Contents lists available at EKB

Minia Journal of Tourism and Hospitality Research

Journal homepage: https://mjthr.journals.ekb.eg/

Big Data Analytics Application in EGYPTAIR: Perceived Benefits, Skills and Development

Ahmed Mabrouk Moftah Attia [a] , **Wafaa Ahmed Elias** [b]

Hussein Abdel Wahab Abdel Rady [c]

[a] Assistant Lecturer, Tourism Studies department, Faculty of Tourism and Hotels, Minia University
[b] Professor, Tourism Studies Department, Faculty of Tourism and Hotels, Minia University, Egypt
[c] Associate Professor, Tourism Studies Department, Faculty of Tourism and Hotels, Minia University, Egypt

Keywords

Big Data,

Big Data Analytics

EGYPTAIR Airlines

Abstract

This research paper attempts to investigate big data analytics application in EGYPTAIR, bringing to the fore its perceived benefits, skills and development. The enormous volume of both organized and unstructured data that is difficult to process using standard software approaches or by utilising conventional statistical methods is referred to as "big data". The aviation sector is a typical candidate for the usage of big data technologies due to the volume of data produced. A few examples of the data that must be considered include passenger data, weather data, aircraft maintenance data and air traffic data. This study examines the benefits, Skills, and training needed programs of big data in EGYPTAIR Airlines. To that end, this research uses a questionnaire form and a descriptive analytical methodological approach. The sample consists of (294) EGYPTAIR airlines employees. The research shows that big data has major benefits in providing broad opportunities for EGYPTAIR Airlines management, enhancing flexibility in dealing with each passenger, problem solving, supporting decision making, growing predictive maintenance and improving performance. Moreover, one negative result is the weakness of employees training directed to EGYPTAIR airline employees to enhance their knowledge and skills for big data analytics such as “Maintains security and data privacy skills” and “Statistical analysis technologies”.

Printed ISSN 2357-0652 **Online ISSN** 2735-4741

1. Introduction

Ward and Barker (2013) argue that big data is large and complex data sets that arestored and processed using a variety of methods, such asNoSQL, Map Reduce, and machine learning. According to Zhou *et al.* (2014), One of the major trends is the term "big data," which gives rise to additional research as well as applications in industry and government. Data is regarded as a potent raw resource that can influence the outcomes of diverse research projects as well as those of businesses and governments.

Big data is a term used to describe data that is big in volume, high in velocity, and/or high in variety. It demands new technologies and techniques to gather, store, and analyze it. It is then utilized to support and optimise business processes. Social media, devices, log files, video, text, and image files, Radio Frequency Identification (RFID), and the Global Positioning System (GPS) are just a few of the emerging sources of big data (Watson, 2014).

Big Data is a buzzword that is currently popular in both academics and business, although its definition is still rather ambiguous. They suggest the following formal definition because it is used to define a wide range of topics, including the technological ability to collect, store, and analyze data as well as the cultural shift that is profoundly affecting business and society, both of which are suffocating in information. Big Data is a type of information asset that has characteristics like great volume, high speed, and high variety, making it difficult to evaluate without the use of specialist technology and analytical methods (De Mauro *et al.*, 2015).

To achieve the research aims and objectives there are two supporting questions which would be addressed through the research.

- What is the current situation of big data analytics applications in EGYPTAIR?
- What are the challenges to using big data analytics applications in EGYPTAIR?

2. Literature Review

Big Data Phenomenon

Elmasri and Navathe (2011) point out that a conventional database is a compilation of applicable data, which is defined as well-known information that may be stored and has some sort of implied importance. Give the names, contact information, and addresses of the people you know, for instance. Using a computer and programs like Microsoft Access or Excel, you have entered these details in an address book that is indexable or have saved them on a hard drive.

A database is a grouping of connected data that has implicit significance. Big Data, however, refers to datasets that are larger than what conventional database software tools can gather, save, organize, and process (Manyika *et al.*, 2011). According to Tech-America Foundation's Federal Big Data Commission (2012), big data is a term that refers to massive amounts of fast-moving, combined, and varied data that need sophisticated methods and tools to be captured, distributed, managed, and processed.

Mayer-Schönberger *et al.* (2013) state that big data is a phenomenon that causes three significant changes in the way information is analyzed, changing how society is understood and managed: (More data, more analysis, correlation takes the place of causality).

Characteristics of Big Data

Lakshen *et al.* (2016) suggest that one of the best examples of the "knowledge economy" is big data, which also represents a developing area of study for academics and professionals. Big data refers to big data sets that are developed from scratch, collected from a variety of sources, and are of diverse forms, and definition of big data contain:

- Volume: refers to the significant amount of data that diverse sources generate each second.
- Velocity: Indicates how quickly data can be gathered and analysed.
- Variety: This term indicates that the incoming data may be structured, semi-structured, unstructured, or multi-structured.
- Value: The information that is helpful among this vast volume of data
- - Veracity: refers to the accuracy and correctness of the data. But according to Owais and Hussein, Bendle and Wang (2016) added 4v:
- Variability: denotes data whose meaning is constantly changing.
- Validity: This term describes if the data is accurate and correct for the intended application.
- Volatility: Indicates how long a company must keep data on hand.

- Visualization: the display of data in an understandable and readable way to aid in decision-making.

Big Data Analytics and Techniques

As Sondergaard and Berners-Lee (2019) have put it, the combustion engine of the twenty-first century is analytics, and information is its oil. The following lifecycle is followed by big data (to Data Acquisition, Data Storage, and Data Analytics, from Data Generation to Data Visualization)

a) *Data Generation:* Gathering information from different sources (sensors, video, etc...)

b) *Data Acquisition:* the method of extracting knowledge from data through:

1. Selection data: Choose relevant information that will be useful for the analysis.
2. Pre-processing data: data that is superfluous and inconsistent can be found, cleaned, and filtered.

c) *Data Storage:* continuously storing.

d) *Data Analytics:* The process of obtaining practical insights through the use of both qualitative and quantitative methods is known as analytics:

1. Data Transformation: After data has been gathered, chosen, and preprocessed, it must then be converted into a format that can be mined for data.
2. Data analysis: Various statistical techniques and data mining algorithms, such as regression, classification, and clustering, can be used to analyze data after it has been transformed.

Rabhi *et al.* (2019) mentioned that data Visualization: a dynamic display of data insights that goes through:

3. Evaluation: Count the outcomes of data analysis;
4. Interpretation: interactively displaying the results of data analysis.

In aviation, there is an urgent need to examine the vast amounts of flight data that are generated in real time (*Kasturi et al.,* 2016). Various sorts of organized, semi-structured, and unstructured data can be used by businesses thanks to technological advancements (Lee, 2017).

Aviation Big Data Platform and Information System

Massive quantities of various, intricate, unstructured, and constantly transforming data, or "big data," are present in the aviation sector. For organizations that need to support their operations and enhance the processes they are carrying out, this needs the use of specialized analysis tools to examine it in order to gain relevant knowledge as decision-support (Andronie, 2015).

As Singh and Kaushik (2015) point out, big data has completely changed how the aviation business has developed. It is important in many aspects of aviation, comprising air traffic control, route planning, crew management, air logistics management, flight and airport management, aircraft design and performance enhancement, aircraft operation and malfunction, and maintenance. Due to the complexity of the aviation system and big data, the study of the aviation big data system must use the multilayer network correlation analysis approach. Its essential elements include same layer correlation analysis, adjacent layer correlation analysis, and interlayer correlation analysis.

By being able to collect and analyze enormous volumes of data from both inside and outside the firm, big data enables airlines to differentiate themselves from the competition and keep their position at the top of the market. The analytics system for the organization must operate faster than potential changes in market conditions and client demands. Airlines can utilize the information to boost sales and increase the proportion of repeat customers while cutting operating costs (Sumathi, *et al.*, 2017).

Mikalef *et al.* (2019) affirm that big data enables decision-makers in the aviation industry to better identify issues and acquire deeper knowledge. The fundamental barrier to the growth of the contemporary aviation business has always been inadequate and unequal information. The key to realizing and creating global value is how to realize the organic integration of customer-centered logistics/service flows, value flows, and information flows. Only big data is closely related to Internet

of Things and artificial intelligence can provide the best solutions. Modern aviation industrial production has shifted to a global supply chain pattern.

It is evident that the big data platform for aviation technology and management includes the two essential aspects of big data. In order to ensure flight safety and improve aircraft performance, big data in aviation is largely utilized to record and reflect basic aspects of aircraft design and performance, operational conditions, multifunction diagnostics, and maintenance. Two of its two sub data systems are big data on aircraft operating conditions, malfunction detection, and maintenance, as well as big data on aircraft design and performance enhancement (Dou, 2020). Sun *et al.* (2021) report that big data is largely used in aviation management to collect and reflect the status of aeronautical operations and operational performance, contributing to the maintenance of aviation traffic safety and the improvement of operational performance. Two of its components contain big data in aviation management: macro and micro.

Macro aviation management big data primarily captures and reflects the fundamental states of flight environment, safety management, and route planning. Due to the rise in aerospace vehicles and the shortage of available air route resources, big data are increasingly important in route planning and air traffic control (Holloway, 2016). Big data from micro-aviation management, like that from flight and aviation business management, mainly documents and reflects the core elements of flight and aviation business management. Flight management, which encompasses crew, airport, and flight management, is directly tied to both the regular operation and safety of flights (Milne, 2009). As the inadequacies of conventional manual management systems become more apparent, big data is becoming an increasingly important factor. Aviation business management includes the administration of air logistics as well as aviation operations and services. The aviation logistics market has grown as a direct result of the growth of the civil aviation industry. Therefore, how to secure its security and improve its operational performance is a real topic of concern for aviation firms (Dou, 2020).

The Benefits of Big Data in Airline Travel

a) Better Decision Support

Many travel companies employ big data to improve internal or customer-focused decisions in addition to hastening decision-making and data analysis. These can occasionally benefit from modern technology's quicker big data processing speeds. Frequently, the relevant data is of an internal nature. For instance, these systems store a variety of client information that may be utilized to improve marketing and customer service practices, such in the "British Airways" case study. Big data from outside sources may also be used to enhance other choices made by the travel industry, with advantages for efficiency and safety. For instance, the examination of macroeconomic and weather data could improve forecasting customer demand (Buhalis & Amaranggana, 2013).

Frank *et al.* (2017) argues that although they are not currently exploring such applications, a number of airline executives affirm the potential for predictive maintenance of aircraft, engines, and other equipment based on sensor data.

b) New products and services for consumers

The creation of brand-new consumer goods and services is among the most exciting effects of leveraging big data. Outside of the tourism industry, businesses like Google, LinkedIn, and Facebook have aggressively pursued this benefit. Online travel agencies, travel search businesses, and significant technology suppliers are most likely to be the manufacturers of data-based goods and services in the travel sector. For example, Amadeus has developed the featured results and extreme search capabilities for its users to enhance the travel search experience (Del Vecchio *et al.,* 2014). The travel search engine Hipmunk has created new features including the Ecstasy Index for hotel searches and the Agony Index for evaluating airline tickets. A forecasted pricing offering has been produced by the travel meta-search website KAYAK. Predictive maintenance services may be offered by suppliers of aircraft components. Vendors of travel management services could offer new data-based goods and services to people and businesses (Buhalis & Amaranggana, 2013). With the aid of advanced machine learning algorithms, regulated ad hoc online trials, and enormous volumes of online customer reviews, a new generation of big data analytics businesses are forecasting demand and assessing the market potential for new goods across many industries (Mariani &Wamba, 2020).

c) Better and Stronger Consumers Relationships

As Johannes (2016) has put it, data aggregation should give rise to stronger consumers interactions as historically, customer relationships have been dispersed across numerous systems and databases, which should increase consumer income from more precisely targeted goods and services. Each passenger's preferred travel locales, food and lodging choices, supplementary service requirements, and travel experiences can be determined using predictive analytics. Online analytical services that estimate prices and rank things according to their desirability can make people more likely to buy them.

d) Cheaper and faster data processing

Marr (2017) suggests that information technology advancements have historically been embraced in part due to their improved price/performance ratios. Given the enormous amounts of data that travel businesses must process and the industry's generally low profit margins, it is clear why less expensive, faster big data solutions are appealing. Data processing can be done for fifteen to twenty times less with commodity server clusters running Hadoop and other open-source software compared with earlier data warehousing technology.

Big data is crucial to the operations of companies like airlines and hotel chains, for instance, but Hadoop-based systems are less dependable and secure than earlier

generations of technology. There is a difficult to integrate Hadoop-based designs with the "old" technology systems that are now in use. However, some well-known tour operators, like Air France-KLM, have started experimenting with it and want to utilize it in production settings (Del Vecchio *et al.*, 2014).

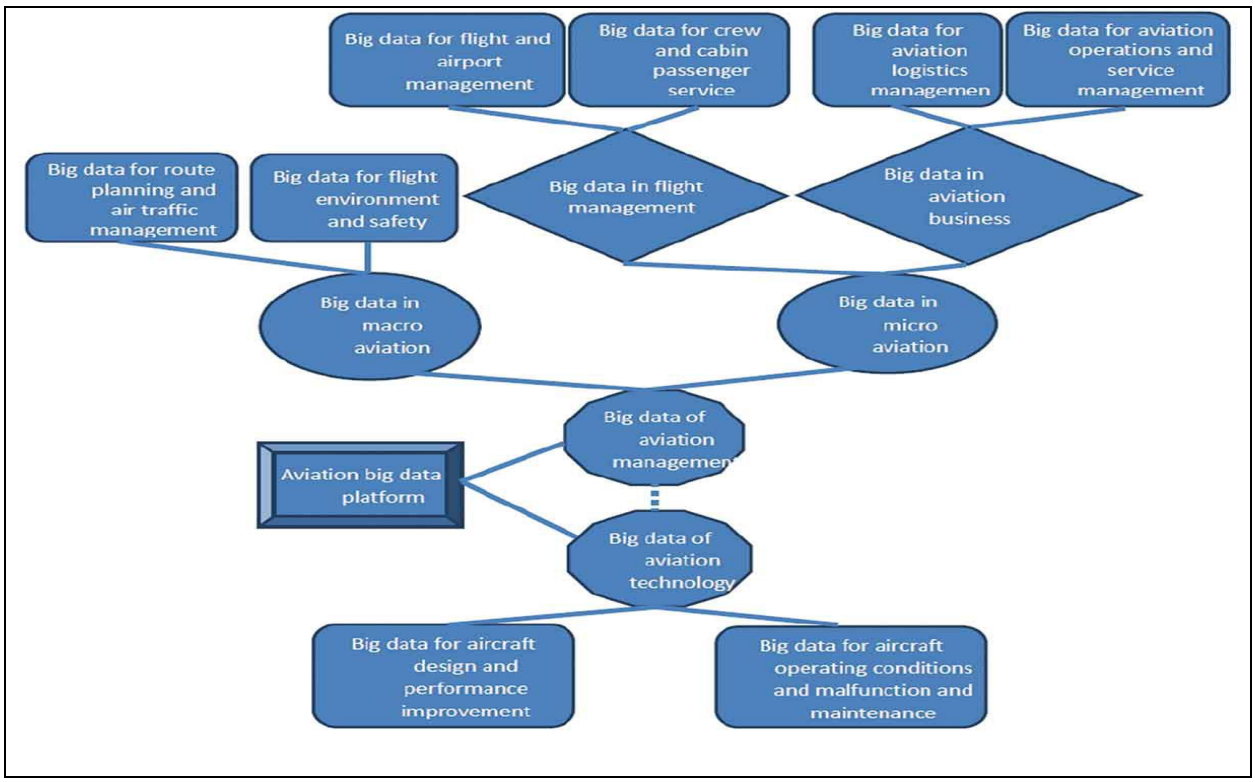

Figure (1): Aviation big data platform and information system

Source: Dou (2020)

3. Research Methodology

A descriptive analytical approach is adopted throughout this research, where a questionnaire was prepared and distributed to a random sample of EGYPTAIR airlines employees. To achieve the general aim of the research and the objectives.

a) Data Collection

Online surveys were used to gather data, and they were designed in a way that was per tinent to the circumstances in order to reduce the number of unreliable responses.
They were distributed to (294) employees in EGYPTAIR Airlines during three months from December 2021 to February 2022.

b) Questionnaire Design and Measure

The research's overall aim is, as previously stated, to shed light on benefits, Skills, and training needed programs of big data in EGYPTAIR Airlines from employees' perspectives. This aim can be achieved through three major objectives: assessing "the employees' skills of big data and training programs in EGYPTAIR airlines", "the

culture of big data in EGYPTAIR Airlines", and "the challenges of use big data in EGYPTAIR Airlines".

The questionnaire form consists of three main sections. Section one is about demographic information provided general information about EGYPTAIR Airline employees, such as their age, educational level and years of experience. Section two contains five dimensions; the first dimension is question about the awareness of big data phenomenon. Dimension two includes question about the importance of big data analytics application in EGYPTAIR airlines. Dimension three includes questions about the big data analytics skills of EGYPTAIR employees. Dimension four includes questions about the training programmers for dealing with big data analytics in EGYPTAIR organized. Dimension five includes information about challenges that appear while dealing with big data analytics in EGYPTAIR airline. The questionnaire's dimensions three and six were anchored according to three-point Likert Scale.

c) Data Validity and Reliability

Data Validity

To verify the readability, format, and measurement capabilities of the data collection tool used in this study's data collection; the researcher distributed the questionnaire instrument to a number of (4) employees in EgyptAir Airlines. The questionnaire instrument was then updated and refined to reflect the comments and suggestions received by the domain employees.

Data Reliability

The degree of accuracy and consistency with which an instrument measures w hatever it is measuring determines how reliable the instrument is **(Ary et al., 2002)**. In order to verify accurate measurement across all questionnaire items before moving on to further analysis, reliability testing was conducted. In actuality, a measure's dependability reveals the consistency and stability of an instrument. In order to assess reliability, the internal consistency of the research instrument, such as the questions (items) in the questionnaire that are regularly offered, is analyzed. Cronbach's alpha coefficient measures this effect and ranges from 0 (no internal consistency) to 1 (maximum internal consistency) (Döckel, 2003).

Cronbach's Alpha Reliability was determined as shown in the table (1). The test results show that the reliability coefficients for all EGYPTAIR employee's questionnaire are equal 0.746 and for all sections the validity coefficient is equal 0.864, which clarifies that the instrument is reliable for being used.

Table (1): Cronbach's Alpha Value

Reliability Statistics		
Cronbach's Alpha (α)	Validity	No. of Items
.746	.864	15

* Validity coefficient = √ Reliability coefficient

To evaluate the constructs used in the study's internal consistency and reliability. The Cronbach's Alpha (α) statistic is used.

Table (2): Cronbach's Alpha Value for EGYPTAIR employees' questionnaire

Variables	No. of Items	Cronbach's Alpha (α)	Validity Coefficient*
The needed skills for big data analytics employees of EGYPTAIR have.	7	.716	0.846
Challenges that appear while dealing with big data analytics in EGYPTAIR.	7	.815	0.903

* Validity coefficient = √ Reliability coefficient

The scales' reliabilities were measured. The Cronbach's Alpha of all scales is presented in table (2) is 0.716 for the needed skills for big data analytics employees of EGYPTAIR have and 0.815 for the challenges that appear while dealing with big data analytics in EGYPTAIR. This means an acceptable Cronbach's Alpha value in each sector, and whenever Cronbach's. this means that the questionnaire form is reliable and valid.

Data Analysis

To achieve the objectives of this study, the research uses the Statistical Package for Social Sciences (SPSS) to process data statistically, including the following statistical methods:

A. Frequency distributions, percentages, means, and standard deviations (SD) describing the characteristics of the study population for the functional variables and figuring out how they react to the study axes.
B. Cronbach's Alpha Test: To determine the questionnaire's stability coefficients and the coefficient of stability for each study axis.

4. Results and Discussion

The results of the questionnaire's EGYPTAIR Airlines employees' dimensions representation is explained in the next section.

Section one: Respondents Demographic Characteristics:

Section one is about demographic information provided general information about EGYPTAIR Airline employees, such as their age, educational level and years of experience.

Table (3) Demographic Characteristics

Items	Categories	Fre.	%
Age	25 Years or less	1	0.4
	From 26 years to 40 years	153	52
	From 41 years to 55 years	140	47.6
Education	High school or less	3	1
	Higher education	287	97.6
	Postgraduate (Diploma, Master, or Ph.D.)	4	1.4
Years of experience	From 3 years to 6 years	6	2
	From 7 years to 10 years	106	36
	More than 10 years of experience	182	62
Total		**294**	**100**

The demographic characteristics of respondents present in Table (3). Most of the employees 52% were aged from 26 to 40 years, whereas 47.6% of them were aged were aged from 41 to 55 years. Regarding the education level, 97.6% of the respondents were Higher education, whereas 1.4% of them were postgraduate (Diploma, Master, or Ph.D.). The majority of the employees' years of experience categories is 62% have more than 10 years of experience, while (36%) of the employees have from 7 years to 10 years of experience.

Section Two:

Dimension one: Awareness of Big Data Phenomenon:

Ninety one percent of employees (91%) are familiar with the meaning of big data, whereas nine percent have never heard of the phenomena. The subsequent analysis does not include the most recent percentage (9%). Thus, the following analysis of 268 replies.

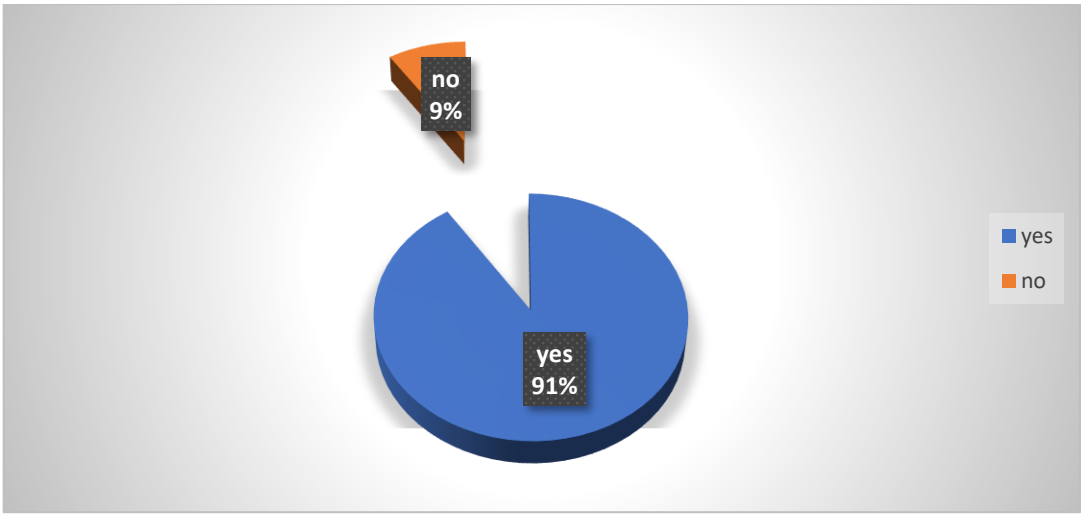

Figure (3) Awareness of Big Data Phenomenon

Dimension Two: The Importance of Big Data Analytics in EGYPTAIR Airlines.

By asking the selected employees, it is found that more than 99% of them know the importance of big data analytics in aviation industry.

Dimension Three: Employees' skills for Big Data Analytics

Dimension three includes questions about the big data analytics skills of EGYPTAIR employees. Three-point Likert scale and seven items of the big data skills that employees of EGYPTAIR they have.

Table (4): Employees' skills for Big Data Analytics

Statement	**%**			**Mean**	**Std. deviation**	**Rank**	**Attitude**
	Not Enough	**Neutral**	**Perfect**				
1.Data handling.	.7	60.1	39.2	2.38	.502	2	Perfect
2.Maintains security and data privacy skills.	39.6	4.9	55.6	2.16	.964	3	Neutral
3.Structured Query Language.	45.9	.4	53.7	2.08	.997	4	Neutral
4.Statistical analysis technologies (such as Scala, Hadoop, Linux, MATLAB, R, SAS, SQL, Excel, SPSS).	49.3	10.8	39.9	1.91	.941	5	Neutral
5.Data mining skills (such as KNIME, Apache Mahout, Rapid Miner).	55.6	17.5	26.9	1.71	.863	6	Neutral
6.Familiarity with public cloud and hybrid clouds (to store data and ensure the high availability of data).	16.8	50	33.2	2.16	.689	3	Neutral
7.Problem solving.	3.7	36.9	59.3	2.56	.568	1	Perfect
Total mean				2.14			**Neutral**

The previous table displays the employees' skills for Big Data analytics items: "problem solving", "data handling", and "maintains security and data privacy skills" with means 2.56,2.38 and 2.16 respectively of the respondents.

Dimension Four: Training Programs for Big Data Analytics

All the employees agree that EGYPTAIR Airlines organizes employees' training programmers for dealing with big data analytics.

To identify which training programs are applied for big data analytics, eleven training programs are gathered from literature. These programs are listed in a table with referring that selecting more than one choice is acceptable. It is obvious from table (5) that the majority of the sample agreed that item of "database architectures" and "SQL-based technologies (e.g., MySQL)" are the most applied training programs. Meanwhile, none of the respondents' state that the other listed training programs are applied.

Table (5): Employees Training Programs of big data analytics

No.	Programs	Yes	
		Fre.	%
1.	Big data Hadoop Ecosystem program.	2	.7
2.	Splunk training: power user and admin.	1	.4
3.	Real-time processing framework (Apache spark and Scala training)	1	.4
4.	PySpark training course.	0	0
5.	Apache Kafka training course.	0	0
6.	ELK stack Training.	0	0
7.	Comprehensive Hive training.	0	0
8.	Database architectures.	262	97.8
9.	SQL-based technologies (e.g., MySQL).	177	66
10.	NoSQL technologies (e.g., Cassandra and MongoDB).	0	0
11.	ETL/Data warehousing solutions (Talend, Informatica) to managing a huge amount of data.	1	.4

Dimension Five: Challenges of big data analytics adaption in EGYPTAIR

The respondents are asked to choose from a list of seven challenges which are the most critical problems need adaption of big data analytics. The statements are measured by three points Likert scale. And the answers are presented in table (6).

Table (6): The Challenges of Big Data Adaption

Statement	%			Mean	Std. deviation	Rank	Attitude
	Disagree	Neutral	Agree				
A lack of professionals in big data analytics applications.	.7	1.1	98.1	2.97	.201	1	Agree
A lack of proper understanding of massive data.	6	11.9	82.1	2.76	.550	2	Agree
A lack of managing large volumes of data.	41.4	33.6	25	1.84	.800	7	Neutral
A lack of technological tools to analyze big data.	2.6	64.2	33.2	2.31	.515	5	Neutral
Confusion when choosing a big data tool.	41.4	9.3	49.3	2.08	.951	6	Neutral
An integration of data from various sources.	1.1	50.4	48.5	2.47	.522	3	Agree
A lack of securing huge data.	19.8	25.4	54.9	2.35	.791	4	Agree
Total mean				**2.40**			**Agree**

It's declared from this table that employees see that all challenges appear while dealing with big data and the most items are: "a lack of professionals in big data analytics applications", "a lack of proper understanding of massive data" and "an integration of data from various sources" with mean 2.97, 2.76 and 2.47 respectively.

5. Conclusion

Following the IT revolution, the corporate sector is currently experiencing the next big data revolution. The big data revolution is mostly due to the massive amount of data that is produced. Aviation and aerospace are examples of industries where big data

solutions can be leveraged due to the volume of data produced by potential passengers as well as by plane sensors and passengers. Just a few of the data that must be considered include passenger data, weather data, aircraft maintenance data, and air traffic data. Handling vast amounts of data will becoming easier as big data technology develops. Future airlines will be able to differentiate themselves from the competitors and keep their lead in the market by being able to produce and analyze large amounts of data, both internal and external. The company's analytics system must be able to adapt to future changes in the market and customer demands more swiftly. Airlines can use the data acquired to reduce operating costs, boost sales, and increase the proportion of return customers.

This paper aims at identifying benefits, Skills, and training needed programs of big data in EGYPTAIR Airlines. For this purpose, this research employed a method of descriptive analytical methodology by using a questionnaire form. The sample is (294) of EGYPTAIR airlines employees.

The following results are obtained benefits areas in airlines where big data systems can be utilized to “cheaper faster data processing”, “better customer relationships” and “new products and services for customers”. This advantage grows as more relevant data is produced. There is lack in big data skills of EGYPTAIR airline employees to enhance their knowledge and skills for data analytics such as “data mining skills”, “statistical analysis technologies”, and “Maintains security and data privacy skills”. As a result of universal interest of the big data analytics applications, EGYPTAIR airline have to apply Baggage tracking radio frequency identification (RFID), Fuel efficiency (performance factor), and Fleet maintenance application. It is important for EGYPTAIR airline to arrange training programs directed to EGYPTAIR airline employees to enhance their knowledge and skills for Big Data Analytics such as Maintains security and data privacy skills, Structured Query Language, Statistical analysis technologies (such as Scala, Hadoop, Linux, MATLAB, R, SAS, SQL, Excel, SPSS), and Familiarity with public cloud and hybrid clouds (to store data and ensure the high availability of data). EGYPTAIR airline should Organize the employees training programs EGYPTAIR for dealing with big data analytics such as big data Hadoop ecosystem program, Splunk training: power user and admin, real-time processing framework (Apache spark and Scala training), PySpark training course, Apache Kafka training course, ELK stack training, comprehensive Hive training, ELK stack training, comprehensive Hive training, NoSQL technologies (e.g. Cassandra and MongoDB), and ETL/Data warehousing solutions (Talend, Informatica) to managing a huge amount of data.

References

- Andronie, M. (2015). *Airline Applications of Business Intelligence Systems*. *Incas Bulletin*, *7*(3), 153.
- Ary, D., Jacobs, L. C., Razavieh, A., & Sorenson, C. (2002). *Introduction to Research in Education* (Belmont, CA: Wadsworth). *Thomson Learning*.
- Bendle, N. T., & Wang, X. S. (2016). "Uncovering the Message from the Mess of Big Data". *Business Horizons*, *59*(1), 115-124.
- Buhalis, D., & Amaranggana, A. (2013). "Smart Tourism Destinations". In *Information and communication technologies in tourism 2014* (pp. 553-564). Springer, Cham.
- De Mauro, A., Greco, M., & Grimaldi, M. (2015, February). "What is Big Data? A Consensual Definition and a Review of Key Research Topics". In *AIP conference proceedings* (Vol. 1644, No. 1, pp. 97-104). AIP.
- Del Vecchio, P., Passiante, G., Vitulano, F., & Zampetti, L. (2014). "Big Data and Knowledge-intensive Entrepreneurship: Trends and Opportunities in the Tourism Sector". *Electronic Journal of Applied Statistical Analysis: Decision Support Systems and Services Evaluation*, *5*(1), 12-30.
- Döckel, A. (2003). "The Effect of Retention Factors on Organizational Commitment: An Investigation of High Technology Employee", Master Thesis, Faculty of Economics and Management Sciences, University of Pretoria.
- Dou, X. (2020). "Big Data and Smart Aviation Information Management System". *Cogent Business & Management*, *7*(1), 1766736.
- Elmasri, R., & Navathe, S. B. (2011). *Database Systems* (9). Boston, MA: Pearson Education.
- Frank, M., Roehrig, P., & Pring, B. (2017). *What to Do When Machines Do Everything: How to get ahead in a world of ai, algorithms, bots, and big data*. John Wiley & Sons.
- Holloway, S. (2016). *Straight and Level: Practical Airline Economics*. Routledge.
- Johannes, M. (2016). *Big Data for Big Pharma: An Accelerator for the Research and Development Engine?* (19). ibidem-Verlag/ibidem Press.
- Kasturi, E., Devi, S. P., Kiran, S. V., & Manivannan, S. (2016). Airline Route Profitability Analysis and Optimization using BIG DATA Analytics on Aviation Data Sets under Heuristic Techniques. *Procedia Computer Science*, *87*, 86-92.
- Lakshen, G. A., Vraneš, S., & Janev, V. (2016). Big Data and Quality: A Literature Review. In *2016 24th telecommunications forum (TELFOR)* (pp. 1-4). IEEE.
- Manyika, J., Chui, M., Brown, B., Bughin, J., Dobbs, R., Roxburgh, C., & Hung Byers, A. (2011). *Big Data: The Next Frontier for Innovation, Competition, and Productivity*. McKinsey Global Institute.

- Mariani, M. M., & Wamba, S. F. (2020). "Exploring How Consumer Goods Companies Innovate in the Digital Age: The Role of Big Data Analytics Companies". *Journal of Business Research*, *121*, 338-352.
- Marr, B. (2017). *Data strategy: How to Profit from a World of Big Data, Analytics and the Internet of Things*. Kogan Page Publishers.
- Mayer-Schönberger, V., & Cukier, K. (2013). *Big Data: A Revolution that Will Transform How We Live, Work, and Think*. Houghton Mifflin Harcourt.
- Mikalef, P., Boura, M., Lekakos, G., & Krogstie, J. (2019). "Big Data Analytics and Firm Performance: Findings from a Mixed-method Approach". *Journal of Business Research*, *98*, 261-276.
- Milne, G. (2009). Airframe Development and Flight Testing for Entry into the 2009 Outback Challenge.
- Rabhi, L., Falih, N., Afraites, A., & Bouikhalene, B. (2019). "Big Data Approach and its Applications in Various Fields". *Procedia Computer Science*, *155*, 599-605.
- Singh, A., & Kaushik, A. (2015). "Knowledge Based Retrieval Scheme from Big Bata for Aviation Industry". In *2015 International Conference on Computational Intelligence and Communication Networks (CICN)* (918-923). IEEE.
- Sondergaard, P., Coase, R., & Berners-Lee, T. (2019). "Information is the Oil of the 21st Century, and Analytics is the Combustion Engine". *Gartner Research, Datasciencecentral. com*.
- Sumathi, N., Gokulakrishnan, S., Kaushik Ramana, S., Muralitharan, R., & Kamal, C. V. (2017). "Application of Big Data systems to Airline Management". *International Journal of Latest Technology in Engineering, Management & Applied Science (IJLTEMAS)*, *6*(12), 129-132.
- Sun, X., Wandelt, S., Zheng, C., & Zhang, A. (2021). "COVID-19 Pandemic and Air Transportation: Successfully Navigating the Paper Hurricane". *Journal of Air Transport Management*, *94*, 102062.
- Tech America Foundation's Federal Big Data Commission. (2012). *Demystifying Big Data: A Practical Guide to Transforming the Business of Government*.
- Ward, J. S., & Barker, A. (2013). "Undefined by Data: A Survey of Big Data Definitions". *arXiv preprint arXiv:1309.5821*.
- Zhou, Z. H., Chawla, N. V., Jin, Y., & Williams, G. J. (2014). "Big Data Opportunities and Challenges: Discussions from Data Analytics Perspectives" [Discussion Forum]. *IEEE Computational Intelligence Magazine*, *9*(4), 62-74.