

ABSTRACT

Big data refers to the huge amounts of information in the structured and unstructured form that cannot be processed using traditional data systems. Big data technology facilitates the utilization of high volumes of external and internal data to create new products, services and improve business operations. In the era of big data, airlines can provide services that are more satisfying to customers and to stay competitive in their fierce marketplace. Airlines can reap many benefits from big data, but many challenges still remain. This study illustrates how airlines successfully adopt big data technology. The paper also explores the opportunities and challenges of big data in the airline industry. Based upon the qualitative approach, 27 semi-structured interviews with employees and experts at airlines in Egypt were conducted. The findings reveal that big data has a great importance in providing broad opportunities for airspace management, enhancing flexibility in dealing with each passenger, boosting problem solving, supporting decision, providing safe flights, boosting predictive maintenance, and improving performance. The findings illustrate a range of challenges that airlines may face when dealing with big data, such as shortage of qualified human resources, absence of data-driven culture, dealing with and processing huge amounts of data, as well as data privacy and security issues. Finally, implications for practice as well as future researches are discussed.

INTRODUCTION

With the advent of digitalization, more enterprises are adopting big data and business analytics to analyze available data in order to improve their products, services and sustain smart decision-making (Maroufkhani et al., 2019). The development of big data management research has generated a range of analytical tools that could be utilized to better respond to such sudden 'black swan' risks, like COVID-19 pandemic (Ienca and Vayena, 2020). Big data was described as the massive volume of both structured and unstructured data, difficult to process using common software techniques or by using traditional statistical methods (Baggiom, 2016). Big data is being generated through different sources including internet traffic, mobile Hamida Mohamed and Mahmoud Al-Azab, (JAAUTH), Vol. 21 No. 4, (December 2021), pp.73-108 transactions, user generated content, and social media (George et al., 2014). There are also sources of big data such as the content captured through sensor networks, business transactions, and many other domains such as bioinformatics, healthcare, and finance (George et al., 2014). Big data provides promising opportunities for modern societies and companies (Fan et al., 2014). It helps companies understand the purchasing behavior of the customers to create more efficient marketing strategies (Sternberg et al., 2018). It may also lead to more

accurate analysis, more valuable decision-making, and greater operational efficiencies (Song and Liu, 2017). Extracting insights from big data includes two main sub-processes (Gandomi and Haiderm, 2015): data management and data analytics. Data management comprises processes and supporting technologies to acquire and store data and to prepare it for analysis (Larsen, 2013). On the other hand, data analytics refers to techniques used to analyze and acquire intelligence from big data. Big-data analytics is the process of examining huge amounts of data of a variety of types to discover hidden patterns, indefinite correlations as well as other useful information (Larsen, 2013).

Airlines described big data as the “third wave “, after traditional databases and webbased content (Hausladen and Schosser, 2020). The airline industry is characterized by low profit margins, frequent entry of new players, disruptive competition, fierce airfare wars, severe legal and safety requirements (Chen et al., 2016; Kastur et al., 2016). The adoption of big data technology can transform the organizational airline operations in different ways (Odarchenko et al., 2019); 1- ground handling preparations are faster due to a reduction in the processing cycle time, 2- data analysis offers the ideal solutions in the field of airspace management, which in turn increase efficiency; 3- data analysis allows airlines to discover an individual approach to each passenger. Besides, big data offers unique advantages for airlines in achieving new sources of competitive advantage, including optimizing operations, customer intelligence, innovation in products and services, personalized marketing, better pricing and cost reductions (Fan et al., 2014; Chen et al., 2017; Lee, 2017; Sternberg et al., 2018; Odarchenko et al., 2019).

Big Data: Definitions and Characteristics

Big data is considered a driving force that can enhance economic growth, prosperity and solve societal problems (Mayer-Schönberger and Cukier, 2013; Verhoef, et al., 2016). Big data comprises an array of modern analytical technologies and business possibilities (Mikalef et al., 2018). These new systems handle a wide range of data, from sensor data to Web and social media data that enhances business agility by fostering automated real-time actions and immediate decision making (Mikalef et al., 2018). Moreover, big data is a cultural and technological phenomenon that stands on the interaction of (1) Technology: maximizing computation power to gather, analyze, link, and compare large datasets. (2) Analysis: to identify patterns in order to make economic, social, technical, and legal claims. (3) Mythology: large datasets offer a higher form of intelligence and knowledge that can provide insights that were previously unfeasible (Boyd and Crawford, 2012). Big data represents the information assets characterized by such a high volume, velocity and variety to require specific technology and analytical methods for its transformation into value (De Mauro et al., 2015). In sum, it is a larger-scale and complex data that traditional data processing applications and software tools are insufficient to capture, curate, manage, and process it within a reasonable period of time

(Snijders et al., 2012). Big data is commonly described by the three “Vs”, volume, velocity and variety of data (Laney,2001; McAfee and Brynjolfsson, 2012). Most definitions of big data include the three main characteristics of volume (amount of data), velocity (speed of data in and out), and variety (range of data types and sources) (Song and Liu,2017). Volume refers to the sheer amount of data available for storage, processing, and analysis (Hausladen and Schosser, 2020). This includes all data sources from aircraft, airports, and institutions strongly connected to them, which could be databases of maintenance centers, weather stations, satellite networks, and the Internet (Yin and Kaynak, 2015; Kasturi et al., 2016). Velocity refers to the speed at which data are generated and processed (Lee, 2017). Variety refers to the different types and sources of data collected (Akter, 2016). In aviation, very large amount of flight data is generated and there is an essential need to analyze such data in real time (Kasturi et al., 2016). Technological advances allow firms to use various types of structured, semi-structured, and unstructured data (Lee, 2017). Structured data refers to the tabular data found in spreadsheets or relational databases (Gandomi and Haider, 2015). Text, images, audio, and video are examples of unstructured data, Extensible Markup Language (XML), a textual language for exchanging data on the Web, is a typical example of semi-structured data (Gandomi and Haider, 2015). Some data types of aircraft parameter may be structured some may not (Kasturi et al., 2016).

Big Data Analytics

There has been considerable attention from both academics and practitioners on the value that organizations can derive from the use of big data analytics towards the attainment of organizational goals (Mikalef et al., 2019). Big data analytics was regarded as the leading future for innovation, competition, and productivity (Manyika et al., 2011). Big data analytics is defined as a collection of data and technology that accesses, integrates, and reports all available data by filtering, correlating, and reporting insights (Jifan Ren et al.,2017). Big data analytics is considered a new generation of technologies, designed to extract value from very large volumes of a wide selection of data, by enabling high velocity capture, discovery and/or analysis (Mikalef et al, 2017). The airline industry is pioneered in adopting big data analytics (Sternberg et al., 2018). Big Data analytics could increase the business performance (McAfee and Brynjolfsson, 2012). According to Labrinidis and Jagadish (2012), Bendre and Thool (2016) and Burmester et al. (2018), big data analytics revolve through the following five stages:

1. Data generation or integration: Large amounts of data can be gathered from different applications such as publishing factual data, search engine pages, world events, social media graphs, analysis of natural language content, BBC online content, etc., with different types for future analytics (Sikos, 2015).
2. Data acquisition or management: It is the process of gathering, filtering and cleaning large amounts of data (Lyko et al., 2016).

3. Data storage: The platform with a clustered network of servers and community hardware are used to store the data (Bendre and Thool, 2016).

4. Data analytics: It is the process of examining useful information from the huge data storage using complicated machine learning and data mining techniques (Chen et al., 2014).

5. Data visualization or knowledge presentation: The graphical format representation of data can easily be understood and represented in a simple way (Bendre and Thool, 2016).

In addition, the following techniques represent a significant subset of the tools available for big data analytics (Gandomi and Haiderm, 2015; Bendre and Thool, 2016):

- Text analytics: refers to techniques that extract information from textual data. Social network feeds, emails, blogs, online forums, survey responses, corporate documents, news, and call center logs are examples of textual data.
- Multimedia data analytics: It is a process of finding useful insights from images, audio files, and videos.
- Web data analytics: It is a process of measurement, collection, analysis, reporting and viewing of web data.
- Social media analytics: social media analytics refer to the analysis of structured and unstructured data from social media channels.
- Mobile analytics: It refers to analyzing data collected from user's different activities such as websites visits, install-uninstall applications, play online games, make online transactions and so many discussions through mobile phones.

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Conclusion

Big data as a new technology paradigm for data that is generated at high velocity and high volume, and with high variety, has captured the attention of both researchers and practitioners. Davis (2014) describes big data as expansive collections of data (large volumes) that are updated quickly and frequently (high velocity) and that exhibit a huge range of different formats and content (wide variety). Big data analytics is a process of examining information and patterns from huge data. The airline industry is interesting because of its importance to the global economy, international presence and fierce competitive environment (Sternberg et al., 2018). The current paper is one of the studies that inductively explain the challenges and opportunities that big data can provide to airlines. For this purpose, an inductive qualitative analysis based on intensive semi-structured interviews have been conducted with employees and experts at airlines in Egypt (N=27). The findings provide several insights into the main challenges that airlines may encounter as well as the opportunities they may capture in the aviation industry, which has enabled the development of a theoretical framework explaining these challenges and opportunities and other issues related to big data in airlines (see Figure 3). The results advocated that the concept of big data from the point of view of airline employees differs from one individual to another. The interviewees considered big data as all data related to the customer from personal data, contact data, customer's profile on social networking sites and e-mail, while others highlight that big data in airlines relates to all data related to the flight from reservation data and data related to ground and operational services as well as services provided before, during and after the flight. This difference may be due to their work affiliation, as each of them observes the concept of big data according to his position in the airline and the type of data he deals with.