Responsible Big Data Analytics for E-Business Services

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ABSTRACT

This paper examines responsible big data analytics for e-business services and looks at how to use responsible big data analytics to obtain responsible e-business services. It addresses why responsibility matters to big data analytics and e-business services. It reviews big data analytics and looks at Google Analytics as a data processing flow-oriented analytics, and presents a data processing flow approach to big data analytics. This paper discusses responsible big data and big data analytics based on two case studies and examines big data analytics services as an e-business service and proposes two strategies on how to apply responsible big data analytics to obtain responsible e-business services. The proposed approach in this paper might facilitate the research and development of big data, business analytics, responsible big data analytics, e-business, e-services, and e-society.

CCS CONCEPTS

• **Information systems** → Information systems applications; Decision support systems; Data analytics; • **Information systems** → Information retrieval; Retrieval tasks and goals; Business intelligence..

KEYWORDS

Big data, big data analytics, responsible big data analytics, e-business services, artificial intelligence, digitalized society

ACM Reference Format:
Zhaohao Sun and Narasimha Rao Vajjhala. 2021. Responsible Big Data Analytics for E-Business Services. In *2021 the 5th International Conference on Big Data Research (ICBDR) (ICBDR 2021), September 25–27, 2021, Tokyo, Japan.* ACM, New York, NY, USA, 7 pages. https://doi.org/10.1145/3505745.3505750

1 INTRODUCTION

Big data and big data analytics have become one of the most important research frontiers in academia and industries [1, 2]. Big data and its emerging technologies including big data analytics have been making big changes in the way e-business services operate [3]. Big data analytics is an emerging big data technology and has become a mainstream market adopted broadly across industries, organizations, and geographic regions and among individuals to facilitate big data-driven decision making for business and individuals [1, 4]. Big data and big data analytics are increasingly critical elements for nearly all industries and key to a successful digital business and intelligent business, based on the following three predictions from Gartner researchers [5]: 1). 30% of organizations will exceed data and analytics ROI (Return on investment) by governing the least amount of data that matters most to their strategic goals by 2023, 2). By 2022, as a kind of big data analytics, augmented analytics technology will be ubiquitous [2]. 3). By 2023, 90% of the world's top 500 companies will have converged analytics governance into broader data and analytics governance initiatives.

E-business and its services have benefited all the people in the world [6]. In the age of coronavirus pandemic and in the digitized society, e-business services have become indispensable for billions of people around the world.

However, responsible big data analytics for e-business services is an emerging and challenging issue for both academia and industries. This issue can be detailed into the following research questions.

- Why does responsibility matter to big data analytics and e-business services?
- What is responsible big data and big data analytics in the digitized society?
- How can responsible big data analytics be used to obtain responsible e-business services and make responsible decision making?

This paper will address each of them by providing corresponding answers. To address the first research question, this paper looks at the data monetization of Facebook and Google. To address the second research question, it discusses responsible big data and big data analytics based on two case studies. It also looks at Google Analytics and presents a data processing flow approach to big data analytics. To address the third research question, this paper examines big data analytics services as an e-business service and proposes two strategies on how to apply responsible big data analytics to obtain responsible e-business services and make responsible decision making.

The remainder of this paper is organized as follows. Section 2 looks at why responsibility matters to big data analytics and e-business services. Section 3 looks at Google Analytics and proposes a data processing flow approach to big data analytics. Section 4 proposes responsible big data analytics based on two case studies.

ICBDR 2021, September 25–27, 2021, Tokyo, Japan

ACM ISBN 978-1-4503-8433-9/21/09…$15.00
https://doi.org/10.1145/3505745.3505750

Section 5 looks at big data analytics services as an e-business service and proposes two strategies on how to apply responsible big data analytics to obtain responsible e-business services. The final sections discuss the related work and end this paper with some concluding remarks and future work.

2 WHY RESPONSIBILITY MATTERS TO BIG DATA ANALYTICS AND E-BUSINESS SERVICES?

In the age of big data, analytics, and artificial intelligence (AI), big data and big data analytics should be responsible, because monetizing big data using big data analytics can not only improve the business performance but also be hundreds of billion-level profitable by selling its internal data and big data analytics services to external consumers [7, 8]. Data monetization of Facebook and Google has become a miracle in the past decade. They have no traditional natural resources like the iron core of the mining giant Rio Tinto. They have only two artificial resources; one is big data received from the artificial donation and aggressive collection using intelligent techniques based on intelligent algorithms. Another is big data analytics that can transform big data into smart insights and big value [1, 2]. The question arises: are the big data and big data analytics of Google and Facebook are responsible?

Gmail was launched in 2004; Google subsequently admitted that it has scanned private correspondence for personal information. In the same year, Facebook was founded, its business model is also based on the capture of and access to personal information [9].

Why does responsible data analytics really matter to intelligent business and e-business services? There are many different answers to this question from different researchers. Big data analytics uses predictive algorithms and mathematically calculate human behavior, and then data giants sell certainty to business customers who would like to know with certainty what one does. The best way to make the predictions desirable to customers is to ensure that they come true: "to tune, herd, shape, and push us in the direction that creates the highest probability of their business success" [9].

In the Cambridge Analytica (CA) scandal [10] (also see Section 4), every aspect of CA's operations was simply mimicking a day in the life of a surveillance capitalist" [9]. Trade of human futures using big data and big data analytics is irresponsible and illegal – like the slave trade was made illegal [9].

3 BIG DATA ANALYTICS: A DATA PROCESSING FLOW APPROACH

This section reviews big data analytics and Google Analytics and presents a data processing flow approach to big data analytics. The latter is important for every stage of data processing flow to use responsible big data analytics.

3.1 What is Big Data Analytics?

Big data analytics is a science and technology about organizing and analyzing big data, and discovering knowledge, insights, and intelligence from big data, visualizing and reporting the discovered knowledge and insights for assisting decision making [3]. The main components of big data analytics include big data descriptive analytics, predictive analytics, and prescriptive analytics [3, 11].

- Big data descriptive analytics is descriptive analytics for big data and is used to discover and explain the characteristics of entities and relationships among entities within the existing big data. It addresses the problems such as what happened, and when, as well as what is happening.
- Big data predictive analytics is predictive analytics for big data and focuses on forecasting trends by addressing the problems such as what will happen, what is likely to happen, and why it will happen. Big data predictive analytics is used to create models and insights to predict future outcomes or events based on the existing big data.
- Big data prescriptive analytics is prescriptive analytics for big data, which addresses the problems such as what one should do, why one should do it, and what should happen with the best outcome under uncertainty.

The fundamentals of big data analytics consist of mathematics, statistics, engineering, human interface, computer science, and data science [3, 13]. The techniques for big data analytics include a wide range of mathematical, statistical, and modeling techniques [12]. Therefore, big data analytics can be represented below [3].

$$\begin{aligned} \textit{Big data analytics} &= \textit{Big data} + \textit{data analytics} + \textit{DW} \\ &+ \textit{DM} + \textit{SM} + \textit{ML} + \textit{visualization} + \textit{optimization} \end{aligned} \quad (1)$$

Where + can be explained as "and"; DW, DM, SM, and ML are the abbreviations of data warehousing, data mining, statistical modeling, and machine learning, respectively. This representation reveals the fundamental technological relationship between big data, data analytics, and big data analytics. It also shows that computer science and data science play a dominant role in the development of big data analytics through providing sophisticated techniques and tools of DW, DM, ML, and visualization [2]. SM and optimization still play a fundamental role in the development of big data analytics [2, 11].

3.2 Google Analytics as a Data Processing Flow Oriented Analytics

A data processing flow consists of four stages from left to right, from upstream to downstream: 1. Store and organize, 2. Collect and clean, 3. Analyze and test, and 4. Visualize and report [14], as illustrated in Figure 1. In what follows, this subsection looks at each stage of data processing flow and its corresponding Google Analytics services.

3.2.1 Store and Organize. The most left of the data processing flow is the first stage: store and organize. The corresponding Google Analytics aims to store and organize website tags, which is accomplished by Google Tag Manager™. Tag Manager also allows running website surveys and multivariate optimization tests, tracking social media audiences [14]. Tag Manager can make changes to the website without requiring editing the site itself.

3.2.2 Collect and Clean. The second stage on the next left of the data processing flow is to collect and clean data. The corresponding Google Analytics aims to collect and clean data [14]. All the analytics tools in this stage have their own APIs, but some external data

Figure 1: A model for data processing flow-oriented Google Analytics

sources like social media sites require data collection separately. The Google data cloud gathers big data and prepares it for analyzing and reporting. For example, one can collect social media engagement data from third-party vendors in a cloud MySQL database or Google Sheets. One can also extract ad data from third-party advertising systems and store it in Cloud SQL™.

3.2.3 Analyze and Optimize. The next stage on the right of the data processing flow is to analyze and optimize. The corresponding Google Analytics, Google Optimize, and Google AdWords aim to analytically analyze big data and optimize the discovered value [8], knowledge, and insights [14]. Google Analytics tells the user what is happening on the website, which is a kind of descriptive analytics. Google Optimize can test out a variety of assumptions to understand what works best on the sites. Google AdWords then enables the users to market to the audiences that they prove effective with Google Analytics and Google Optimize [14]. Google Analytics alone used to be the star of the show, but now it is one part of the Google Analytics platform.

3.2.4 Visualize and Report. The rightest stage of the data processing flow is to visualize and report. The corresponding Google Analytics is Data Studio™. Data Studio can assemble and visualize big data and discover knowledge and insights [14]. Data Studio is where the user transforms his big data into knowledge and insights, then makes strategic recommendations about what to do next, which can be a part of predictive and prescriptive analytics [2]. One can make a basic but effective public relations reporting system out of Google BigQuery™ with the raw news feed from Google News.

3.3 Data Processing Flow-Based Big Data Analytics: A Unified Approach

The above discussion demonstrates that Google Analytics is a data processing flow-based. Google develops analytics as systems and services for each stage of the mentioned data processing flow, from upstream to downstream, like the streams of supply chains [6].

With the dramatic development of big data and big data technology, big data has become an industry with a revenue value of hundreds of billion. The data processing in the big data industry, more generally, consists of n stages of data processing flow from upstream to downstream, where n is a natural number, as follows.

$$DP1, DP2, \ldots., DPn \tag{2}$$

Where DP is the abbreviation of data processing. Corresponding to each of the above stages of the data processing flow, there is intelligent analytics, a set of analytics, for example,

$$DP1analytics, DP2analytics, \ldots., DPnanalytics \tag{3}$$

Every DPi (i$\in$ {1, 2, . . ., n}) analytics might be renamed properly.

With the further development of the big data industry, the number n will be increased to very great and even to infinity (∞). Therefore, more and more new intelligent analytics and their services will be emerging [1]. There are also more challenges and opportunities for developing big data analytics and intelligent analytics as a system or as a service based on data processing flow.

In addition, a full analytic workflow encompasses stages from data preparation via visual exploration to insight generation [1]. This corresponds to the proposed data processing flow and leads to data processing flow-based analytics. One who controls the data processing flow-based analytics from upstream to downstream will dominate the data industry, just as Google has been doing.

4 RESPONSIBLE BIG DATA AND BIG DATA ANALYTICS

This section looks at responsible big data and big data analytics based on two case studies.

Based on Cambridge Dictionary [16], the term responsible means 1. "having control and authority over something or someone and the duty of taking care of it or them" 2. "Having good judgment and ability to act correctly and make decisions on you own". Therefore, big data analytics is responsible if it satisfies the following three conditions.

- It has control and authority over something or someone.
- It has the duty of taking care of it or them.

- It has good judgment and the ability to act correctly and make decisions properly based on the existing law and rules.

Responsible big data and e-business services can be defined in a similar way. The responsibility of big data and big data analytics is relative in terms of individual, organization, community, society, and world. That is, for example, big data analytics should be responsible for individuals, organizations, people, community, country, national interest, and for international fairness. The following two cases will look at if the big data and big data analytics of Facebook and Google are responsible for individuals, communities, and societies.

Cambridge Analytica (CA) was a British analytics firm and aimed to use big data to build detailed and deeply personal, psychological profiles about people and then target them with what is essentially emotional manipulation in the form of ads [17]. CA had an app, which had collected and exploited a total of over 87 million Facebook users' data before the profiling was exposed [10, 18]. CA could have created psychological profiles of 230 million Americans according to estimates. At that time, Facebook's platform did permit the apps to access the data from the users of the app and their friends, unless the friends explicitly prohibited the collection in their privacy settings [17].

In March 2018, CA was accused of engaging in enhanced microtargeting and unethically using this information to support political campaigns in various countries [10]. CA used behavioral microtargeting through its massive dataset to deliver targeted messages supporting the Trump campaign in the 2016 US Elections [17].

The Facebook-CA data and analytics case raised several ethical issues related to the responsible usage of big data by social networking sites, including user data collection and use practices [10, 17].

In February 2021, Facebook banned Australian users from viewing or sharing news content from publishers' pages on the platform in response to a proposed media bargaining law in Australia that would make data giants pay for news content on their platforms [19, 20]. Australian authorities had drawn up the laws to "level the playing field" between the data giants and struggling publishers over profits. Of every Aus$100 spent on digital advertising in Australian media these days, Aus$81 goes to Google and Facebook. Under the ban, Australian publishers were also restricted from sharing or posting any links on their Facebook pages. Facebook also denied Australian access to many key government agencies, including police and emergency services, health departments, and the Bureau of Meteorology. This action was irresponsible from an Australian government viewpoint. The ban sparked an immediate backlash. Many Australians were angry about their sudden loss of access to trusted and authoritative sources. This action also forced some Australians to select other choices to replace the big data and big data analytics services of Facebook.

Both of the above-mentioned cases are related to responsibility and accountability. Responsible big data and big data analytics are required at every stage along with the data processing flow from upstream and downstream. A new issue raises here: How can responsible big data and big data analytics be applied to obtain responsible e-business services through monetization of big data and big data analytics as an e-business service?

5 APPLYING RESPONSIBLE BIG DATA ANALYTICS TO OBTAIN RESPONSIBLE E-BUSINESS SERVICES

This section looks at big data analytics services as an e-business service and proposes two strategies on how to apply responsible big data analytics to obtain responsible e-business services.

5.1 Responsible e-Business Services

Digital information sharing is indispensable for our work and lives in the digitalized society in general and in the COVID-19 pandemic. Facebook is a digital giant with a set of e-business services on that many rely daily, just as they rely on foods for daily survival. The question is: are the e-business services of Facebook responsible to ban news sharing to Australian people recently?

Making data available to external organizations is a key mechanism for business-to-business (B2B) e-business services in the age of big data [7]. Big data analytics has increased the use of this digital data exchange thanks to AI and cloud computing. Open data initiatives, data marketplaces, and vendors that offer data sets are also emerging in every aspect of business and society. The core services of e-business giants including Facebook, Google, Amazon, and Alibaba are big data services and big data analytics services. Are their e-business services responsible? These issues require solutions to responsible e-business services.

5.2 Big Data Analytics Services as an e-Business Service

Currently, big data and big data analytics are based on four cutting-edge technology pillars of cloud, mobile, big data, and social technologies [1] [3], each of these pillars corresponds to a special kind of e-business services, that is, cloud services, mobile services, e-services, and social networking services; all these constitute modern e-business services. Each of these services has been empowered by sophisticated ICT technologies including big data and big data analytics [1, 11], as shown in Figure 2.

Currently, the core services and technologies of big data analytics include [1]:

- Support building, deployment, and management of analytics in the cloud based on data stored both in the cloud and on-premises through cloud analytics technology.
- Enable users to connect to, query, and ingest data, while optimizing for performance.
- Support for drag-and-drop, a user-driven combination of data from different sources, and the creation of analytic models through data preparation technology.
- Automatically generate and curate a searchable catalog of analytic content, and package and deliver analytic content in a compelling, easily understood form for presentation to decision-makers through insight generation and interpretation technology.
- Apply AI techniques to automatically generate findings or insights for end-users.
- Support for highly interactive dashboards and exploration of big data through data visualization technology.

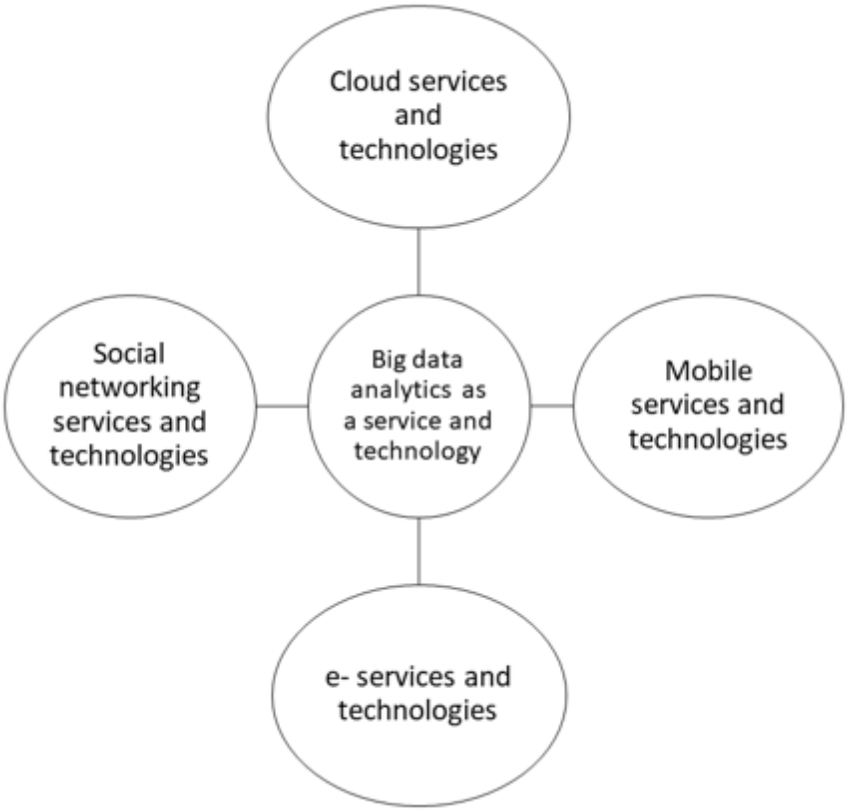

Figure 2: Big data analytics as a service is at the center of e-business services

- Create and distribute intelligent reports for end-users through visualization and reporting technology.

In addition, techniques of security, management, natural language query and generation have also built-in big data analytics to empower e-business services [1].

5.3 Applying Responsible Big Data Analytics to Obtain Responsible e-Business Services

This subsection proposes two strategies on how to apply responsible big data analytics to obtain responsible e-business services.

The first strategy is that big data analytics and its services should meet the basic ethic standard mentioned in the top nine ethical issues in AI [21, 22], besides satisfying the three conditions mentioned in the definition of responsible big data analytics.

- Unemployment. What happens after the end of jobs?
- Inequality. How is the wealth created by AI machines distributed?
- Humanity. How do machines affect the behavior and interaction of people?
- Artificial stupidity. How can AI be guarded against mistakes?
- Racist robots. How can AI bias be eliminated?
- Security. How can AI be kept safe from adversaries?
- Evil genies. How can AI be protected against unintended consequences?
- Singularity. How does one stay in control of a complex intelligent system?
- Robot rights. How can the humane treatment of AI be defined?

Responsible big data analytics should provide a rational and satisfactory answer to each of the above for the world, taking into account the existing regulations and laws worldwide. The second strategy is that big data analytics and its services should be explainable, that is, every service of big data analytics should be explainable and auditable based on the new regulation of AI systems [23]. In such a way, the scandal of Facebook and Cambridge Analytica or similar ones can be avoided [17]. Big data analytics and its services can also be used responsibly to obtain responsible e-business services.

6 RELATED WORK AND DISCUSSION

This section will discuss the related work on responsible big data analytics and their incorporation into e-business services, based on big data-driven small data analysis [13]. It also examines the limitations of this research.

Google Analytics as a data processing flow-oriented analytics is a contribution to the academic community and industry. The proposed model is revised from the four layers from bottom to top: 1. Foundation, 2. analyze, test, and grow, 3. Collect and clean,

and 4. reporting, proposed by [14], based on the lifecycle of data mining [24]. The proposed model for data processing flow-oriented Google Analytics is also motivated by analytic flow [1], supply chain management [6] as well as petroleum and chemical industry. Therefore, the proposed model is a unified model of integrating data processing and analytic flow. The extended form of the proposed model is data processing flow-based big data analytics: A unified perspective.

Google search for "responsible data analytics" found about 16,600 results (retrieved on July 7, 2021). This implies that responsible data analytics has appealed to academia, industries, and governments. Google Scholar search for "responsible data analytics" found 25 results (retrieved on July 7, 2021). This implies that responsible data analytics is still an emerging discipline in academia although AI and business analytics have become hot topics. Among these 25 results, for example, Leonard considers trust, fairness, transparency, and discrimination as the concerns for responsible data analytics [25]. Clarke proposes the principles and business processes for responsible AI [26].

Big data analytics for e-business services has drawn increasing attention in the computing, business, and e-commerce community. For example, de Véricourt and Perakis consider the management of data analytics services as one of the frontiers in service science [27]. However, they have not detailed the issues of responsible data analytics services.

A limitation of this research is that it should provide a deeper investigation into the case of Facebook and Google in terms of big data and big data analytics services to provide more rationales for responsible big data analytics. Another limitation of this research is that it should provide more practical strategies for applying responsible big data and big data analytics to responsible e-business services because responsible big data and big data analytics for enhancing responsible e-business services is the real expectation from most customers. We will delve into this challenge through theoretical investigation and experiential study as the future work.

7 CONCLUSION

This paper examined responsible big data analytics for e-business services. This research highlights: 1. Responsibility is important not only for big data analytics but also for e-business services. 2. Big data and big data analytics services are of significance for the development of e-business services. 3. It is important to address the research question: How can responsible big data analytics be used to obtain responsible e-business services and make responsible decision making. The research demonstrated that responsible big data analytics for e-business services is an important part of "Responsible AI and analytics for an ethical and inclusive digitized society", which has become a theme for research and development of AI, analytics, and e-services (https://www.i3e2021.com, retrieved on July 7, 2021). This paper has at least two main contributions: 1). It presented a data processing flow approach to big data analytics 2). It proposed two strategies on how to apply responsible big data analytics to obtain responsible e-business services.

The future work will survey information technology managers to collect data on the acceptability of responsible big data analytics for e-business services. Based on this planned survey, further work will investigate how responsible big data analytics could be used for empowering e-business services. Another future work will explore intelligent techniques of responsible big data analytics and their applications in e-business services.

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