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AN EFFECT OF BIG DATA ANALYTICS ON ENHANCING AUTOMATED AVIATION

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Abstract: The increase in the delays of flight has become the major problem in today's aviation industry. This led to loss of time and money and eventually causing more inconvenience to the passengers. This paper work recommended the solutions of the above problem using comparative study with help of R programming tool. This paper focuses to evaluate the industrial progression and cause of incovenience to the automated aviation industry. Big Data covers the entire aviation industry to improve the efficiency of functioning using techniques like Data Acquisition System, Data Curation and Hadoop process and algorithms like K-Means Clustering and Logistic Regression. Even though the technology and digitalization has become advanced, there is a dire requirement of improvement in the aviation industry as the delay of flights in this industry is very frequent and leads to time consumption of the people and sometimes it may lead to accidents, thus leading to air traffic. Technological Big Data is one such area which helps in the improvement of the service of aerospace to the travelers and aviation too. The scope of this project is confined to departure and arrival time management of the flights prior to big data and after introduction of big data and also to understand the maintenance of usage of machinery.

Keywords: ***Data Analytics, Data Processing, Large Scale Distributed System, Hadoop data File System.***

I.INTRODUCTION

Aviation plays a vital role in the life of a passenger who travel by air. It has undergone a incredible change from its invention to the present days, more so after the digitalization. There has been lack of technology when the industry was not computerized regarding the flight arrival and departure which is inexperienced now. In the present day, technological instruments like Data Acquisition System and Global Positioning System is given the most important criteria and it plays a crucial role from the moment the flight takes off in the air from the origin airport and reaches its destination. Time is very important module in everybody's life and aviation takes the role of reaching the passengers on time without much wastage of time. At this juncture, it is important to know about the exact arrival time of flight as the departure which enables the passengers to plan their schedule accordingly. In case of any miscommunication, the passengers program might get interrupted who may plan to attend an important meeting in other country and various other activities. Hence it is essential to study the past about the development that took place in communication of flight arrival and departure before digitalization and after digitalization and the comfort which digitalization has brought to the passengers improvements that could be made in communicating to the passengers which could attract more passengers traveling by flight. This study is focused on a comparative study of the past i.e., pre digitalization to the post digitalization era and to the present day of big data.

Fig 1: An Employee Updating The Flight Status Manually

In the above Fig 1, the lady belongs to Air India. Since those were the days where the computer did not come into force, the employees used to update the information for the arrival and departure of flights manually. After updating the information, they used to get verified by the pilots. They also note the

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information of the flight departure and arrival. After this verification process, they used to check the statistics for every one month and tried to reduce the errors. The detecting of the errors was very difficult by the employees manually. This resulted in the time consumption and eventually also in the late departures and arrivals of the flights. At that time, it was only possible to analyze the performance but it is not possible to generate new solutions for those problems. The passengers were not provided with the acknowledgement about the timing of the flights when they were delayed. This resulted to the lot of inconvenience to the passengers. The number of passengers traveling by air also decreased gradually. This brought the airline companies face financial loss.

Later, the computers came into force, the detection of errors became very easy and most importantly the time consumption got decreased gradually and the number of passengers traveling by air increased. This brought lots of profits to the airline companies. Slowly, the number of airline companies relying on computers increased. As the days passed, technology became more advanced and it resulted in introduction of the big data. This is mainly used to analyze the data from many streams without which the airlines cannot sustain. Hence, the growth for the airlines increased. By analyzing the data from many streams the accurate results will be derived.

II.LITERATURE SURVEY

A. ANALYSIS OF AIRCRAFT ARRIVAL AND DEPARTURE DELAY CHARACTERISTICS ERIC R. MUELLER AND GANO B. CHATTERJI NASA AMES RESEARCH CENTER, MOFFETT FIELD, CA 94035-1000(2002): The increase in delays in many countries has been the subject of many studies in recent years. These reports contain delay statistics over the entire NAS, along with some data specific to individual airports, however, a comprehensive characterization and comparison of the delay distributions is absent. Motivated by the desire to improve the accuracy of demand prediction in en route sectors and at airports through probabilistic delay forecasting, this paper analyzes departure and arrival data for few airports in the United States that experience large volumes of traffic and significant delays. To enable such an analysis, several data fields for every aircraft departing from or arriving at these ten airports in a 21- day period were extracted from the Post Operations Evaluation Tool (POET) database. Distributions that show the probability of a certain delay time for a given aircraft were created. These delay-time probability density functions were modeled using Normal and Poisson distributions with the mean and standard deviations derived from the raw data. The models were then improved by adjusting the mean and standard deviation values via a least squares method designed to reduce the fit error between the raw distribution and the model.. Finally, correlation between the number of departures, number of arrivals and departure delays is examined from a time-series modeling perspective.

B. ANALYSIS OF AIRCRAFT DELAY AND AIRPORT ON-TIME PERFORMANCE(M.S. TONGJI UNIVERSITY, CHINA, B.TECH. HUAZHONG UNIVERSITY OF SCIENCE AND TECHNOLOGY YUQIONG 0BA , 2004) : In this research, statistical models of airport delay and flight arrival delay were developed. The models use the Airline On-Time Performance Data from the Federal Aviation Administration (FAA) and the Surface Airways Weather Data from the National Climatic Data Center (NCDC). Multivariate regression, ANOVA, neural networks and logistic regression were used to identify the pattern of airport delay, aircraft arrival delay and schedule performance. These models are then combined in the form of a system for aircraft delay analysis and airport delay assessment. The assessment of an airport's schedule performance is discussed now. The results of the research show that the daily average arrival delay at Orlando International Airport (MCO) is highly related to the departure delay at other airports. The daily average arrival delay can also be used to evaluate the delay performance at MCO. The daily average arrival delay at MCO is found to show seasonal and weekly patterns, which is related to the schedule performance. The precipitation and wind speed are also found contributors to the arrival delay. The capacity of the airport is not found to be most important. This may indicate that the capacity constraint is not an important problem at MCO. This research also investigated the delays at the flight level, including the flights with delay greater than or equal to minute and the flights with delay of maximum 15minutes, which provide the delay pattern of every arrival flight. The characteristics of single flight and their effect on flight delay are considered. The precipitation, distance of flight, season, regular days, arrival time and the space of time between two arriving flights are found to contribute to the arrival delay. We shall measure the time interval of two consecutive flights spacing and analyze its iii effect on the flight delay and find that for a positively delayed flight, as the space of the time increases, the probability of the flights being delayed will definitely decrease. While it was possible to calculate the immediate impact of originating delays, it is not possible to calculate their impact on the cumulative delay. If a late departing aircraft has no empty space at all in its down line schedule, it will no doubt, continue to be late. If that aircraft enters a connecting airport, it can penetrate its late affect to another airplane. In this research we also consider solving only the arrival delay at MCO, excluding the flights with originating delay. This model makes it possible to identify the pattern of the aircraft arrival delay. The weather conditions are found to be playing the most important factors that influence the departure and arrival delay due to the origin airport and destination airport.

C. ANALYTICS ON BIG AVIATION DATA: TURING DATA INTO INSIGHTS RAJENDRA AKERKAR (WESTERN NORWAY RESEARCH INSTITUTE SOGNDAL, NORWAY-2014) :The business world is undergoing a revolution driven by the use of data and analytics to guide decision making. While many forces are at work, a major reason for the business analytics is the rapid growth of the amount of data available to be analyzed. Recent days, big data is beginning to have a major impact on air travel

with more data being created both through the plane sensors and the passengers on board; the opportunities to use this data will only increase. It provides innovative companies with the opportunity to improve major aspects of their business, from using data to improve customer retention through to making planes safer and more reliable. In this paper, we discuss a big data concept, definitions and further present some cases for aviation industry to analyze data from every possible channel, for example, customer data to create a unique profile for each customer based on a wide range of demographic data, behaviors and preferences.

I. IDENTIFICATION OF THE PROBLEM

The flight delays are measured by few technical ways. As we discussed earlier, flight delays are caused by Engine malfunction, improper communication in the cockpit, bad weather conditions, and sudden ill health of the passenger or the problems at the destination airport. The punctuality of operations is one of the most important factors in the service quality of airline business. For example, an aircraft that has just arrived is to be inspected immediately and was prepared to departure to another airport. Such overloaded schedules easily make flight delays and they propagate to subsequent flights to cause further delays. An important first step to avoid this problem is to predict flight delay in advance. In this section, we shall draw a solution to the problem as a binary classification problem. It is reasonable to define this problem as a classification problem because the on-time performance rating, a common measure of airline service quality, is defined as the ratio of flights where the delay is lower than a certain threshold, and this rating does not concern the amount of delay time. In this paper, delayed flights are defined as flights whose departure time is fifteen minutes behind the schedule. There might be some engine malfunctions which cannot be predicted sometimes. The best approach for this problem is to check the flight condition before taking off from the origin airport lest the lives of the passengers and crew is in jeopardy and in view of this checking of the flights before takeoff is essential to avoid much loss to the airline company as well as to save the lives of the passengers. The passenger health should be monitored by the airline officials during the boarding process so as to avoid the future problems. The origin airport should communicate very frequently to the destination airport.

III.PROBLEMS DUE TO DELAY OF DEPARTURE & ARRIVAL OF FLIGHTS

The study tries to analyze the reasons for the delayed flight arrival which is due to the factors in the connecting airports and communication of delay in the other airports which is not accurate but approximate.

Fig 2: Before the Big Data

The above Fig 2 shows us the screen displaying departure/arrival of flights. It displays the destination, time of departure of the flight, the status of the flight and the gate from where the flight is departing. Before the digitalization, these were not available. The passengers used to get the information manually through the announcement. The announcement was made only when the flight got arrived or going to depart. There were no announcements made when the flights got delayed. This made the passengers wait for longer time. This caused the inconvenience for the passengers.After the digitalization, during the period of 1990's this above screen used to display the information of the flight and the inconvenience to the passengers decreased gradually. This was the first stage of the growth of the technology in the field of aviation.

Fig 3: After the Big Data

The above fig.3 shows us the information of the flight information after the big data. This is used in the current world. We can nowhere find the passengers in this current generation who is feeling inconvenience from knowing the departure/arrival of flights. The passengers traveling by air and the financial growth of the airline companies increased. The above screen displays the destination time, estimated arrival time, distance to destination, time of the origin and destination before departing. There are some factors in the above screen that were missed before the big data. This can be seen not only in the airport but also from anywhere in the world. This technology is penetrated in the entire aviation industry. This resulted in the decrease in the consumption of the time.

IV.SIGNIFICANCE OF DELAY OF ARRIVAL AND DEPARTURE

The study focuses on communication to the passengers about the arrival and departure of the flights and which was made manually before and it is made in the contemporary world. Aviation industry has occupied a predominant role in the world. This is considered as the safest travel in the world. People are opting this aviation industry even for the shortest distances because of its quick travel and less time consumed to travel. At this juncture, the study gains significance which would indicate the paradigm from manual operations to digitalization and usage of big data which could save the time and its cost effective.

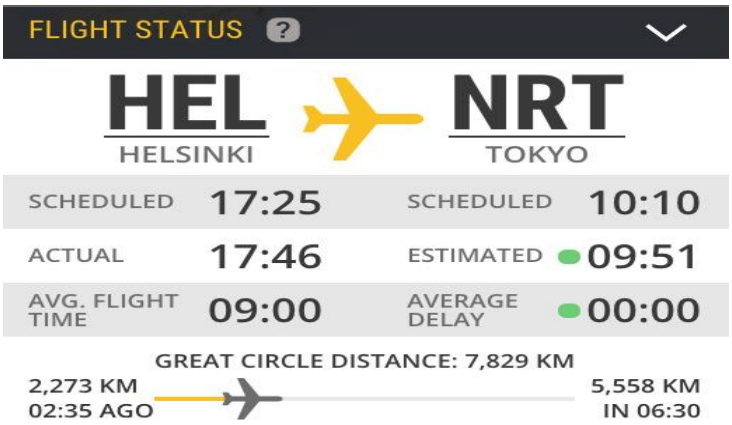


Fig 4: Knowing the Flight Status Using Mobiles

The above Fig 4 shows us the status of flight. Before the big data or the digitalization, this was one of the challenges faced by the airport authorities and employees. No one could accurately explain the status of the flight until it reached a particular destination. After digitalization, the estimated time of arrival/departure of flights became the solution for the passenger to reduce their time consumption. But finding the flight distance from origin to destination was the most challenging part. This took years to solve this challenge and also provided the passengers traveling by air with the convenience of knowing the flight status every time. This can be known just using our mobiles. Knowing of the movement of the flights through our mobiles/tablets/laptops was the biggest achievement by the aviation industry till date.

V.END TO END ANALYSIS IN DELAY OF ARRIVAL AND DEPARTURE OF FLIGHTS

Flight delay is the complex phenomenon because it may be caused by any problem like engine malfunction, improper communication in the cockpit, bad weather conditions, sudden ill health of a passenger or the problems at the destination airport, anyone of the above of factors rarely occurs. The delay problems in the present generation are caused by the origin airport or the destination airport. Thus resulting the delay of other airplanes. Before the Big Data was introduced, the communication for the delay of flights has become quite difficult and also putting the passengers into inconvenience. That became one of the reasons for the delay of flights. Since it was the period of pre digitalization, the passengers had no choice but to wait for the flight for a very long time.

No sooner digitalization and the big data came into force, the movement of the flight was kept in observation and every information was known to the passengers. Generally, flight delays are the responsibility of the airlines. Each flight is given a time allotment at every airport. The flights that arrive to the arrival gate after the fifteen minutes prior to scheduled time are called as the "high delay" flights whereas the flights that arrive earlier to the prior time are recorded as the "Low level". If the flight exceeds that time, another flight gets affected and also resulting in every passenger putting into inconvenience. These days, each minute information is known to the passenger through mobiles and they can plan their schedule accordingly. The low-delayed flights represent 15% of the data set and high-level delayed flights represent 85% of the data set.

Table 1: Sample Data Used For The Fight Delay Analysis

Period(in year)	Low delay of flights	High delay of flights	Total number of flights
2005	7810	2590	10400
2010	6690	4125	10815
2015	6450	5540	11990

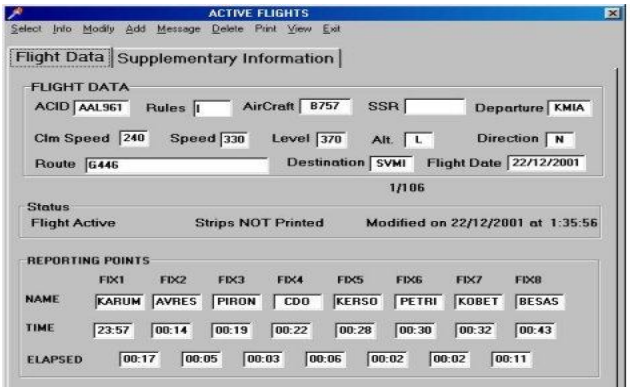


Fig 5: Saving the Information before Big Data

The above fig 5 shows us the information of the flight after the introduction of digitalization. Since the computerization was new to the aviation industry at that time, the source to store the information was very less. That created the bog problem to the aviation industry. Few data were incomplete in storing. In that process, the storing of the data like the accurate arrival of the flight to the destination, accurate time of the departure of the flight was not mentioned in the computers. The employees working in the aviation industry uses the data to verify with another departure and arrival of flights. At this moment, the original information was not available since it was not stored. This created the big problem to the aviation industry. Slowly, when the technology advanced, this problem gradually decreased.

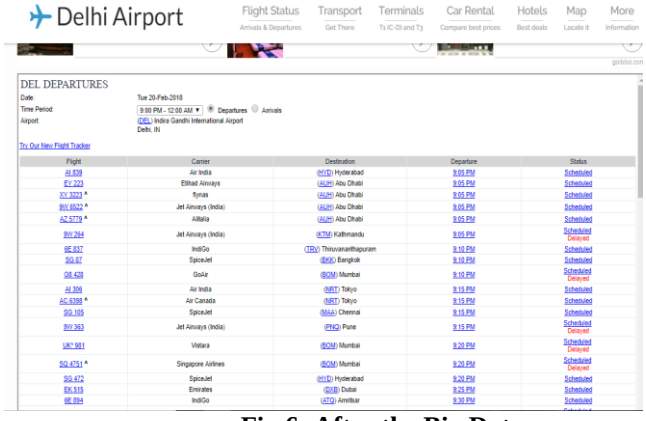


Fig 6: After the Big Data

The above data mentions each and every detail about the flight that is departing from the Delhi airport in India. The first

column shows the flight number, the second column shows us the name of the airlines, the third column mentions the destination, the fourth column mentions the departure time of the flight, the fifth column shows us the status of the flight.To guide the people in the correct path regarding the status of flight, the officials of the airline company has used some proper colors to mention the status. The status that is mentioned in blue color indicates us that the flight will depart as per the schedule. The status that is mentioned in the red color indicates that the flight is delayed by some time. Even after the big data, the delayed time, arrival time mentioned is approximate but not accurate.

VI.RECOMMENDING THE SOLUTION FOR THE PROBLEMS

As we discussed earlier, the main problems for the delay of flights are Engine malfunction, improper communication in the cockpit, bad weather conditions, sudden ill health of the passenger or the problems at the destination airport. The engine malfunction is the most dangerous problem that occurs. There are many cases where the flights were delayed and caused the passengers much inconvenience. But at the same time, there are also equal cases where flights met with an accidents due to engine malfunction. To reduce this problem of delay due to engine malfunction, the best way of approach is to check the airplanes very frequently to avoid further problems. This may also reduce the insecurity of the people traveling by air. The second problem is the improper communication in the cockpit. There are very rare cases where the communication played a vital role in the delay of flights. This caused lot of inconvenience to the passengers to travel by air. Whenever the flight is scheduled to take off, the pilots should verify the communication with the control tower to ensure the safety.

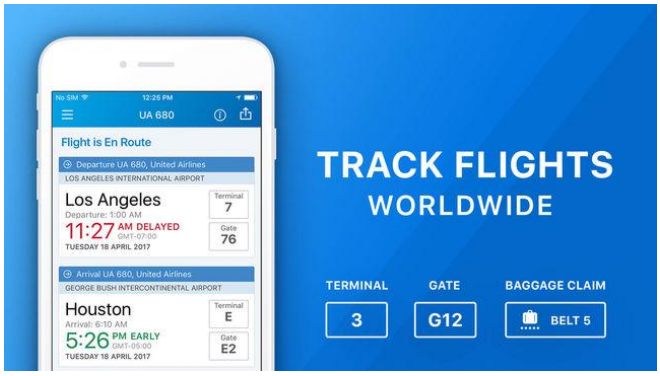


Fig 7: Tracking through Mobile

Due to the bad weather conditions, the flights used to get delayed or canceled without announcing to the passengers. This was the big challenge faced by the passengers. Now, after big data came into force and digitalization, the passengers are getting to know every movement of the flights through mobiles. This has resulted in saving time of passengers by not wasting their time at airports. The passenger health should be checked during the boarding process because during the takeoff if the passenger feels sick, then the flight may have to perform emergency landing which results in delay of the same flight and the same will be penetrated to other flights of the origin and the destination. The immediate acknowledgement should be given by the destination airport to the origin airport if there are any technical issues. If these goes in a systematic process, then the flight delay may get reduced and thus saving money to the airline companies.

The above fig 7 the screen displays the terminal number from where the aircraft is departing, the gate number and where to claim our baggage. The phone in the picture displays us the departure city and arrival city. It also clearly mentions the time of departing and if delayed, it tells us by what time it is delayed. We can operate this entire thing by just sitting at our home so that the passengers can plan accordingly.

VII.RECOMMENDATIONS

The data from the past has been collected to analyze and to recommend the new solutions in order to prevent the delay of departure and arrival of flights. The above outputs clearly states that Big Data has been penetrated throughout the aviation. With the proper usage of computerization of Big Data, the delay in the departure and arrival of flights decreases. Thus it results in the decrease of insecurity from the minds of people traveling by air. The recommended solutions have been clearly shown in the form of G programming for collecting Big Data and R programming for comparison.

VIII.CONCLUSION

The aviation industry suffered a lot before the digitalization through financially, decreasing of passengers day by day. The entering of data manually became an hectic work for the employees, thus resulted in the consumption of time. The passengers across all the countries suffered a lot without the acknowledgement of the flight status and waited in the airport for hours and hours and also in worst cases they waited for days to board their flight. The manual entry created lots of errors and it led to the agitation of the airlines because errors in the entry were not balanced. Sometimes they were increasing and decreasing. This created a billion dollar loss for the aviation industries across all the countries. As a result, the passengers traveling by air got reduced dramatically. Everyone in the aviation industry expected the change. Then the digitalization came into force. The computers made the work much easier. The dream of doing work with efficiency for every employee working for the aviation industry came true. The computers easily detected the errors and they solved it. Within no time the computers were penetrated across all the fields of the aviation industry. Everyone relied on computers in such a way that without them the work became impossible. The technology started becoming more and more advanced since then.

Later, big data was introduced. The aviation industry started to use the big data to analyze the data to detect the errors and to improve the on time performance of the flight. The aviation industry expanded a lot after digitalization and also after big data. No passenger is inconvenient to travel by air. In fact, the

number of passengers traveling by air dramatically increased. All the passengers could easily track the information of the flight just by sitting at home so that they can plan accordingly. This was the one of the reasons where the passengers suffered a lot from. That problem disappeared slowly. Though the big data was introduced and tried to reduce the problems of the passengers and the aviation industry, the problem did not get solved permanently.

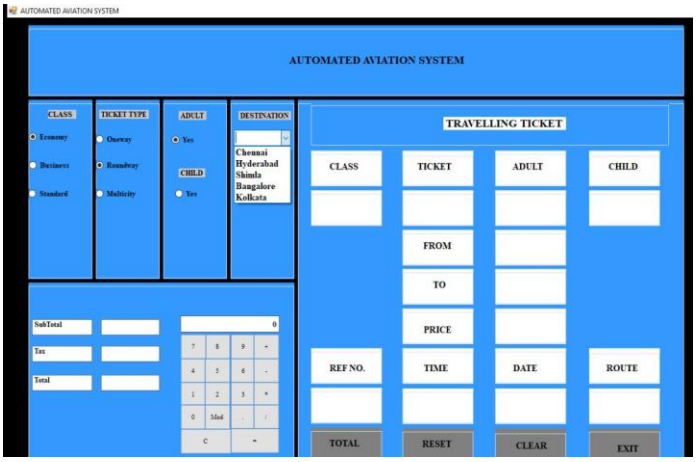
In this paper, the comparative study was done on how the aviation industry was before and after the big data and want to create awareness in the minds of the people that traveling by air is absolutely the best thing in order to save the time. We have taken the statistics of the delay of arrival and departure of the flights of a particular place and analyzed that data. We are recommending ideas on how the aviation industry can be improved further thus saving the billions of dollars to the aviation industry.

IX.FUTURE ENHANCEMENT

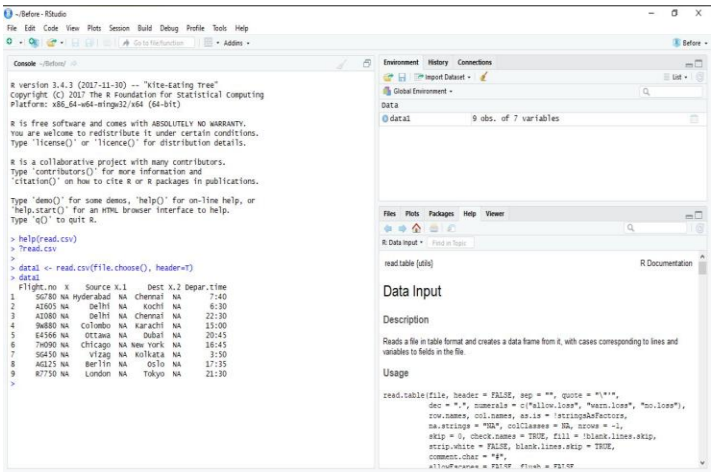
Even after introduction of the big data, the aviation industry is facing problems somehow. Thus with the idea that mentioned in this paper, the problems that the aviation industry is facing might get reduced and inconvenience for the passengers traveling by air also gets reduced. In adverse conditions, collecting big data solved many problems and it has given lots of solutions. Eventually, if the same problem repeats in the future the big data will overcome. Hence it saved time and money to the airline companies.

X.REPORTS

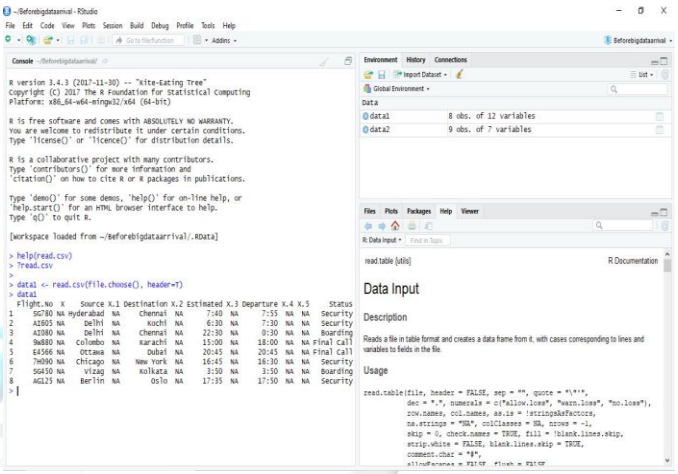
The reports that are displayed below recommend the solutions inorder for the aviation industry to work more efficiently. This makes the work done very quickly and also the errors gradually decreases.



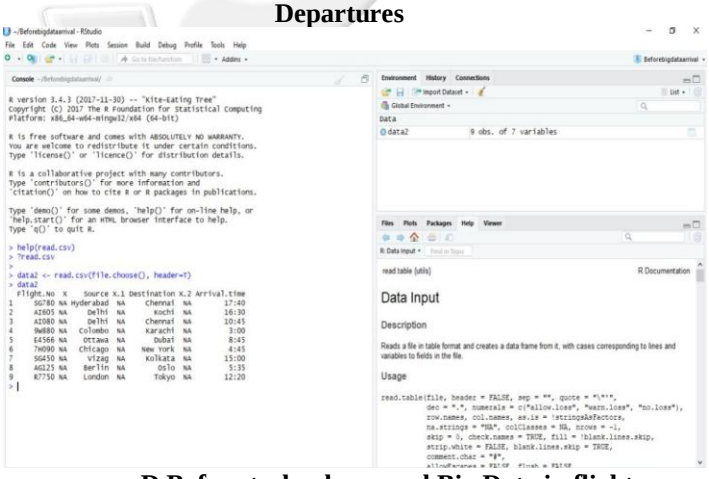
A. Automated Aviation System



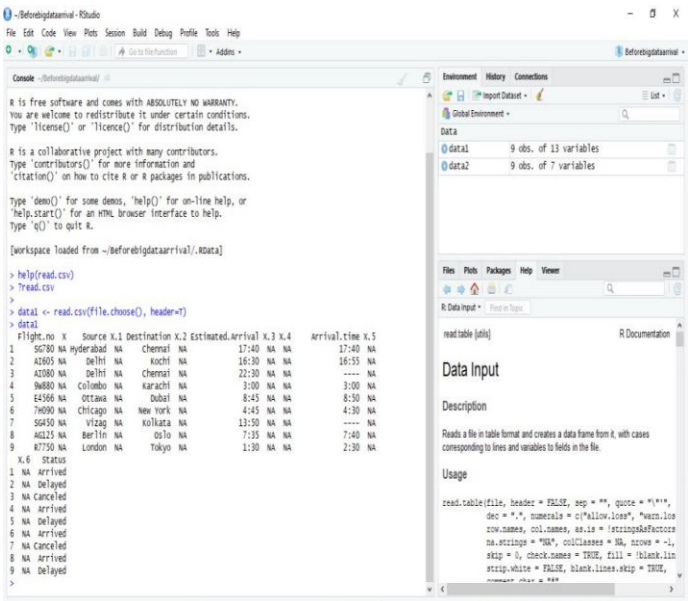
B. Before Technology Used Big Data In Flight Departures



C. After Technology Started Using Big Data In Flight Departures



D.Before technology used Big Data in flight arrivals



E.After technology started using Big Data for flight arrivals.

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