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Using 'IOT' To Enhance Knowledge Management: A Case Study From the Insurance Industry

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USING IOT TO ENHANCE KNOWLEDGE MANAGEMENT: A CASE STUDY FROM THE INSURANCE INDUSTRY

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ABSTRACT

The Internet of Things (IoT) technology has been successfully used in many different industries. However, research on IoT in the knowledge management (KM) field is still scarce. Current knowledge management system (KMS) is not optimally designed to support real-time decision-making because of the lack of real-time data. Studies on the impact of IoT on enterprise KM are still quite limited. It is important from the business and technical perspective to further research and examine the impact of IoT on KM. This paper presents a case study related to Progressive Corporation, one of the top five US car insurance companies, to explain how the capabilities offered by IoT benefits KMS while enhancing KM practices and innovation through collecting, analyzing, processing and distributing various data in real-time. Implications, limitations, and recommendations for further research on the impact of IoT on knowledge management systems and practices are also presented.

KEYWORDS

IoT, big data, insurance industry, knowledge management, knowledge management system

INTRODUCTION

Internet of Things (IoT) has provided a promising opportunity to build powerful enterprise systems and applications (Xu, He, & Li, 2014). IoT refers to the electronic components embedded in sensors and other objects. Today researchers often refer IoT to uniquely identifiable interoperable connected objects with radio-frequency identification (RFID), sensors, actuators, GPS devices and mobile devices (Ashton, 2009). Specifically, the integration of sensors/actuators, RFID tags and communication technologies provide a foundation for IoT and explains how a variety of physical objects and devices can be associated to the Internet via Internet protocols to respond to environmental stimuli (Rot & Sobinska, 2018). IoT offers a great potential to allow physical objects and devices to cooperate and to communicate with one another to reach common goals such as improving effectiveness of decision-making, operating capacity, flexibility and turning data into knowledge (He & Xu, 2014; Rot & Sobinska, 2018). There is a growing interest in using IoT technologies in various industries to help companies manage their knowledge assets with more innovative and effective methods (Zhang, 2017). Some industrial IoT projects have been conducted in areas such as agriculture, the food processing industry, logistics, environmental monitoring, banking, security surveillance and others (Kshetri, 2017). However, using IoT to specifically support tasks such as turning data into knowledge is inadequately discussed in academic literature. A google scholar search only found several papers that discuss how IoT could be used to help companies for knowledge management (KM) purpose (Uden & He, 2017; Rot & Sobinska, 2018; Santoro et al., 2018). More case studies are needed to help industries and businesses understand the use, benefits and limits of IoT in improving KM practices. Currently, most IoT papers are technical in nature and lack adequate contribution from the KM perspective. As knowledge management systems (KMS) are critical to knowledge management, this paper will use a case study from the car insurance industry to explain how IoT can help facilitate knowledge flows to enhance KMS within organizations.

LITERATURE REVIEW

IoT Applications in Different Domains

The Internet revolution led to the emergence of IoT which involves a network of intelligent physical objects and human beings. IoT enables information sharing among Things. The data which are collected through the devices can be processed in real-time to efficiently improve the entire system. IoT has gained wide acceptance to meet the personal and business needs in recent years. Barboutov et al. (2017) forecast that there will be 29 billion IoT devices across the world by 2022. The primary purpose of IoT is to share information of objects. IoT increasingly involves collection, processing and distribution of a wide variety of data to services and other devices. IoT technology has been

successfully used in different areas. For example, Humana's Healthsense eNeighbor remote monitoring system via inhome sensors measures patient's routine daily activities with data analytics reports. It prevents adverse events from escalating to emergency room visits or hospital stays (Lee & Lee, 2015). FedEx uses IoT sensors and software to monitor the temperature, location and current status of their packages (Lee & Lee, 2015). IoT devices dramatically maximize transportation and logistics companies' productivity and operational efficiency. Currently, there are few studies that investigate how IoT can best be used to help organizations achieve their goals for knowledge management. It is unclear how to design and implement IoT systems that positively transform organizational knowledge management.

Knowledge Management Systems

Knowledge management is "a process used to create, store, retrieve, transfer, and apply knowledge" (Alavi & Leidner 2001). Darroch (2005) found that effective knowledge management helps organizations improve financial performance, develop incremental innovation, anticipate problems, enhance organizational learning, use superior information, and achieve competitive advantage. KM is one of the necessary processes to reach the goal of sustaining and maintaining competitive advantages in current knowledge-driven environment (Darroch, 2005). A knowledge management system (KMS) is a system, which captures knowledge and allows the knowledge to be applied at a variety of levels in organizations (Gallupe, 2001). A KMS is typically used to manage organizational knowledge and to support the organizational process in terms of knowledge creation, storage/retrieval, transfer, and application (Alavi & Leidner, 1999). As knowledge is a critical resource of the growth of any organization, it is important for organizations to continuously improve and evolve their existing KMS so that they can remain their competitive edge (He & Abdous, 2013).

Traditional knowledge management faces some issues such as information lag, information asymmetry, and unreasonable analysis (Sambamurthy & Subramani, 2005; Renzl, 2008; Uden & He, 2017). For example, as insurance industry is less integrated with technology, insurance companies often inefficiently collect customer information, inaccurately analyze collected data, carry out simplified assessment methods, and are unable to maximize knowledge with personalized customization. It leads to some issues such as fraudulent claim, unreasonable pricing and low customer satisfaction. In many industries, traditional knowledge management causes certain problems. For example, traditional transportation management approach faces issues in regulating transportation management due to fixed site inspection, sampling inspection, and limited human force. In addition, as the number of vehicles keeps increasing, information asymmetry and insufficient supervision often exist. To resolve these issues, it is critical to integrate emerging technology into the transportation management.

USING IOT TO ENHANCE KNOWLEDGE MANAGEMENT SYSTEMS

Knowledge management in the organization often relies on enterprise information systems in which the data are entered, processed, stored and extracted as the output and the basis for analysis (Lech, 2014). IoT can be used to gather data for enterprise systems and facilitate knowledge flows within organizations to enhance and evolve different enterprise systems including KMS. KMS improves innovation capacity through exploiting flows of knowledge (Santoro et al., 2018). Since IoT can enhance organization's capabilities in terms of data collection, processing and distribution, IoT has the potential to change the way knowledge is collected, acquired, transferred and managed within organizations and brings a number of benefits to develop a new generation of knowledge management system (Rot & Sobinska, 2018). Uden & He (2017) point out that current KMS cannot be used effectively for decision-making because of the lack of real-time data. They provided a case study related to intelligent parking service supported by IoT devices of vehicles. Their study shows that data collected from IoT devices can be transformed into useful knowledge to improve parking service and make decision-making more quickly and effectively. In addition to providing real-time updates, Rot and Sobinska (2018) suggest the use of IoT for knowledge discovery. IoT helps organizations respond to customer behavior more quickly since products can be tracked at any time. Since IoT has the capacity to monitor and track various assets including packages and products, data analytics software can be used to conduct automatic location analytics to discover new knowledge regarding potential issues like delay and low productivity throughout various manufacturing, supply chain, and businesses processes. This knowledge can also allow organizations to better understand customer behavior and use of their products in order to predict future behaviors (Rot & Sobinska, 2018). The discovered knowledge can be stored into the KMS and later studied for the purpose of optimization and productivity improvements.

To use huge amounts of IoT data collected from various sensors, Mishra et al. (2015) recommend using big data analytics to analyze the IoT data in order to support knowledge development and decision making. By leveraging big data technologies such as machine learning and deep learning, organizations can gain analytical insights from real-

time IoT data more efficiently to discover problems and issues in a timely manner to avoid negative effects on business operation and reconfigure their key processes as needed (Xu et al., 2016). The integration of big data analytics and IoT data provides an opportunity to enable organizations to make informed and evidence-based decisions (Akhtar et al., 2018).

METHOD

Yin (2017) defines a case study is "an empirical method that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context may not be clearly evident". The case study research method allows researchers to focus in-depth on a case or cases. Many researchers in the business domain successfully use the case study research method to study real business situations issues (Eriksson & Kovalainen, 2015). To research the application of the IoT in knowledge management, a qualitative case study research methodology is adopted. Currently, most of the IoT activities are centered in transportation, manufacturing, consumer applications and smart city (Uden & He, 2017). In this paper, a case study from the automotive domain is used to describe how to convert IoT-related big data into useful insights and knowledge. The case selected in this paper was based on a comprehensive review of online published documents such as news stories, corporate websites, customer reviews and media reports. Two researchers worked collaboratively to review the gathered materials and had multiple meetings to discuss and refine the case study. We also invited an expert to provide additional feedback and input. The case study aims to clearly compare and explain the application of IoT in KM before and after the premium discount rate, customer acceptance, insurance payout rate, accident decline, etc. This case allows researchers to uncover interesting insights about IoT's potential in KM.

CASE STUDY

Progressive Corporation, one of the top five US car insurance companies, is the first insurance company that started using the UBI system (Desyllas & Sako, 2013). In 2009, Progressive implemented the MyRate program (currently called Snapshot). By installing an IoT sensor device into a car, Progressive collects drivers' driving data and then customizes their premiums. This process contributes to more agile knowledge management through collecting, analyzing and managing various data in real-time (Desyllas & Sako, 2013). A detailed explanation on how this works is listed below.

The Information Collection and Feedback Process

Car insurance is traditionally priced based on self-reported information from the insured person (Verbelen, Antonio & Claeskens, 2018). The information includes age, license age, postal code, use of the vehicle, engine power, and claims history. However, these observable risk factors are proxy variables (Verbelen, Antonio & Claeskens, 2018). They do not reflect current driving habits and driving style. The premium of the customers who seldom have car accident is used to pay for those customers who are involved in frequent car accidents. Insurance companies cannot accurately identify customers' information due to only relying on claim records to collect data. Thus, it could be challenging for insurance companies to provide or justify differential pricing services based on customer risk-related characteristics.

In Progressive car insurance program, Snapshot program relies on a sensor named On-board diagnostics (OBD) communications port of the car. OBD is one type of IoT devices, and it has a memory chip, cellular radio and a GPS radio that communicates with satellites for location tracking, also sensors for the tires. By plugging an OBD into a car, it could collect data including driving mileage, driving hours, driving area, and driving habit such as harsh braking, harsh acceleration, rash turning, and phone use when driving to assess the risk levels of the drivers. At the same time, Snapshot uses a wireless device for data transmission to Progressive. At first, drivers have to plug the device into their cars. So Progressive will put drivers in a 30-day "probationary" period where they evaluate drivers' behavior and give an initial discount for the remaining five months. Six months later they will give drivers a renewal discount and take back the equipment. Through OBD systems, the automatic collection and receipt of information allow the insurance company to monitor its customers' driving habits, underwriters can increasingly distinguish between drivers who are safe on the road from those who merely seem safe on paper (Martin, Marottoli & O'neill, 2013). This IoT-enabled technology could provide information on how far people drive (driving mileage), how people drive (driving habits and driving style such as harsh braking, harsh acceleration and cornering style), when people drive (driving in rush hour or after midnight), and where people drive (the type of road and territory).

Information Processing

All IoT-gathered information is reported to insurers monthly. Thus, insurers could evaluate their drivers more accurately. Firstly, insurers will get automatically generated daily, weekly, and monthly reports for every driver by

using the data collected. The daily reports show the number of sudden braking, mileages, quantity of trips, harsh acceleration, cornering style and other metrics that may indicate unsafe and aggressive driving habits. Then they could select important parts of the report as key index, retain some data as a type of reference viable, and discard useless data. Later, insurers combine driver's profile and historical information to set up a data pool and set up a model for data analysis. After big data are collected, human knowledge will be used to refine and optimize the model. In the end, the refined model will be used to evaluate the risk level of every driver and provide a discount as needed. The process is shown in figure 1.

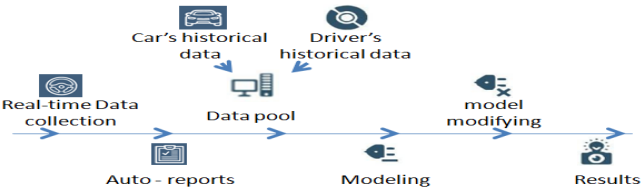

Figure 1. Information processing workflow

For example, young drivers and drivers in other high-risk groups, who used to face hefty insurance premiums, can be evaluated based on how they actually drive. Because of better monitoring of driving habits, the integration of IoT and KM can greatly reduce the information asymmetry issue. At the same time, since a large amount of data are collected, insurers could use those data to provide better advice to customers. For example, as big data results found that high-risk period is between midnight and 4:00am, drivers are encouraged to reduce or avoid driving during that period.

Using IoT Knowledge for Pricing

Based on driver's driving records, Progressive gives customers customized premium discounts ranging from 5% to 25%. The transparent and simple pricing rules offer customers a sense of fairness for the service they receive. According to a manager of Snapshot program, this program attracts cautious drivers that belong to high-premiums groups and those parents or family who need to monitor young drivers and elderly parents (Farris et al., 2017; OFFER, 2013; Desyllas & Sako, 2013).In traditional insurance process, premium is determined and approved based on experience. In this improved insurance process, insurance company can more accurately calculate premium for each driver based on each driver's detailed driving behavior and situation and better quantify the accident risk of each driver (Figure 2)

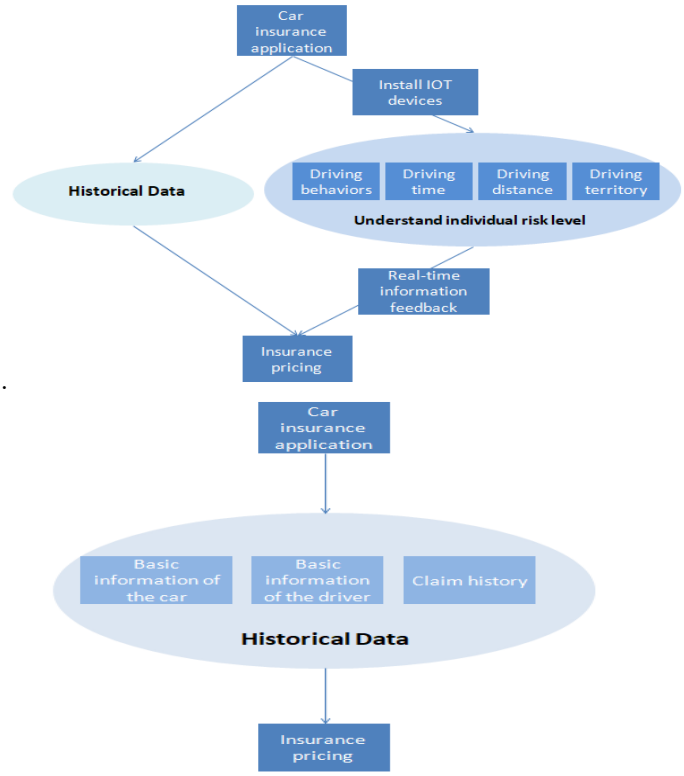

Figure 2. Traditional Pricing Process VS. Snapshot Pricing Process

The Insurance Claim Process

Traditionally, car insurance company needs a lot of time and labor to verify the car accident. If the accident is complex, it is difficult to determine who is at fault if we only rely on the drivers' statement and evidence collected at the accident. Therefore, the traditional process is inefficient. After the installation of IoT device, the insurant does not need to call the insurance company. The sensors will automatically send the accurate information related to the car owner, the accident location/time, driving speed, and other driving data to the insurance company. Those data will help insurance companies better determine who may be at fault. Since the insurance company obtains real-time driving data, their digital underwriting process will become more efficient in terms of improving insurance claims proficiency and reducing costs.

According to the Computer World Institute's report (2015), 63.41 percent of car owners consider claims efficiency is an important factor when selecting an insurance company. Therefore, claim efficiency reflects insurance company's information processing ability. The IoT services include direct communication with a help-center in the case of an emergency using an emergency/panic button, automated accident notification, roadside assistance and theft protection utilizing GPS technology. Using the monitoring device, Progressive can also track and recover stolen vehicles. In conclusion, IoT can help insurance company improve the information processing efficiency and maximize the use of information collected in the KM process.

DISCUSSION

After implementing IoT technology for organizational knowledge management, Progressive has achieved some positive outcomes such as improved customer information management and increased use of insurance knowledge. For example, the Snapshot program is now available in 20 states and is compatible with nearly all vehicles nowadays. Drivers who are on the Snapshot program and who practice safe with low risk driving habits can get a discount on their car insurance premium (up to 25% discount). About 31% of customers purchased Progressive and signed up for Snapshot, while 10% purchased Progressive after Snapshot trial period. According to the survey, Snapshot positively impacts satisfaction among customers who are able to demonstrate they are safe drivers and who realize extra cost savings. Findings of the 2013 U.S. Auto Insurance Study show overall customer satisfaction is a significant 21 points

(on a 1,000-point scale) higher among Progressive customers who use the Snapshot program than among those who do not use this program.

IoT also helps to improve information acquisition. The IoT in KM enables the comprehensive and more accurate monitoring of a product's condition, operation and external environment through sensors and external data sources. Using data from the IoT, insurance company can efficiently collect and control information related to driver, car, road, and surrounding, analyze driver's real-time driving information, and then reduce the cost of premium for those customers with good driving behavior, innovate the use of customer information, accurately target customer groups, and increase sales. Furthermore, IoT helps to improving information sharing and communication. The information collected from IoT devices in KM can be analyzed through automated algorithms that are built into the device or reside in the product cloud. Therefore, IoT technology can help insurance company enhance its analysis capabilities on vehicle and driver information, determine the liability of accidents in a timely manner, and improve the speed of response and service quality. With the use of big data technologies, insurance companies can quickly find useful information from large amounts of IoT data and then make more informed decisions.

The use of IoT could improve support on customers. With real-time KM applications, customers can better understand insurance process and value. Insurance company can interact with real-time information to provide rapid service support, improve risk control and management, and retain existing customers. Furthermore, the use of IoT is likely to encourage drivers drive safely, develop good behavior habits, and reduce dangerous behavior with the use of cars. As drivers drive more safely, the number of claims could be reduced. It is a win-win situation for drivers and insurance companies. However, there are also some concerns with the widespread use of IoT. With increasing volumes and detail of IoT data flows, people are getting concerned with security and privacy risks resulted from IoT-connected devices because these devices may emit identifiable information that can reveal the activities of device users (Wilson et al., 2018). The KM system must take this concern into the consideration and take measures to safeguard the potentially sensitive and identifiable information. Otherwise, the KM system may be challenged by some people and result in limited use in practice.

CONCLUSION

This paper presents a novel case study from the insurance industry to describe how the capabilities offered by IoT benefits the knowledge management systems as well as the business. The case study revealed some interesting insights about using IoT to enhance KM and the potential transformative effects of IoT for the car insurance industry. Currently, KMS is being impacted by emerging technologies such as IoT and big data. IoT changes the way knowledge is managed in organizations. For example, IoT can help insurance companies improve their existing KM systems and empower them to better serve their customers while making more revenues or reducing the costs through new and improved services. Snapshot has been used in automotive insurance for so many years. The application of Snapshot has significant implications. It not only improves customer satisfaction but also leads to good social effects. In this paper, we introduced this Snapshot technology from the perspective of KM to help readers and business organizations understand the role of IoT in KM in terms of the process of information collection, processing, and distribution. The process of real-time collection, analysis, processing and distribution of information can be beneficial to many fields. To encourage the implementation of IoT in KM, organizations need to provide incentives to get buy-in from customers and pay attention to the ethical implications and potential consequences of IoT-related technology in practice. By doing this, the application of IoT in KM will be more likely to gain acceptance in practice. Research on IoT in the knowledge management field is still scarce, and as a result, our knowledge on the impacts of IoT on KM is still far from conclusive. Regarding future research, the field needs more case studies discussing both positive and negative implications of IoT on KM. The research has some limitations. The research only involves one case study from one company. More case studies from different companies will provide more evidence and make a stronger case regarding the benefits of IoT for KM. As for future research, we plan to develop a questionnaire to survey a large number of insurance company employees to better understand how IoT facilitates different KM processes in their companies and better understand the impacts, barriers and challenges in using IoT to support both business operation and KM.

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