alternative to accommodate patients who may skip appointments due to fear of infection at the medical facilities. The pandemic has accelerated the transformation to cloud computing underscored by the need for scalability, security, reliability, and cost-effectiveness of off-premise technology services in a virtual environment (Pwc 2020).

Artificial intelligence (AI) refers to the ability of a computer to exhibit human intelligence and carry out tasks commonly associated with intelligent beings. Dananjayan and Raj (2020) describe examples of AI used to battle the COVID-19 pandemic. They include early outbreak warning systems that spotted COVID-19, diagnostic toolspredictingsurvivalratesofCOVID-19infectedpatients, and AI-based computer vision camera systems that scan crowds for COVID-19 symptoms. In some countries like China and Russia, mobile devices and facial recognition systems are being used for domestic surveillance to spot the spread of the virus and control the movement of people to prevent further spread (Corera 2020). Smartphone technology also plays key roles during the pandemic in disseminating updated information about COVID-19 and extending telemedicine (Iyengar et al. 2020).

2.4. Misinformation and Disinformation

Misinformation refers to false information that is spread unintentionally whereas disinformation refers to intentionally disseminating false information. Both types of misrepresentation are prevalent during the pandemic. Simpson & Conner (2020) described that, "The uncertainty surrounding the coronavirus, paired with intense global demand for information, created a perfect storm of speculation, conspiracy, and sharing of false or even harmful information." It further suggested that the coronavirus misinformation is prevalent on social media exacerbating the spread of false or misleading narratives. Tagliabue et al. (2020) stated that due to the rapid evolution of the COVID-19 pandemic, "Doctors must provide the public only with evidence-based information in a simple and shared way in order to avoid misinterpretation and misunderstanding." It further indicated the need of better coordination between the medical community, governments, and the mass media to avoid the spread of disinformation through different channels, and thereby, limiting the dissemination of fake news.

Hemsley et al. (2020) discussed the dark side of social media in the exploitation of misinformation. Simpson and Conner (2020) indicated the health risk during the coronavirus was due to the prevalence of disinformation and misinformation on social media platforms. It further suggested a few steps in order to mitigate COVID-19 mis/disinformation that include elevating authoritative public health sources, fundamentally changing both the user-facing front ends and the algorithmically powered back ends, and regulatory changes and structural reckoning with the fundamentally predatory elements.

3. Knowledge Management in the Pandemic

The pandemic accentuates the need for better and timely knowledge management to identify the onset of COVID-19 and to coordinate tracking and worldwide responses. The timely clinical knowledge helps identify best practices, reduce the length of hospital stay and deaths. It provides a counter measure against disinformation, domestic or foreign. It facilitates the capability of anticipating the social needs in fighting current and future threats. It provides the means by which society can adjust to the new normal such as remote work, online leaning, e-commerce, and digital transformation.

Simone (2020) described that remote workers now make up 51%-75% of the workforce. It indicated how companies are currently approaching digital transformation and knowledge management to meet the demands of remote work, business forecasts and changing business models. Wells (2002) indicated the greater use of cloud services, accelerated digital transformation, and a stronger appreciation for knowledge management among the key changes. It has become more critical for a huge remote workforce across geographic and temporal boundaries to source knowledge in a timely manner. Knowledge management plays a critical role in delivering customer service during the pandemic as physical contact centers are replaced by different real-time channels such as cloud-based knowledge-as-a-service. It further describes the embrace of AI technologies and digital transformation. It quoted a recent remark by Microsoft's Satya Nadella saying that "2 years of digital transformation has happened in 2 months."

3.1. Knowledge Management

Knowledge has become a critical asset and intellectual capital that can differentiate an organization's competitive advantage in the new economic order driven by knowledge based on the value of relationships (Galbreath 2002) throughout the inter-organization network. Organizations are trying to institutionalize individual expertise so they can be retained and reused at the organizational level. Knowledge management is a business and technology strategy that facilitates the process of capturing, creating, sharing, and utilization of knowledge. Nonaka and Takeuchi (1995) described a knowledge creation model that consists of socialization, externalization, combination and internalization. Socialization and internalization are involved in the creation of tacit knowledge respectively from tacit and explicit knowledge. Externalization and combination are involved in the creation of explicit knowledge respectively from tacit and explicit knowledge. In the following, we will exploit the state-of-the-art deployment of knowledge management during the pandemic via the advances of cloud computing, Big Data, and digital transformation.

3.2. Big Data

Big Data are datasets whose size is beyond the ability of typical database software tools to capture, store, manage, and analyze (Manyika et al. 2011). Big Data is characterized by its volume, velocity, variety, veracity and value. Big knowledge management refers to knowledge management with Big Data sources, which include high volume enterprise transactions, social media, machine-to-machine communications, the Internet-of-Things, Web data, spatial

data, healthcare data, industry and government reports. Big Data analytics refers to advanced analytics that include predictive and prescriptive analytics to provide foresights and best outcomes.

Haleem et al. (2020) indicated that Big Data technology is used to provide the storage of large volume of data and the analytics for insights and control of the virus. It described Big Data applications applicable to the pandemic. They include the capability of storing the complete medical history of all patients in the identification of infected cases, using travel history to analyze risk, keeping records of symptoms, analyzing and identifying persons who can be infected, tracking and monitoring the movement of people, fast-tracking the development of new medicines and equipment for current and future medicinal needs.

Healthcare data bears the characteristics of Big Data that are applicable in the pandemic. The amount of patient health data is increasing exponentially. Current estimates suggest a single patient generates close to 80 megabytes each year in imaging and electronic medical record (EMR) data (Harmony 2020).According to Marr (2018), 2.5 quintillion bytes (million terabytes) of data are created each day and the pace is accelerating with the growth of the Internet-of-Things (IoT).

Bresnick (2017) described that healthcare information accounts for a respectable proportion of the data gushing through the world's wires and that some of the data such as patient vital signs in the ICU must update in real-time at the point of care. Real-time alerts can prevent a serious safety event that could end in disaster for the individual (Bresnick 2016).Healthcare data comes in all shapes and forms that include structured and unstructured data in patient records, test reports, scans and images, ultrasound waves, electrocardiography (ECG) waveform and electromyography (EMG) data.

The Orwellian society predicted in George Orwell's 1984 (Orwell 1949) is well and alive in 2020 with disinformation and denial of truth abound. The government is failing being a credible source of information. The spread of dis/mis-information over social media is threatening the survival of society in fighting COVID-19. The Big Data characteristic of veracity is gaining importance in its role during the pandemic to gain trust of people in making fact-based decisions. Gregory (2020) reported top COVID-19 vaccine myths spreading online. Short of adequate policies and regulations to safeguard the authenticity of information, technology is providing the remedies to mend the gaping hole with the emergence of truth-finding, and fact-checking applications. Fact checking tasks are imbedded in knowledge management technologies (Cazalens et al. 2018).

3.3. Cloud Computing

Cloud computing emerged in the last decade providing an on-demand utility model eliminating the need for users to own the resources. Users subscribe these resources from cloud providers distributed through the Internet via a "pay-as-you-go" service model. The COVID-19 pandemic has changed business models driven by the necessity of remote work, online collaboration, e-commerce, and hybrid solutions. Companies are accelerating IT infrastructure projects to leverage cloud computing. According to Cisco (2018),cloud data center traffic will represent 95 percent of total data center traffic by 2021, compared to 88 percent in 2016.

The underlying technology enabling cloud computing include virtualization and grid computing (Sultan 2013). Basic cloud service includes Software-as-a-service (SaaS), Infrastructure-as-a-service (IaaS) and Platform-as-a-service (PaaS). The cloud platform provides Knowledge-as-a-service (KaaS) which is a pull-based service model that is any-time, anywhere, based on user needs around the world. It serves as an on-demand knowledge store, where knowledge can be stored and processed (Rustam & Van der Weide 2014). Depeige & Doyencourt (2015) described the shift from a global push to a full service approach with knowledge management in the cloud. It supports the life cycle of knowledge management in the acquisition, creation, dissemination, storage, and application of knowledge (Chan 2018). The cloud platform is massively collaborative not only among people, but also among objects and devices (Delic & Riley 2009).

4. A Conceptual Model

Figure 1 summarizes the approach discussed in this paper in addressing the COVID-19 pandemic utilizing cloud computing, Big Data, knowledge management and digital transformation. The cloud provides the platform connecting big knowledge sources to different components of knowledge management in the acquisition, creation, dissemination, storage, and utilization of knowledge supporting Nonaka & Takeuchi (1995)'s SECI knowledge creation cycle. The conceptual model describes stages that consist of ingestion, processing and retrieval.

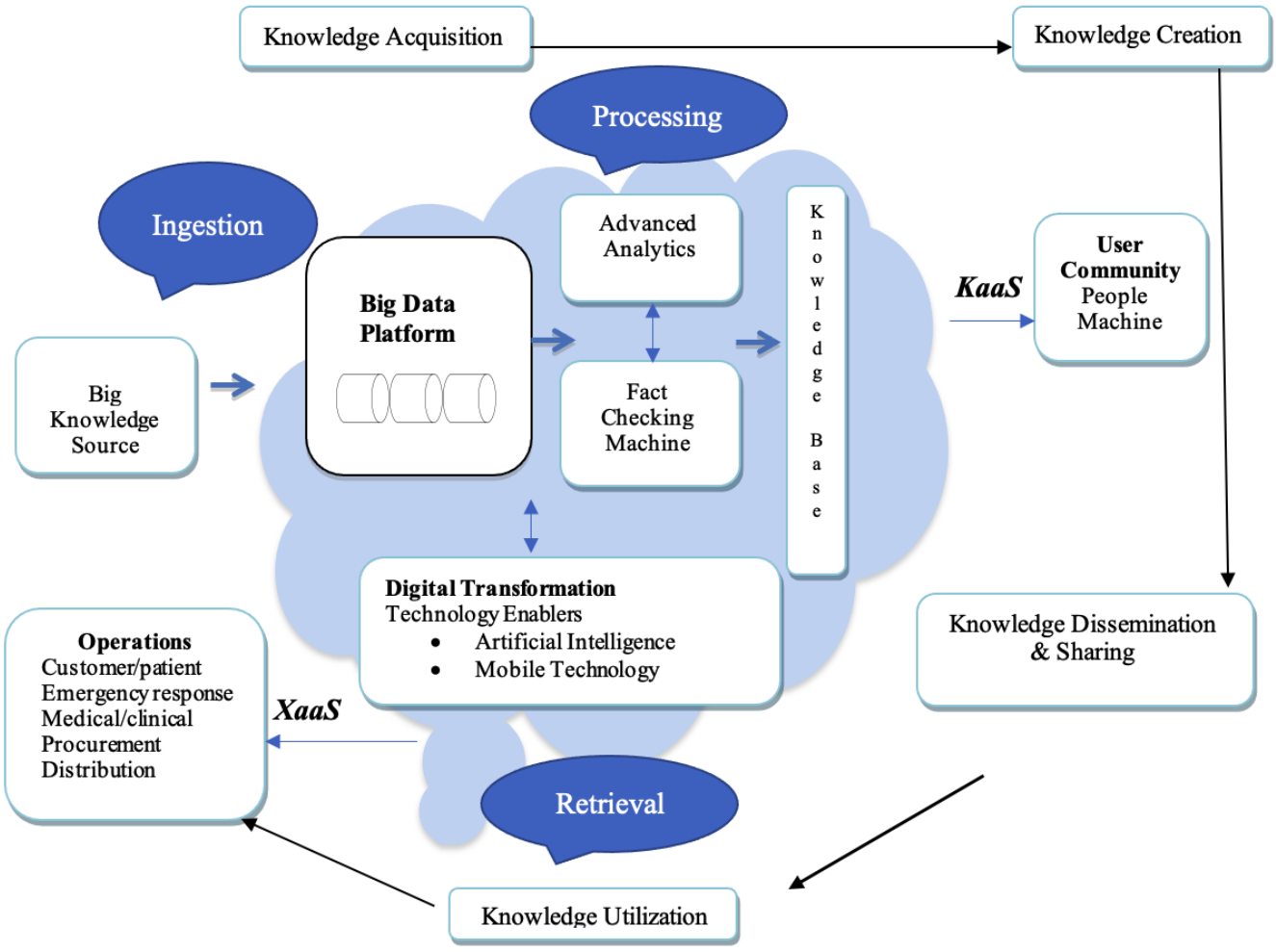
Data ingestion starts with collecting data from Big Knowledge sources that include high volume enterprise transactions, social media, the Internet-of-Things (IoT), Web data, geospatial data, healthcare data, and different types of industry reports. Data is loaded into Big Data platforms which are highly scalable and capable of parallel processing. A popular platform consists of Apache Hadoop and NoSQL database such as Hbase.

Processing of Big Data consists of advanced analytics that include predictive, prescriptive, and knowledge analytics where analytics are applied to specific knowledge domains. A fact-checking machine is added to analytics to emphasize the veracity of data. Processed data are stored in a knowledge base for further consumption. The cloud distributes knowledge and other actionable intelligence as a service model via KaaS (knowledge-as-a-service) and other XaaS (everything-as-a-service) mechanisms.

Knowledge is distributed on-demand to a user community that consists of people and machines that include different objects and devices where collaboration and new knowledge creation occur.

Knowledge in the knowledge base is retrieved and applied to enhance business operations supporting functions such as patient management, clinical operations, emergency management, response and recovery, medical and personal protective equipment procurement and distribution, vaccine procurement and distribution. Digital transformation of the organization such as advances in artificial intelligence and mobile technology contributes to the knowledge management process.

Figure 1: Conceptual Model of Knowledge Management Utilizing the Cloud



5. Conclusion

The world has awoken to the COVID-19 pandemic that has changed the normal way of life for billions of people around the word. There are many issues that society is confronted with in fighting the pandemic; it may be science, politics, government, culture, and the general concern of humanity. Information and technology management stands out as a critical element in fighting the pandemic. The world has become a learning organization as the pandemic progresses. Government relies on accurate information to formulate policies, including imposing guidelines in travel and lockdown. Businesses and institutions need information to strategize on store and school closing, remote work, online learning, production capacity, and resource allocation. Health providers need information to gain best practices in treatments, replenishment of medical equipment, and projection of hospital and staff capacity.

In the midst of this pandemic storm where there is a dire need of trustworthy information, the world is infected with another pandemic where misinformation is spreading across our society exacerbated by social media. Information also comes in different shapes and forms beyond traditional structured data. It overwhelms the storage and processing capability of prevalent technologies as characterized by Big Data in volume, variety and velocity.

The acquisition and distribution of information also changed from a static push-based model to a dynamic pull-based model, where information is provided on-demand in real-time, anywhere and anytime based on user needs. These requirements have created a perfect storm for the arrival of an effective knowledge management system, based on Big Data and cloud computing.

This accelerated the digital transformation of organizations towards the creation and dissemination of real-time big knowledge through a knowledge-as-a-service model. Knowledge is consumed by a community that consists of people, machines and objects in a massively collaborative and scalable platform. The cloud-based knowledge model is enabled by technologies including Big Data, advanced analytics, artificial intelligence and mobile computing. This paper presents a conceptual model of knowledge management in the digital transformation of organizations to address the problems posed by the COVID-19 pandemic and beyond.

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