Value of Telecom Operators’ Big Data in Social Public Management

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Abstract. Big data is treated as the oil of 21st century, and can bring tremendous changes and opportunities to many industries. Telecom operators possess large amount of telecom data by nature with precious value. Based on telecom operators’ data features analysis, this paper highlights the value of big telecom data in social public management. Telecom big data can play an important role in the improving public management and public welfare, such as transport, public security, tourism, and disaster rescue. Besides, this paper presents a discussion about the implications of the telecom big data. This paper is expected to provide insights into the value development of telecom operators’ data based on big data.

1. Introduction

Big data is treated as one of the most important strategic resources for many countries, while some ones named it as “new oil” of 21st century. Big data contains tremendous potential, which can bring great value with proper mining and develop. As to Wikipedia, big data “is a collection of data sets so large and complex that it becomes difficult to process using on-hand database management tools”. In IBM, big data contains the characteristics of 4Vs (volume, variety, velocity, and veracity), which respectively reflects scale, different forms, analysis streaming data, and uncertainty of data [1].

As to Telecom operators, it faces both challenges and opportunities well in big data era. For one thing, telecom operators are enduring fierce competition from industry inside and outside. Traditional telecom products (e.g. voice, SMS) are already reaching saturated market in more and more countries and areas. As a result, competition between telecom operators has transformed from faster bandwidth and wider coverage scope into telecom service usage perceptions (e.g. convenient in transaction, satisfied consumer care, better product design and reliability in-network) [2]. Besides, many OTTs bring their services which plays a replacement for telecom operators’ traditional telecom services, such as Facetime to phone and WeChat to SMS. For another thing, big data also opens a door for telecom operators in searching new ways of growth. By using the information system constructed (e.g. billing system, network management system), telecom operators have already collected and stored many data (structured, semi-structured non-structured) based on their accomplished business during many years. If these data reached sufficient development, they can be transformed into huge energy. Furthermore, data of telecom operators has a specific feature, it covers almost all of population in many countries [3]. Therefore, mobile network big data can now obtain individual behavioural insights in a large scale that never before. Accordingly, this can be seen as the most precious untapped asset for telecom operators in 21st century.
2. Big Data of Telecom Operators

Telecom operators’ data contains structure, semi-structured, as well as unstructured data, and many researchers have made attempts to classify them. In this paper, the data collected by telecom operators are categorized into six classes.

The first one is demographic information, which mainly includes the customer name, gender, age, house address, or even identity ID in some regions. The second class is telecom basic data, which reflects the customers’ information in relation to telecom data usage. It includes a phone number, handset brand/type/IMEI, customer type (post-paid/pre-paid) and level, network type, service brand, data package, network access license, credit record and billing record. The third class is telecom time/space usage data and is collected during telecom services. It includes start/end time of a call, call/web browsing duration, latitude/longitude, location of NodeB. The fourth class is telecom action data, which shows the customers’ telecom usage habits. It includes service order history, phone connection relationship records, URL surfing history, data volume per month, voice volume per month, and SMS/MMS. The fifth class is customer experience data, which mainly reflects the speed of download/upload, drop/interrupt rate of call, response latency of video/game, and call centre completing rate. The final one is network infrastructure management data, which is collected by telecom equipment monitors (i.e. switch monitor, signalling monitor) in order to control or optimize the operation of telecom network, or deal with emergency telecom equipment accident.

The most used data from telecom operators are CDRs and network logs. Moreover, with the rapid popularized smartphones and the rapid development of telecom technologies (e.g. Deep Packet Inspection), telecom operators can collect extra data than ever before. For instance, APPs download history and usage habits, information of mobile payment, and gyroscope position.

3. Social Public Value of Telecom Operators’ Big Data

Apart from enhancing traditional telecom services and exploiting new businesses, telecom operators’ big data is also valuable in improving public welfare. Mobile networks generating a large amount of data in real-time can turn into a perfect social sensor for social behaviour investigation. This is important in promoting city management efficiency (Jiang et al., 2012), which includes urban planning, city administration policymaking [4], social opinion monitor [5], and reduce city administration fee [6]. This section introduces the typical big data usages in city management and public welfare promotion.

3.1 Transportation Planning and Control

Some prior researches point out that the greatest advantages of telecom operators’ big data is in its ability of real-time dynamic feedback and space-time combination [7]. Therefore, it is very useful in public transportation management, which mainly includes two aspects: transportation planning and transportation control.

In transportation planning, city administrators realize smarter traffic based on information combined with data from telecom operators. By connecting data of cell tower with GPS or WiFi, city administrators can get much more accurate movement information of a specific group of people [8], depict their movement locus during 24-hours, thus better optimizing transport planning so as to satisfy peoples’ requirements and consumption level. For example, city administrators can design better grade transport based on traffic flow refining from workers’ movement data in the rush-hour [9]. In addition, city administrators can have a deeper insight into the traffic flow of certain spot, understand the transfer features (where people come from, where they go and when get peaks). Consequently, they can make plans not only satisfying the current situation but also considering future changes.

In transport systems, telecom operators’ big data facilities the real-time monitoring of traffic on the streets. The mobile phone data opens a door in describing people’s movement besides video monitors and helps the city traffic administration department trace changes in traffic flow in real-time. It is very useful in finding traffic jams or congested roads, and split traffic in special areas before it deteriorates [10]. Besides, telecom operators’ big data has a wide usage range in reign, it is helpful in optimizing traffic system, both in developing [11] or developed countries.
3.2 Public Security Management
Since telecom operators’ data can focus on certain individual or group with details while reflecting time-space features, it is also essential in identifying hotspots or popular interests. This enhances public safety [12], preventing crime and terrorist attacks. Numerous studies have investigated the relationship between telecom data and special events (e.g. crowd gathering, celebrations), and concludes that telecom data can be seen as a significant forward indicator. For instance, based on CDRs from mobile telecom operators, Traag et al. (2011) build a framework model in positioning individual’s probability in attending special social events, thus giving a proposal for timely organization in monitoring potential dangerous people [13].

Telecom big data is not only useful in monitoring and preventing the potential threat, but it also helps in providing pertinence tools to deal with emergencies. The applications developed based on operators’ data is important and essential in emergency or risk danger prevention/handling [14]. For example, during the 2016 European Cup in France, the city administration in Paris developed an APP (named as “Terror Alert”) which aimed at preventing terrorist attack and for tourists’ safety. By connecting data from various resources, the government could confirm suspicious terrorist attack areas in a few minutes, thus convey a warning messages and evacuation signals to nearby tourists. Correspondingly, tourists could also see the safety level of each tour hot spots or stadiums in real-time hence averting crowding or dangerous events through this APP.

3.3 Tourism Management
The results of data mining from telecom operators can also be seen as a tool for tourism management, with cities dependent on tourism reaping additional benefits. One of the features of tourists is their fast movement and hotspots centralization and this brings great challenges to tourism destination cities’ management for they know very little about their guests. Telecom industry has network features which determine telecom operators. They must consider and satisfy the peak usages when constructing their networks, and also should distinguish the nature local subscribers and non-local ones. As a result, by analysing the roaming data from telecom network, the tourism management department can get important information.

For instance, each mobile phone must transmit a signal to a nearby cell tower every few minutes in order to keep an emergency connection. This signalling includes the information that indicates where the mobile phone comes from and from whom. Based on these data, the tourism management department can easily calculate how many visitors are in the city, and whether they are tourists or local citizens. In addition, based on combined data describing tourists’ movement track, tourism management department can analyze the favorite landscapes or famous spots for tourists visit, what time they frequent these places and whether they like centralize there or not[15][16].

Some researchers have made practical big telecom data usage in tourism management. Calabrese et al., (2011) developed an application reflecting the population density of people in Rome’s historic travel landscapes by mining mobile data [8]. Based on this application, the tourism management department of Rome could easily understand the lifestyles and characteristics of the city tourists. Hence making targeted marketing activities and optimizing tourist routes.

3.4 Disaster Rescue
Besides, data from telecom operators is important in helping evacuation during disasters, such as flood, earthquake and epidemic. By cooperating with telecom operators, the government can estimate the number of population affected in real-time. Furthermore, since the telecom operators’ big data can be located to a specific individual and her/his condition during disaster. This is much precious in locating disaster-affected people, proposing a mode to establish aid and rescue plan [17], hence optimising rescue resources usage efficiency. For example, SIM cards data were treated as indispensable information resources in monitoring the victims’ movement trend after the earthquake in Haiti in 2010.

Disaster rescue is one of the most important practical application of telecom big data. Telecom data is very useful in predicting epidemic breakout, diffusion, and infection monitor [18]. Based on telecom
operators’ cell tower connection data, epidemic prevention department can easily understand the potential infectors who are in infected area in time, trace their travel track, thus evaluate the potentially infected area scope hence effecting prevention. Many researchers have made attempts to analyse CDRs, yielding results that show its importance in predicting the diffusion of malaria, flu, and cholera.

3.5 Scientific Research and Others
Data from telecom operators (especially the mobile ones) can also be used in scientific research for various subjects, such as geography, social science, human communication, as well as demographics. Telecom big data is an effective data resource which provides useful supplements to scientific research. This data can provide a novel investigation view for researchers, helping them to construct an innovative part in interdisciplinary research. In conclusion, there is a great cooperation potential between telecom operators and research institutions/universities in sharing data. In addition to above, telecom big data also be used in population census, natural resources use, or even health [19].

4. Discussion and Conclusion

4.1 Implications, Obstacles and Roadmap
Although there is an excellent expectation, so many potential applications mentioned above, as well as precious value waiting to be explored from telecom operators’ big data, some obstacles exist. First of all, one of the greatest challenges for telecom big data usage is that telecom operators’ data are stored, owned and analyzed by separate departments inside telecom industry during traditional operation. Consequently, it is difficult to integrate, no wonder there is organizational barriers or in technological obstacles. Dealing with telecom big data needs a wholehearted cooperation of different departments of a telecom operator. It certainly brings new challenges to the management layer of telecom operators, thus it needs excellent management skills and effective mechanism to harmonize conflicts between the different departments.

Secondly, the flourish of various data, needs significant improvement in capacities of data preparation, data cleaning, data storage, as well as data visualization, but the traditional ones are insufficient in most enterprises. Besides, since big data has the features of 4Vs, big data analysis needs the matching of sufficient hardware and infrastructures, effective data analysis tools and software, adequate data scientists, and adjustments in management policies. However, there is a gap between investment in big data architecture & technology, and benefits from big data analysis. This situation gets much severe for telecom operators. Thus new technologies dealing with massive network and real-time customer data, sufficient infrastructure to adopt the new methods and tools, need to be introduced into telecom information systems as soon as possible. The investment in big data-related infrastructure makes the budget of telecom operators even much tighter. A good point is that due to the fall in costs from improved fast technology in data storage, transfer, analysis, and operation, big data expense has been recently coming down to an affordable level in some extent.

Thirdly, telecom big data usage needs sufficient efforts in privacy protection. The privacy issues have always taken a center stage in data usage, and big data expands the threat and harm of data misuse, bringing the needs for data security protection into a new level. Big data brings two great changes in traditional privacy protection. Actually, the partition between privacy and non-privacy becomes obscure. Besides, in the world of big data, it is very difficult to define the boundary between privacy and non-privacy data, since by combining of non-privacy data from various resources (public or private), non-sensitive data can become sensitive. Further, privacy protection of big data cannot be handled by a single department or science subject, it needs cooperation from multiple sides.

As to telecom operators, they need great care of subscribers’ privacy protection in legislation while exploiting their data. Since most telecom operators’ service clauses do not include the use of customers’ personal data in details (with the rapid development of big data and related laws, more clauses should be added). This creates barriers in exploiting data in laws and regulations, especially when cooperating with other companies. In order to overcome this shortage, some telecom operators
have made several efforts. For example, a British mobile telecom operator EE provides ‘inform and consent’ policy, which informs users the type and usage (includes use both of EE and its potential partners) of data to be collected while they are using EE’s telecom services. In return they get some benefits such as some free additional services promotion (e.g. free WIFI city connection). If the customers choose do not allow, they consent to another service clause, which EE confirms the privacy/secrecy of their data, but of course without enjoying the free additional services.

4.2 Future Research
There are three potential fields suggested for further research. First, in order to develop the value of telecom big data extensively, the process and implications all need full collaboration of different departments inside telecom operators, which are difficult in the current situation. Future researches can study organization and structures of a telecom operator, and thus make attempt/provide to adjust in order to solve this problem. For instance, they can design a new management mechanism of balancing benefits between departments inside telecom operator more rationally, study the necessary adjustments in departments setting and management hierarchy, or the support system integration and control.

Secondly, since big data is novel and fast developing due to Internet & Mobile Internet, the privacy policy aimed at traditional telecom services are no longer fit for big data usage. As a result, telecom operators need to study individual information protection policies, adjust their private policy which directs to telecom big data implications as soon as possible, and these are the fields need future researches to make contribution greatly. Moreover, future researches can make more investigation in proper privacy protection, such as how to separate privacy-sensitive subscribers from non-sensitive ones, how to eliminate risk/anxiety about personal information disclosure of subscribers, how to protect subscribers’ sensitive information from corporate or other entities.

Finally and most important, telecom industry is always in the rhythm to catch up with and surpass new technology, while the development situation, customer consumer habits, government regulation all differ much between various countries or regions. Many previous studies have confirmed that the effects of telecom operators’ big data are different between regions, cultural customs, customers’ telecom usage habits. Therefore, telecom operators must make independent and individual strategies/develop framework based on its features when implementing big data into action and this can be effected in future researches. Moreover, future researches should perform further analysis in studying the methods/differences in exploiting value from telecom big data between various telecom operators, such as ones in developed countries versus developing countries, the ones cover the whole country vs. the ones only provides services in certain regions, famous large companies versus SMEs, and the ones of leader/priority versus chasing/inferior ones.

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