

Privacy and ethical issues of Big Data in the Airline industry

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Abstract: Big data technology has grown rapidly in recent years, and increasingly applications of this magic in all kinds of occupations bring out a series of effects, be they positive or negative. The airline industry, one of the biggest data producers, has prevailing advantages to utilize big data technology. It assists airline companies to optimize the process of booking, ordering and luggage tracking. Meanwhile, due to the huge amount of data generated, it is possible for them to predict flight delays and then provide better services for consumers. However, the application of big data in the airline industry also results in privacy and ethical issues. Users' information is tracked without permission and several immoral companies overly collect irrelevant personal private data. More disappointing thing is that some airline companies are not able to protect users' information, which causes bad damage on both company values and reputations and consumers' benefits. As it turns to the ethical issues, the case of United Airlines incident makes people aware of the further needed improvements for overbooking system. And it is also necessary for merchants to reconsider the unfair price strategy. Relevant laws and regulations are required to protect the user information and improve on existing issues.

1 APPLICATION OF BIG DATA IN AIRLINE SERVICES

Nowadays, big data can collect information from various sources and make better analysis for businesses in every industry (Martin, 2015). This is in particularly useful for aerospace companies, since they have adopted and invested in big data on large scale than the rest of the industries (Badea, Zamfiroiu and Boncea, 2018). The main motivation of the airline industry is the utilization of big data technology to provide services that are more satisfying to customers. By doing so, it can optimize several existing functions, including flight inquiries, booking, payment, and ordering (Noyes, 2014). Big data technology can help the aviation industry to collect and analyze passenger information effectively, and increasingly attracts the attention of numerous airline companies.



Figure 1: the choices of CEOs in different industries.

According to Accenture Industry Report (2015) shown in Figure 1, it is apparent that 61% of CEO in airline industry regards the application of big data as the top priority, and it is the largest proportion among all the eight industries. There is a total of 90 percent of CEOs adopting big data analytics amongst their top and top three priorities, which is considered very high among all the industries.

Airlines can utilize Big Data technology to stay competitive in industry (Hodgson and Waldmeir, 2018). The original services and products in the airline industry can be refined, since big data can

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assist aerospace companies to provide more personalized services.

The most significant changes happen in the process of check-in and departure. In the past, passengers need to come to the airport to check in early. In Year 2018, they can use the mobile phone APP or other network methods such as WeChat to purchase tickets, self-check-in, and check flight situation. At several airports, a part of passengers only needs a QR code that can be used for boarding (Bi, 2016).

Loss of luggage always causes problems for passengers. The increasing number of loss luggages causes concern and many passengers feel uncomfortable about that (Gupat et al., 2016). In order to reduce the number of cases in luggage loss, Shenzhen Airlines takes advantages of big data technology to monitor the baggage for 24 hours, so that passengers can easily know where their luggage is. In addition, personalized booking and personalized ordering services are promoted across numerous airline companies.

In terms of some flight services with the most complaints from passengers, some companies use big data to design a real-time APP. Passengers can keep track on their flights and its updates in advance, particularly in flight delays caused by air traffic control, bad weathers and other uncontrollable factors. Such an APP can greatly alleviate conflicts caused by flight delays (Wang 2014).

Hu (2017) presents how to use big data to predict flights delay and explains its benefits for both airline companies and passengers. By predicting possibilities and conditions resulting in delays, emergency plans can be prepared in advance. This can help the airports reduce number of delays and recover large amounts of direct economic losses for airlines. As shown in Figure 2, flights delays from diverse sources were collected. The three factors, mainly bad weathers, flight duration, passengers' situation and air traffic control, are influencing factors for analysis of flight delays. After comparison with several models, it is recommended to use the Random Forest model, since it can use the paralleled category of ensemble-learning to predict the flight delay for better performance (Hu, 2017).

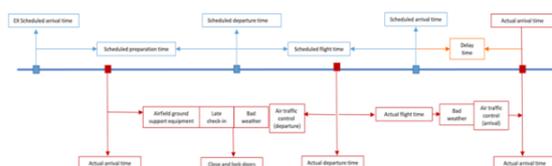


Figure 2: Flight delay process analysis flow chart (H, 2017)

1.1 United Airlines: Improving Services Using Big Data

In the past, United Airlines adopted the "collect and analyze" data method, which aggregates information from passengers, such as their choices of services and routes, so that they can analyze what is the best-selling product.

United Airlines has changed their strategy and method. The company has identified "collection, detection, and action" as a new three-step data analysis approach, continuing to improve their services. United Airlines attempts to understand who each passenger is and whether he or she has potential buying intension. In order to identify a passenger's potential preferences, the company computes it by adding more than 150 variables, which could affect passenger spending, as well as the travel destinations, into their metrics, rather than just summing up a large amount of passenger data. Their analyzed results can be obtained after merely 200 milliseconds with an extreme good accuracy. In addition, its terms of service, page layout and other factors will vary according to the specific information of each passenger (Noyes 2014).

1.2 Shenzhen Airlines: 24-hour Monitoring to Avoid Missing Luggage

Shenzhen Airlines use big data to monitor luggage, and consumers also can check their baggage in any time. Availability of the 24-hour baggage monitoring system means that after the passenger has checked the baggage, back-office staff can start to carry out 24-hour baggage monitoring on the baggage. At the same time, the passengers can also check their baggage on the mobile phone. In case of baggage delays, it is necessary to arrange a third-party delivery company to pass the baggage. Shenzhen Airlines will use a one-time code lock to encode the baggage and send the code to passenger by SMS. By doing so, it can guarantee that baggage is intact during the delivery. Since the launch of the business, a total of more than 1,000 text messages have been sent to customers, which has been well received by passengers.

In addition, in order to locate the baggage, the manual baggage sorting system is replaced by an intelligent tracking system, which is introduced by Shenzhen Airlines to improve on efficiency. After the baggage is transferred to the system via the check-in carousel, each step is automatically recognized by the system. By applying this real-time monitoring system, the error rate could be reduced significantly

by 90%. At present, more than 30 flight terminals such as Shenzhen, Guangzhou, Beijing, and Nanjing have been using such system (Jiang 2018).

2 PRIVACY ISSUES IN APPLICATION OF BIG DATA RELATED IN AIRLINE SERVICES

2.1 At The Stage of Collecting Data

In the 21st century, the airline industry has undergone reforms in several aspects, such as boarding, ticketing, and passenger identification processes. All of these measures are due to security reasons. However, a number of additional vulnerabilities may result from these initiatives. When a consumer plans to purchase a ticket online or booking a ticket from a third-party platform, it is required to register on the website and submit a series of personal information, including limited name, date of birth, address and passport number. Several airline companies can provide online services, but they lack of protection of their consumers' private information or even infringe their privacy. Zachary and Trzop (2014) reported that Delta Airline Company violates California Online Privacy Protection Act (Cal OPPA), which requires online service providers to make their piracy policies understandable and reasonable for their users. Consumers could download a free Fly Delta mobile app provided by Delta, from Apple's iTunes Store and Google Play markets, or from its own official website. Like other airline applications, Fly Delta users could use this app to check in, make reservations, track baggage, and search for airport facilities. In order to provide users with these services and to meet business demands, this app collects users' personal information, including name, phone number, date of birth, email address, credit card information, photos, and GPS location, and strongly suggest users select "Delta Sky Club near you" function. Unfortunately, consumers have no way of knowing where the information is used, whether the data is safe and whether the data will be transferred to any third parties.

Any individuals are often not able to detect personal information leakage problems when they use a computer or cell phone to buy a flight ticket online. Customers with advanced computer skills find several pieces of evidence that certain airline websites do not value consumers' privacy. Konark Modi (2018), a data security and privacy advocate, claimed

that the activity of booking flight ticket online could generate 300 data points. When a user selects a seat or meal preference through clicking manage preferences, the booking ID, passport ID, full name and other related information will be passed to approximately 14 different third-party trackers, such as Crazy egg, Boxever, Coremetrics, Google and Facebook, etc. If a user books a flight ticket online, the ticket could be inexplicably edited or canceled due to such personal information leakage.

More details is presented as follows. When a user complete booking on Emirates Airline Company webiste, he or she will receive a confirmation letter from the company. Konark (2018) notice that the user could enter a new webpage to take further action by clicking "Manage Booking". When this process happening, a redirection chain takes place.

Users may not notice that this link will share with numerous third-party trackers implemented by Emirates on the web pages. The information is delivered by HTTP links, which is possibly attacked by network adversaries. Links demonstrated in figure 3 might be sent to numerous third-party platforms and several pirated or compromised links could be utilized to access user's personal information and even booking details. Some tools, like Gostery, may help us to notice the trackers on the webpage.

qubit opentag
google tag manager
bing ads
mediaV
baidu ads
boxever
google analytics
crazy egg
ibm customer experience
appdynamics
getyourguide
facebook
captcha
qubitproducts
ads-twitter
coremetrics
bstatic

Figure 3: A part of trackers on the booking page.

As a result, these third parties and even network adversaries not only can visit this pirated information but also can edit them, such as changing flight, revising seat, add more products, changing passport information.

In China, there are privacy issues in aviation services as well. Feng (2018), a reporter from Southern Metropolis Daily, disclosed that Umetrip App is accused of exposing personal information. Umetrip is the first travel service mobile product launched by China Civil Aviation Information Network Co., Ltd. in 2012. It can provide passengers with complete information services, from travel

preparation to things to know in destinations. In early 2018, Umetrip launched a new social function, which results in a series of privacy issues. After booking a flight ticket, a user could click "seat number" function to check which seat has been already reserved and which one is not. However, information about the user of the reserved seat could be visited by anyone else. As shown in Figure 4, "Personal tag" can be generated based on the user's behaviors. Hence, it shows some characteristics of this passenger, and "heat map" shows which city this user usually visits and it is easy for other people to infer more information according to this map. Before this situation revealed by some newspaper resulting in a heated discussion, the personal page cannot be turned off.

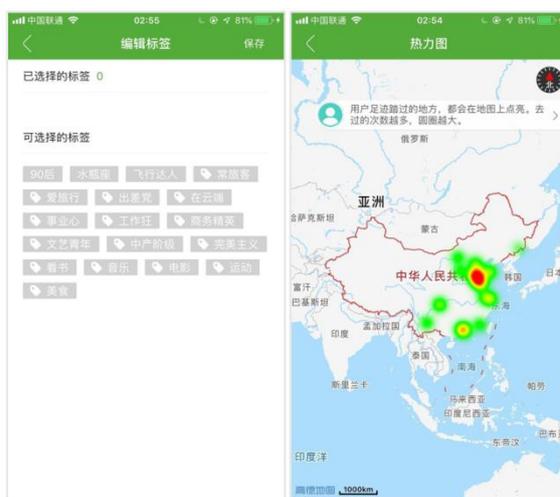


Figure 4: information about a certain passenger collected from Umetrip App.

2.2 At The Stage of Storing Data

SITA (2016) issues an airport IT trends survey towards to present situation of information technology application in the airline industry. As shown in Figure 5, this survey demonstrates the challenges in IT security as well. Clearly, there is a good progress that the percentage of airports providing cybersecurity management service have risen steadily since 2013. However, it still has the room for improvement. Just 55% of airports admitted they have mature and operational cybersecurity plans, while further 41% claimed that their IT security plans are still at the development stage. 4% of airports have no plans for IT security.



Figure 5: Percentage of airports providing status for cybersecurity management.

After the user register in an airline industry website and submit their personal information to purchase a flight ticket, it is the company that has the responsibility to store these virtual properties safely. Unfortunately, several airlines have not fulfilled their obligations.

Lee (2018), a journalist from South China Morning Post, reported that Cathay Pacific announced that approximately 9.4 million passengers' information was stolen. The data contains the passenger names, nationality, date of birth, telephone number, etc., as well as 860,000 passport numbers and 245,000 Hong Kong identity card numbers. In addition, due to the failure of Cathay Pacific to confirm and announce the information leakage in a timely manner, the incident immediately attracted a lot of attention. According to the incident report, Cathay Pacific announced to the public it five months later after the security breach happened. This could not allow passengers enough time to renew their credit cards and possibly any information related to financial loss.

Gottsegen (2018), a reporter from Cnet, revealed that hackers attacked the British Airways website from August 21 to September 5. During this period, personal data and financial data of 380,000 passengers who booked flights online via debit or credit cards were stolen. The data leakage has affected all customers who booked flights online or using the app, from 10:58 pm on August 21st to 9:45 pm on September 5th. British Airways insists that customers have been notified as soon as possible and have reported to the police.

2.3 Negative Effects

There are numerous data theft cases in the airline industry, and all of them have a significantly negative effect on the airline company and on the whole society.

2.3.1 Impact on Business

First and foremost, users' personal information leakage causes a series of company operation problems. It is noticeable that there is a negative reaction in the stock market, which shrinks the market value of the related company. Figure 6 indicates that British Airways parent IAG's stock falls 3% after the release of hacking news, wiping out about \$648 million in the market value. More serious issues happened at Cathay Pacific Airways. As shown in Figure 7, data breach incident has severely affected Cathay Pacific Airways' stock price. Cathay Pacific shares fell 6.8 percentage to close at 9.90 Hong Kong dollars, a nine-year low. Cathay Pacific has suffered losses for two years and is currently working to reduce costs and increase revenues in order to better compete with low-cost airlines in the Middle East and China. In August, the company said that despite the tight trade relations between China and the United States, the loss in the first half of the year was reduced due to rising fares and rising freight rates. It is expected that the operating conditions will further improve in the second half of the year. This data leakage news undoubtedly posed a negative impact on the company. In addition, the occurrence of such information leakage incidents will damage the reputation of these companies and let consumers lose trust in them. There are some users who expressed concern about their information security. Some users claim that they will never use the services of these companies in the future. Moreover, these related companies have to pay a large sum of money to compensate their users. British Airways CEO Alex Cruz has apologized for the data theft incident and claimed that the company will work with any customer affected and they will compensate for any financial hardship suffered. British Airways may also face hundreds of millions of pounds fine by the Office of the Information Commissioner (ICO). According to the EU's new data protection rules (European Data Protection Regulations 2018), the institute may impose a fine, which is up to 4% on British Airways' turnover. If this fine applies to British Airways, it may face 488 million pounds fine. If the penalty percentage is applied to International Aviation Group, the parent company of British Airways, the amount may reach 825 million pounds.

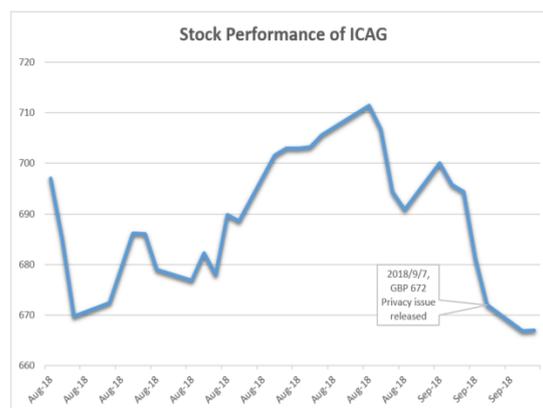


Figure 6: Stock performance of IAG.

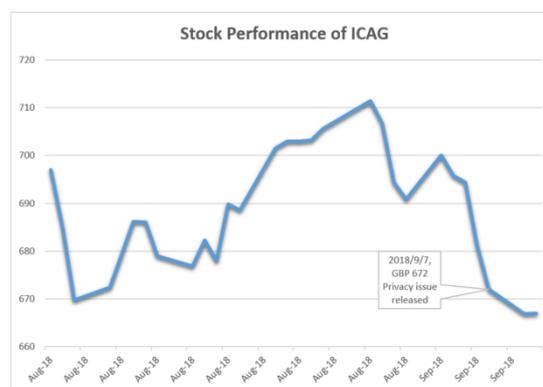


Figure 7: stock performance of Cathay Pacific Airways.

2.3.2 Impact on Society

While bringing business opportunities to enterprises, the utilization and sharing of passengers' private data also has had a negative impact on individuals. For example, some airline companies recommend special products or new travel routes for their users based on the consumers' past flight behavior and preferences. Obviously, this information can be obtained from the analysis of big data. The concern about privacy is an important factor influencing customers' behaviors in buying flight ticket online (Liang and Shiau, 2018). Furthermore, the utilization and sharing of such data pose a risk to the user. The frequent occurrence of personal privacy leakage threatens personal life safety and also becomes a major factor affecting public security. According to the statistics of Beijing Zhongguancun Police Station, the number of telecom fraud cases in 2012 account for 32% of whole crime cases. There are 6 types of fraud. When personal or friends circle information is stolen, the criminals

pretend to be official staff members to commit crimes. Pretending to be a seller to implement fraud after acquiring the consumption information. Sending prize-winning notice to individuals, after obtaining contact information such as telephone, QQ or email. Distributing false recruitment information after the job information is leaked. Pretending to be a friend of the victim after the social information is leaked. Kidnapping after the leakage of family information. As a result, this evidence shows that many companies cannot protect their users' personal information to varying degrees. Additionally, the leakage of personal privacy information has caused panic among users, who are worried about the loss of private data or malicious theft. A poll report shows that 72% of people are worried that their online behavior is tracked and analyzed by the company. Therefore, most people have raised their awareness of privacy protection. However, Zhang et al. (2015) demonstrate that several companies have paid insufficient attention to user privacy protection, resulting in serious economic losses.

3 ETHNICAL ISSUES IN APPLICATION OF BIG DATA RELATED IN AIRLINE SERVICES

Although big data has brought a lot of opportunities to aviation companies, if it is used improperly, it will also generate many ethical problems.

3.1 Overbooking

Overbooking is a revenue strategy and almost every airline companies measure this method to promote profit (Zheng, 2018). The airlines count the data of each route, annual data, daily data, summer and winter data, and get the average seat rate of the route, and calculate the percentage of the empty seat. Aydin et al. (2012) discovers that if a 100-seat aircraft sells for \$200 each, but if only 95% of passengers attend, the airline can lose \$1,000. In the case of US flights, if each airline does not oversell, the loss will reach millions of dollars per day. Under the premise that the flight will have a 5% of absent rate, the airline will sell 5% more tickets in order to make up for the loss. In a sense, overbooking is not just good for airlines. When a flight attendance rate is low, the cost will naturally pass on to other passengers. Then they could set the overbooking strategy. Overbooking is a revenue management measure of airlines companies,

aiming at reducing or eliminating the negative economic impact of customer no shown up (cancel or change flights). It means that the actual number of seats exceeds the actual carrying capacity of the flight so that it is very frequently for passengers who have purchased tickets but were denied boarding. This oversell system solves the problem of the seat-emptiness causing by absence.

It is difficult for the airline company to determine how many seats should be oversold. In other words, "less overbooking, less profits". More overbooking means more compensation are required for the volunteer passengers to leave of the flight. The U.S. Department of transportation releases air travel consumer report every year, which includes the situation of overbooking. Referring to Fig. 8 based on the air travel consumer report (2018) released by U.S. Department of Transportation's Office of Aviation Enforcement and Proceedings, it indicates that the number of people denied boarding was 288,881 in 2017 but declined to 259,965 in 2018. The number of voluntary individuals is 252,576, while the number of involuntary ones is 7,387 in 2018.

Passengers Denied Boarding by Reporting U.S. Airlines

Airline company	January - September 2018				January - September 2017			
	Denied Boardings(DB'S)		Enplaned Passengers	Involuntary DB'S per 10,000 Passengers	Denied Boardings(DB'S)		Enplaned Passengers	Involuntary DB'S per 10,000 Passengers
	Voluntary	Involuntary			Voluntary	Involuntary		
DELTA AIR LINES	59,111	22	104,216,236	0.00	103,338.00	679.00	99,796,155.00	0.07
ENDEAVOR AIR	12,348	5	9,844,852	0.01	-	-	-	-
JETBLUE AIRWAYS	2,013	23	28,645,708	0.01	1,648.00	1,475.00	27,255,038.00	0.54
HAWAIIAN AIRLINES	779	7	8,282,837	0.01	230.00	92.00	8,422,734.00	0.11
UNITED AIRLINES EXPRESSJET	28,168	70	74,381,024	0.01	38,574.00	2,087.00	70,030,765.00	0.30
REPUBLIC AIRLINE	6,321	18	6,938,099	0.03	16,247.00	785.00	11,738,912.00	0.67
PSA AIRLINES	11,443	93	13,580,377	0.07	-	-	-	-
AMERICAN AIRLINES	8,976	96	10,100,293	0.1	33,244.00	4,517.00	98,017,132.00	0.46
MESA AIRLINES	41,108	1,041	100,531,822	0.1	-	-	-	-
ALLEGANT AIR	8,716	108	9,847,814	0.11	-	-	-	-
SKYWEST AIRLINES	357	136	10,566,004	0.13	-	-	-	-
SOUTHWEST AIRLINES	22,493	389	26,881,797	0.14	27,345.00	917.00	24,516,354.00	0.37
ALASKA AIRLINES	16,934	2,012	120,210,562	0.17	32,089.00	6,678.00	115,988,988.00	0.58
FRONTIER AIRLINES	6,485	638	24,042,404	0.27	6,422.00	658.00	18,817,824.00	0.35
ENVY AIR	11,549	281	9,747,616	0.29	-	-	-	-
SPRINT AIRLINES	3,730	962	14,491,205	0.66	1,618.00	540.00	12,059,843.00	0.45
TOTAL	16,047	1,486	20,571,188	0.72	6,110.00	3,509.00	16,879,482.00	2.98
TOTAL	252,576	7,387	592,819,638	0.12	266,964.00	21,917.00	503,523,327.00	0.44

Figure 8: Statistics of overbooking in 2017 and 2018.

The airline company should pay a lot of efforts to tackle overbooking issues. The general oversold contradiction has been resolved before the passenger boarding. The airline will first notice the passengers about the situation and inform the compensation conditions, and collect the "volunteers" to change the flight (Pizam, 2017). However, if there is no passenger voluntarily changed, the airline has the right to refuse certain passengers to board the plane. When this then happens, it must comply with the relevant regulations to manage the number of boarding, and arrange compensation for these passengers. According to the regulations of the US Transportation Bureau, if the subsequent change of the flight requires passengers to wait for 1 to 2 hours, the airline will compensate the passengers for at least

2 times the ticket price, and the maximum compensation is 675 US dollars. If it requires passengers to wait more than 2 hours, then at least 4 times the ticket prices are required, with the maximum compensation is \$1,350. However, it should be noted that if a passenger is forced to change, and it only costs less than an hour to take the new flight, then the airline does not need to pay compensation.

In many cases, the airline's compensation is not enough to attract enough "volunteers". At this time, it is necessary to force some passengers to leave, although many companies, including United Airlines and Delta Air Lines, have clearly stated that disabled people and unaccompanied passengers have priority to reserve seats (Horowitz and Ostrower, 2017). Since airline companies own a large quantity of consumers' information, it is reasonable to concern that after classifying users into different groups whether the company gives privilege to those first-class or business class passengers and force flyers who purchase discounted tickets to change the flight.

However, if the airline companies merely collect data of the inferior quality, they will have a worse overbooking strategy. In the worst case, the company may lose customers forever as what happened to United Airlines. Pizam (2017) reported that, on 9 April 2017, a Chinese man was dragged off from a United Airlines because of overbooking and failures to find volunteers who were willing to go down. Therefore, they choose to kick off the people randomly and forced a man to leave. Later, the video was disseminated all over the Internet. This unethical problem made a huge impact on the brand reputation of United Airlines and irritated the masses.

3.2 The Unfair Price Strategy

Some companies utilize big data technology to set inequitable price strategy for their customers. In general, merchants classify consumers according to analysis of these consumers' historical consumption data. They divide customers into different groups, such as price-sensitive group and price-insensitive group. For the same products, different prices are offered between price-insensitive and non-price-insensitive customers.

In fact, price discrimination is not a new strategy. E-commerce giant Amazon has carried out similar experiments as early as September 2000 (Ramasastry, 2005). In order to boost higher retail sales, they applied this price strategy on DVD discs and judged purchasing power of their users. The company collected information about the shopping preference,

the operating system used, and then output different prices to different customers. For a \$20 product, the price difference between new and old users fluctuates around \$4. Although these DVDs represented only a tiny fraction of Amazon's tens of millions of products, a certain number of users discovered that this inequitable strategy existed for less than a month. In a music forum called DVDTALK, hundreds of "netizens" made manual comparisons by publishing the prices of the products they bought. All the consumers were extremely angry and they suspected that Amazon was collecting and analyzing the customers' private data so that the CEO had to stand up and guarantee that Amazon will never differentiate any customers.

18 years went passed. In China today, more and more companies have adopted the same unfair practices (Yang, 2018). For example, many Internet service companies provide multiple services, including flight booking service, travel service, movie ticket service, and these companies use big data to analyze users' different habits and their demands, then provide higher prices for old or rich users. In short, the price of goods or services for a rich user who frequently uses this app is higher than the one for new users.



Figure 9: Same flight has a different price on different devices.

As shown in Figure 9, it is clear that the same flight at the same time has a different price on different devices. Based on the information of the notification bar, the price on the right picture is from IOS and the left is from Android, and the device with IOS is usually more expensive than the one with Android (Economic View, 27 May 2018). It is evidence that several unethical companies analyze the users' information to set different prices for different individuals. If a customer has an expensive device, or

there is some other information shows that the consumer is affluent, then he or she might pay more.

The China Youth Daily Social Investigation Center has conducted a survey of 2008 respondents with a questionnaire network. According to the data, 51.3% of respondents have encountered Internet companies using big data to set inequitable prices and 63.4% of respondents believed that Internet companies use big data to apply the unfair strategies. It can be seen that any ordinary consumers have to pay more on the services unconsciously.

3.3 Faulty software design

On 29 October 2018, Lion Air Flight 610, from Soekarno-Hatta International airport to Depati Amir Airport, crashed into the Java Sea, and all the 189 people (181 passengers, 8 crew) on board were killed. Nearly 5 months later, on 10 March 2019, Ethiopian Airlines Flight 302, from Addis Ababa Bole International Airport to Jomo Kenyatta International Airport, crashed near Bishoftu after 6 minutes takeoff, which killed 151 people. The airplanes involved in those two tragic accidents are Boeing 737 MAX-8. According to McGregor (2019), on 17 March 2019 Dagmawit Moges, the Ethiopian Minister of Transport, claimed that there was a clear similarity between the two accidents and this would be the focus of the investigation process.

The cause of both accidents has still been in the process of investigation by Boeing and related governments. The final investigation report has not been concluded. But now the investigators are paying attention to a specific tech feature – Maneuvering Characteristics Augmentation System (MCAS), which is fitted on all Boeing 737 MAX-8. This system is designed to point the flight nose down in order to avoid it from stalling. Hawkins (2019) reported that the Lion Air crash may due to a wrong report which triggered MCAS. The pilot may not have enough control power or adequate time to against this software system (Ostrower, 2019). In this case, all designs must be undergone vigilant tests and ethical system design. It cannot be because one problem cannot be fixed, and then another solution is designed, and in this process, it then creates another problem. We would argue that ethics will require a comprehensive review in the aircraft design, tests and test flights thoroughly before making any commercial flights in actions.

4 DISCUSSION

Countermeasures should be taken to reverse unsatisfactory situations described in the earlier section. For the privacy issues, the company should hire more skillful information technology staff to develop information storage and encryption systems to consolidate systems against hacking. The higher and stricter information storage standards can be adopted when companies set up their databases and web services (Li and Cheng, 2012). The users' information should be classified into different classes for protection (Pearson 2009). Although many governments have introduced laws and regulations on information protection, it is necessary to enact relevant laws for continuous improvement and enhance their execution. Bansar and Davies (1999) announced that all regulations must protect individual personal information. For the ethical issues, airline companies should utilize big data technology more effectively and develop a humanized overbooking system, to avoid the grim cases like United Airlines case take place again. Zheng (2018) suggests that the airline overbooking terms are written on the contract, but the contract is extremely difficult to find and understand.

On the other hand, Air France's overbooking term is easy to understand and individuals are very clear how much compensation they should receive, which is a successful way for business. Unfair price strategy is a kind of price discrimination. Zou and Liu (2018) illustrate that strengthening the legal regulation of price discrimination is a real problem for China's further development of the Internet industry. It is thus necessary to accurately define the behavior of illegal price discrimination and investigate potential illegal activities and acts exercised by airlines companies. Consumers could vote with their feet and have the backing from the consumer unions. The whole market globally should develop ways to punish those unethical airline companies.

5 CONCLUSION

Big data applications and services can benefit the airline industry extensively, since it is not only for the efficiency of operation system but it also includes the level-up of their services. Various airline companies have adopted big data instead of traditional methods to understand more about their performance and customers. Airline companies such as the United Airlines should introduce more efficient approaches collecting and analyzing data. For example, they could add more than 100 variables into the analysis method and printed out the accurate results. Usage of

big data technology in the process of booking, ordering and baggage checking, might improve data privacy. It could save users significant amount of time and provide more personalized services. Shenzhen Airlines introduced an advanced baggage checking system. It increased the rate of luggage registration to 100% and reduced the baggage loss rate by 90% as well. In summary, big data technology posed a positive effect on both airline companies and customers.

However, due to the emergence of big data, privacy and ethical related problems also appeared more significantly in the aviation industry as follows. First, several privacy issues could arise during the stage of collecting and storing information. Several unethical companies collected consumers' information without their permission. Sometimes they were unable to protect their users' information safely. There were numerous information leakage cases in the airline industry, and it undoubtedly caused a negative effect on consumers and undermined the reputation of companies as well. Second, ethical concerns could also attract the public's attention. Overbooking was a legal operation strategy, since every airline companies could adopt this tactic to boost their revenue. However, the choice some companies made were unethical, since they analyzed their users and forced the passengers with discounted prices to get off the flight if the plane was overbooked. The unfair price strategy was another ethical issue. Numerous newspapers reported that certain airline companies or platforms apply different price strategy to different individuals. Heavy users were offered higher prices. If the user was affluent determined by the big data analysis, this consumer might receive a higher price as well. It should be highlighted, that these strategies are not unethical. However, we observe the demand for protection of consumers' benefits by clear regulations.

Our future work will provide a consolidated framework with guidelines, recommendations and solutions to reduce unethical practices and raise the corporate social responsibilities for all levels of customers and businesses activities.

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