

Challenges of Big Data Technology in Aviation Management

¹Nityash Solanki

Ph.D. Candidate, Jagannath University, Jaipur

nityashsolanki@gmail.com

²Prof. S.P.S. Shekhawat,

Head & Dean, Faculty of Law, Jagannath University, Jaipur

shyampalsingh.shekhawat@jagannathuniversity.org

Abstract – Traditional data systems fall short of processing Big Data since high volume of information collected to create successful business opportunities requires high performance computer programs including AI tools or processors. Deep fakes, fabricated recordings, videos and images in a manner that misrepresent the receiver of the information regarding an event that in reality never took place. Processing Big Data safely for Aviation industry's benefit requires dedicated legislative regimes to improve predictability in decision making at the market place. Placing reliance on Big Data technology surely helps aviation industry to overcome various troubles related to air operations with ease. This paper attempts to explore the benefits of Big Data technology for the aviation industry. Readers would probably find a point of reference to eradicate major obstacles of Big Data technology that is hampering growth and technical innovations for the aviation industry. Furthermore, readers would be exposed to discussions regarding lack of technical knowledge or skill to exploit Big Data technology directly affects airline's infrastructure. The paper recommends suggestions to vanquish the identified issues for the aviation industry.

Index Terms – Aviation; Big Data Technology; Data Management; Data Analytics; Artificial Intelligence, Information Technology.

I. INTRODUCTION

Reliance placed on the Aviation sector for easier travel and for commercial activities such as transfer of goods to market place has been troubled by the force, vigor and Deep Web strategies used to commit cyber crimes.³ The incentives for cybercriminals to attack the aviation industry is hidden in the fact that aviation industry gathers data from variety of sources which includes information available at search engine platforms on the internet, published content on WebPages, social media networking domains, and other similar online sources that could easily be accessed through cyber space.⁴ Based on the information collected; the aviation industry segments its passengers in accordance with their behavioral needs, which include air ticket purchase history, pricing patterns, travel locations (zip codes), nationality, social status, and duration of travel, boarding preferences, service facilities, and other related characteristics of the passengers.⁵ Big Data technology assists airlines to process the above stated criteria to strategically meet the expectations of passengers in order to maximize revenue.⁶ The organized manner in which

¹ Ph.D. Candidate at Jagannath University, Department of law, Jaipur.

² Head & Dean, Faculty of Law, Jagannath University, Jaipur.

³ R.C. Nigam, Law of Crimes in India, Principles of Criminal Law. Vol. I (Asia Publishing House 1965) 3; available at https://books.google.co.in/books/about/Law_of_Crimes_in_India.html?id=aTw9AQAAIAAJ&redir_esc=y, last accessed on 9th January 2024.

⁴ Sikos, L. F., (2015), Big Data Applications, In Mastering Structured Data on the Semantic Web, pp. 199-216, Springer; available at https://sci-hub.se/10.1007/978-1-4842-1049-9_8, last accessed on 12th January 2024.

⁵ Klein, S. and Loebbecke, C., (2003), Emerging Pricing Strategies on the Web: Lessons from the Airline Industry, Electronic Markets, 13 (1), pp. 46-58; available at https://www.researchgate.net/publication/233684260_Emerging_Pricing_Strategies_on_the_Web_Lessons_from_the_Airline_Industry, last accessed on 12th January 2024.

⁶ TechVidvan, (2021), Sky is the Limit for Big Data Analytics in the Aviation Industry, available at <https://techvidvan.com/tutorials/big-data-aviation/>, last accessed on 12th January 2024.

cybercriminals operates in the 21st century has exposed the law enforcement agencies to combat offences of the digital world with accurate judicial preferences. In today's parlance, Artificial Intelligence (AI) has facilitated cybercriminals to operate from remote place to commit high profile crimes via deep fakes. Deep fakes fabricate recordings, videos and images in a manner that misrepresent/manipulate/convince the receiver of the information regarding an event that in reality never took place. Consequently, the digital-data driven environment becomes vulnerable to risks such as misappropriation and mishandling by cybercriminals' unlawful intrusions. Data managed and analyzed by aviation industry is no exception to cyber offences that are committed by hackers using internet.

II. MANAGING THE BIG DATA FOR AVIATION INDUSTRY

Big data includes content in structured and unstructured form that is generated from variety of sources available on the cyber space essentially by acquiring access to internet traffic and business transactions done by internet users.⁷ It is worthy to note that aviation industry uses Big Data technology to innovate products/services⁸ to facilitate commercial transactions of business organization for obtaining better hold of the market place.⁹ Traditional data systems fall short of processing Big Data since high volume of information collected to create successful business opportunities requires high performance computer programs or AI tools/processors. As far as aviation industry is concerned, the use of Big Data technology holds relevance to not just improve flexibility in airspace management but also to enhance the problem solving mechanism.¹⁰ Under such circumstances, utmost importance must be given to data privacy and other related aspects of security while processing Big Data for the benefit of airline industry.

It is worthy to note that Big Data technology comprehends the scheme of 'data management' by acquiring information through computer programs for the cyber space.¹¹ The processed information is thereafter forwarded for 'data analytics' to gather Big Data intelligence.¹² Several researches are conducted around the globe on a daily basis to achieve the task of securing Big Data accumulated to benefit aviation industry from external aggression and cyber security issues posed by notorious hackers, who mainly uses Deep Web to steal sensitive information from either servers maintained by airport authorities or airline companies. It is evident that processing Big Data for Aviation industry's benefit requires legislative regimes dedicated to safeguard huge amount of information/data stored on the internet/servers/programs used by the industry especially to restrict online offences committed by cybercriminals.

III. BUILDING AVIATION INDUSTRY INFRASTRUCTURE THROUGH BIG DATA TECHNOLOGY

Apart from stringent safety requirement the aviation industry is extremely competitive when it comes to generating revenue or making profits. The most significant aspect for any airline to entry at the market place remains airfare that is charged to a

⁷ Baggio, R. (2016). Big Data, Business Intelligence and Tourism: A brief Analysis of the Literature, Paper Presented at: IFITTalk@Ostersund: Big Data & Business Intelligence in the Travel & Tourism Domain. ETOUR, Mid-Sweden University, Ostersund (SE), 11-12 April 2016; available at https://www.iby.it/turismo/papers/baggio_BigDataSurvey.pdf, last accessed on 11th January 2024.

⁸ Sternberg, F, Pedersen, K, Ryelund, N, Mulkamala, R. and Vatrapu, R (2018), Analyzing Customer Engagement of Turkish Airlines Using Big Social Data, Conference Paper; available at <https://raghavamulkamala.github.io/files/pubs/2018-IEEE-BigData-Turkish-airlines.pdf>, last accessed on 11th January 2024.

⁹ George, G., Hass, M.R., and Pentland, A., (2014). Big Data and Management, *Academy of Management Journal*, 57(2), pp. 321-326; available at <https://psycnet.apa.org/record/2014-16835-001>, last accessed on 11th January 2024.

¹⁰ Fan, J, Han, F, and Han Liu, H, (2014), Challenges of Big Data Analysis, *National Science Review*, 1, pp. 293-314; available at <https://arxiv.org/abs/1308.1479>, last accessed on 11th January 2024.

¹¹ Larsen, T. (2013), Cross-Platform Aviation Analytics Using Big-Data Methods, In *Integrated Communications, Navigation and Surveillance Conference (ICNS)*, pp. 1-9; available at <https://ieeexplore.ieee.org/abstract/document/6548579>, last accessed on 11th January 2024.

¹² Gandomi, A, and Haidem, M, (2015). Beyond the Hype: Big Data Concepts, Methods, and Analytics, *International Journal of Information Management*, 35 (2), pp. 137-144; available at <https://www.sciencedirect.com/science/article/pii/S0268401214001066>, last accessed on 11th January 2024.

passenger and profit margins that could possibly be generated from airline operations.¹³ Placing reliance on Big Data technology surely helps aviation industry to overcome these troubles with ease. Furthermore, data management and data analytics would open a door-way to beneficial opportunities at the market place for aviation industry if following suggestions are effectively executed:

- (a) A well-equipped ground handling scheme would prepares an airline to cut additional expenses after effective evaluation of the entire flying operation between the destinations before the passenger boards the aircraft;
- (b) Efficiency of airspace management could be increased by successful data analysis especially to predict an ideal solution to airspace problems;
- (c) Individual passenger needs could easily be catered through data analysis;
- (d) Airlines using Big Data technology efficiently solves the issues of rigorous competition by enhancing quality of services for passengers;
- (e) Attractive airfares schemes coupled with unique flying hour advantages could be made available to a passenger especially to secure the passengers choice for that particular airlines;
- (f) Innovative techniques could be employed to gain easy access to passengers' portfolio for optimizing airline's productivity;
- (g) Airlines attempt to prepare personalized marketing strategy is definitely enhanced by the use of Big Data technology;
- (h) Aviation industry relies on Big Data analytics for increasing innovative load control strategies;
- (i) To achieve unique advantages over end-to-end passenger experience it is highly recommend for airlines to technically evaluate prospects of data management and analytics;
- (j) For cost-effective airline operations it is essential that data regarding aircraft maintenance, employees and staff management is in accordance with Big Data technology suggestions.¹⁴

It goes without saying that lack of technical knowledge or skill to exploit Big Data technology directly affects airline's infrastructure. Furthermore, the aviation industry is bound to face numerous airspace obstacles in the absence of Big Data technology resources.¹⁵ Securing Big Data from external aggressions or cyber intrusions becomes essential in the digital environment¹⁶ since huge amount of information is not just managed but critically analyzed for the benefit of aviation industry making the industry vulnerable to cybercrimes including AI powered deep flakes offences.

IV. CONCLUSION

The digital environment of cyber space recognizes individuals, corporations and government entities via proxy data. In other words, the personal data stored on the cyber space is often processed to generate internet users' location, preferences regarding travel, entertainment, consumption of goods and services available at the market place. The digital-data driven environment becomes vulnerable to risks such as misappropriation and mishandling. The decision making process in computerized profiling

¹³ Chen, H., Schutz, R., Kazman, R. and Matthes, F., (2017), How Lufthansa Capitalized on Big Data for Business Model Renovation, *MIS Quarterly Executive*, 16 (1), pp. 19-34; available at <https://core.ac.uk/display/301378386>, last accessed on 11th January 2024.

¹⁴ Odarchenko, R., Hassan, Z., and Zaman, A., (2019). Use of Big Data in Aviation: New Opportunities, Use Cases, and Solutions. In T. Shmelova, Y., Sikirda, N., Rizum, D., Kucherov, and K., Dergachov, (eds.), *Automated Systems in the Aviation and Aerospace Industries: Advances in Mechatronics and Mechanical Engineering* (pp. 336-452), IGI Global, Pennsylvania; available at https://www.researchgate.net/publication/331242645_Use_of_Big_Data_in_Aviation_New_Opportunities_Use_Cases_and_Solutions, last accessed on 11th January 2024.

¹⁵ Izzo, F., (2019). Management Transition to Big Data Analytics: Exploratory Study on Airline Industry, *International Business Research*, 12 (10), pp. 48-56; available at https://www.researchgate.net/publication/335853804_Management_Transition_to_Big_Data_Analytics_Exploratory_Study_on_Airline_Industry, last accessed on 12th January 2024.

¹⁶ Hashem, I. A. T., Yaqoob, I., Anuar, N. B., Mokhtar, S., Gani, A., and Ullah Khan, S. (2015), The Rise of "Big Data" on Cloud Computing: Review and Open Research Issues, *Information Systems*, 47, pp. 98-115; available at <https://www.sciencedirect.com/science/article/abs/pii/S0306437914001288>, last accessed on 12th January 2024.

and marketing, which is employed to reveals hidden patterns and truths often leads to manipulated or unexpected outcomes.¹⁷ Under such circumstances, the gathered data, which was suppose to tailor safety requirements, airspace management, service flexibility and staffing requirements to meet the needs of passengers in the aviation industry is exposed to the risk of misapplication.¹⁸ It goes without saying that smart decision-making requires analytical approach to safely process Big Data for enhancing products and services of aviation industry.¹⁹ In addition, the most significant aspect of managing Big Data is to respond to ‘black swan’ risks posed by events such as COVID-19 pandemic.²⁰

Furthermore, the aviation industry is exposed to face obstacles related to privacy of Big Data. Thus, it is vital for airline industry to manage and analyze Big Data on secure servers and computer programs. The aviation industry road map and success at the market place largely depends on adopting safe data driven culture to generate revenue and to process Big Data through technological development for successfully supporting predictive decision making in airspace operations. At present, only hand full of airline corporations are well-equipped with Big Data technology and majority of others in the same industry remains elusive²¹ from the advantages that could conveniently be availed through the use of Big Data processing or technology. The following suggestions could help the new comers in the aviation industry to build on a categorical infrastructure for better performance:

- (a) Identifying a through vision to assure efficient use of Big Data technology;
- (b) Appointing expert data analysts to innovate successful business strategies;
- (c) Genuine data analysis for scrutinizing passengers’ preferences;
- (d) Reducing additional or unwanted expenditures related to airspace operations;
- (e) Processing appropriate knowledge to significantly develop the data culture and technology;
- (f) Careful assessment of safety measures and risk factors;
- (g) Implementing regular quality checks through data management and data analysis to eradicate technical issues faced by aircrafts;
- (h) Optimizing on services through training programs for employees and ground staff especially to achieve the goal of conducting professionally with minimum scope for errors;
- (i) Securing sensitive data collected over cyberspace from cybercriminals and other notorious intruders on the internet;
- (j) Building a healthy completion in the aviation industry through integrated approach to develop Big Data technology;
- (k) Timely evaluation of legislative regimes to secure management and analysis techniques.

REFERENCES

1. R.C. Nigam, Law of Crimes in India, Principles of Criminal Law. Vol. I (Asia Publishing House 1965) 3.
2. Sikos, L. F., (2015), Big Data Applications, In Mastering Structured Data on the Semantic Web, pp. 199-216, Springer.
3. Klein, S. and Loebbecke, C., (2003), Emerging Pricing Strategies on the Web: Lessons from the Airline Industry, Electronic Markets, 13 (1), pp. 46-58.
4. TechVidvan, (2021), Sky is the Limit for Big Data Analytics in the Aviation Industry.

¹⁷ J. Bing, “Code, Access and Control” in M Klang and A Murray (eds.), “Human Rights in the Digital Age (Routledge-Cavendish 2005); available at <https://www.semanticscholar.org/paper/Human-Rights-in-the-Digital-Age-Klang-Murray/38b5d01ce5ea0215f9755042f920d8ef0d8605dd>, last accessed on 11th January 2024.

¹⁸ Song, H, and Liu, H, (2017), Predicting Tourist Demand using Big Data. In Xiang, Z, and Fesenmaier, D. R. (eds.) Analytics in Smart Tourism Design: Concepts and Methods. Springer International Publishing, Switerland, pp. 13-29; available at https://link.springer.com/chapter/10.1007/978-3-319-44263-1_2, last accessed on 11th January 2024.

¹⁹ Maroufkhani, P., Wagner, R, Ismail, W. Baroto M and Nourani, M. (2019), Big Data Analytics and Firm Performance: A Systematic Review, Information 10, Journal of Business Research, pp. 1-21; available at https://www.academia.edu/83628853/Big_data_analytics_and_firm_performance_Effects_of_dynamic_capabilities, last accessed on 11th January 2024.

²⁰ Ienca, M. and E. Vayena (2020), On the Responsible Use of Digital Data to Tackle the COVID-19 Pandemic, Nature Medicine, 26, pp. 463-464; available at <https://www.nature.com/articles/s41591-020-0832-5>, last accessed on 11th January 2024.

²¹ Waller, D., (2020), 10 Steps to Creating a Data-Driven Culture; available at <https://hbr.org/2020/02/10-steps-to-creating-a-data-driven-culture>, last accessed on 12th January 2024.

5. Baggiom, R. (2016). Big Data, Business Intelligence and Tourism: A brief Analysis of the Literature, Paper Presented at: IFITTalk@Ostersund: Big Data & Business Intelligence in the Travel & Tourism Domain. ETOUR, Mid-Sweden University, Ostersund (SE), 11-12 April 2016.
6. Sternberg, F, Pedersen, K, Ryelund, N, Mukkamala, R. and Vatrappu, R (2018), Analyzing Customer Engagement of Turkish Airlines Using Big Social Data, Conference Paper.
7. George, G., Hass, M.R., and Pentland, A., (2014). Big Data and Management, *Academy of Management Journal*, 57(2), pp. 321-326.
8. Fan, J, Han, F, and Han Liu, H, (2014), Challenges of Big Data Analysis, *National Science Review*, 1, pp. 293-314.
9. Larsen, T. (2013), Cross-Platform Aviation Analytics Using Big-Data Methods, In *Integrated Communications, Navigation and Surveillance Conference (ICNS)*, pp. 1-9.
10. Gandomi, A, and Haiderm, M, (2015). Beyond the Hype: Big Data Concepts, Methods, and Analytics, *International Journal of Information Management*, 35 (2), pp. 137-144.
11. Chen, H., Schutz, R., Kazman, R. and Matthes, F., (2017), How Lufthansa Capitalized on Big Data for Business Model Renovation, *MIS Quarterly Executive*, 16 (1), pp. 19-34.
12. Odarchenko, R., Hassan, Z., and Zaman, A., (2019). Use of Big Data in Aviation: New Opportunities, Use Cases, and Solutions. In T. Shmelova, Y., Sikirda, N., Rizum, D., Kucherov, and K., Dergachov, (eds.), *Automated Systems in the Aviation and Aerospace Industries: Advances in Mechatronics and Mechanical Engineering* (pp. 336-452), IGI Global, Pennsylvania.
13. Izzo, F., (2019). Management Transition to Big Data Analytics: Exploratory Study on Airline Industry, *International Business Research*, 12 (10), pp. 48-56.
14. Hashem, I. A. T., Yaqoob, I., Anuar, N. B., Mokhtar, S., Gani, A., and Ullah Khan, S. (2015), The Rise of “Big Data” on Cloud Computing: Review and Open Research Issues, *Information Systems*, 47, pp. 98-115.
15. J. Bing, “Code, Access and Control” in M Klang and A Murray (eds.), “Human Rights in the Digital Age (Routledge-Cavendish 2005).
16. Song, H, and Liu, H, (2017), Predicting Tourist Demand using Big Data. In Xiang, Z, and Fesenmaier, D. R. (eds.) *Analytics in Smart Tourism Design: Concepts and Methods*. Springer International Publishing, Switzerland, pp. 13-29.
17. Maroufkhani, P., Wagner, R, Ismail, W. Baroto M and Nourani, M. (2019), Big Data Analytics and Firm Performance: A Systematic Review, *Information 10, Journal of Business Research*, pp. 1-21.
18. Ienca, M. and E. Vayena (2020), On the Responsible Use of Digital Data to Tackle the COVID-19 Pandemic, *Nature Medicine*, 26, pp. 463-464.
19. Waller, D., (2020), 10 Steps to Creating a Data-Driven Culture.