Aviation Accidents - Boeing

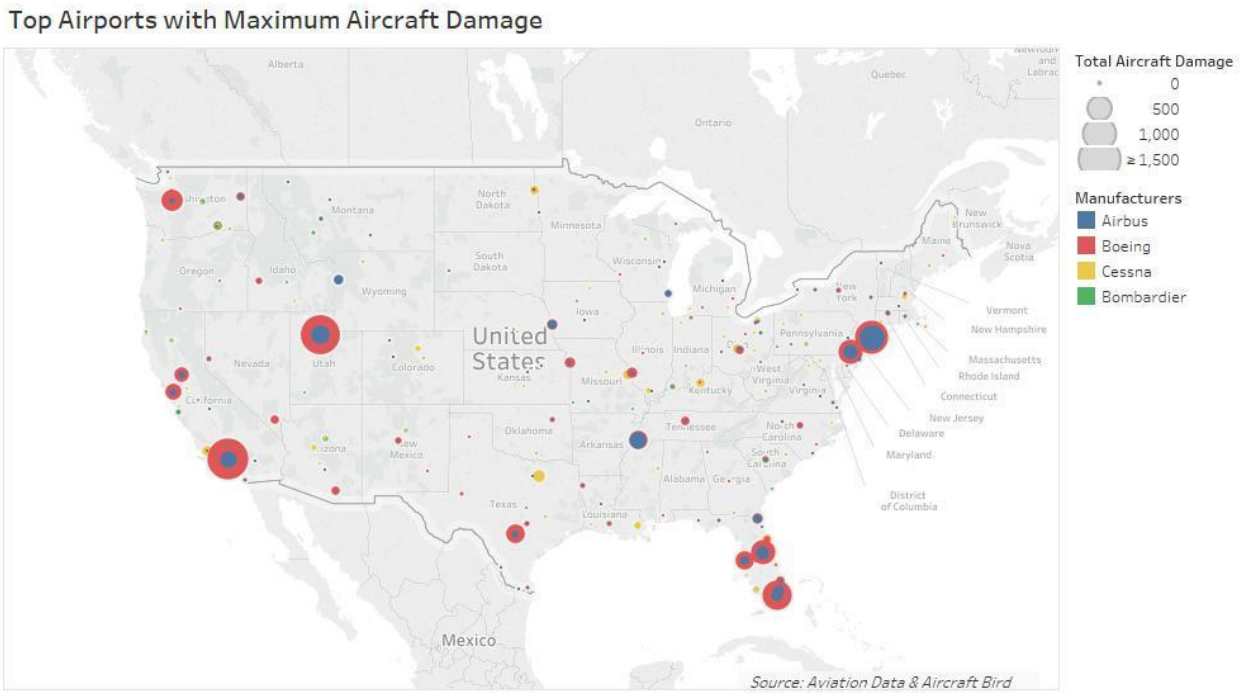
Where are we? What is the time?

Since the day, the Wright brothers gave us mechanical wings to fly, we have shared the air space with birds. Given that we have no control over the flight of birds, over the aviation industry years, there have been a lot of reported damage, not only to birds but also humans and aircrafts. Over the period from 1990 to 2010, FAA has accumulated data of various aircraft manufacturers with respect to the damages they faced and has generated reports warning them where their aircrafts lie on the scale of safety.

As a Boeing official, we would be concerned about the statistics of our own aircraft damages since it not only affects us financially but also has a negative impact on our reputation. Our analytics team has given us some insights as to what our standing with respect to aircraft damages was, not only internally but also define our position in the aviation industry. The following few visualizations will also describe the impact of the correction measures that we took after 2010 till 2015.

Visualization 1: Airports Aircraft Damage

This visualization is about which are the top airports in the US which reported maximum bird strikes over the years. The following visualization uses color as well as shape and size and shape encoding to denote the data. The size encoding defines what is the proportion of damages of top manufacturers of aircrafts.

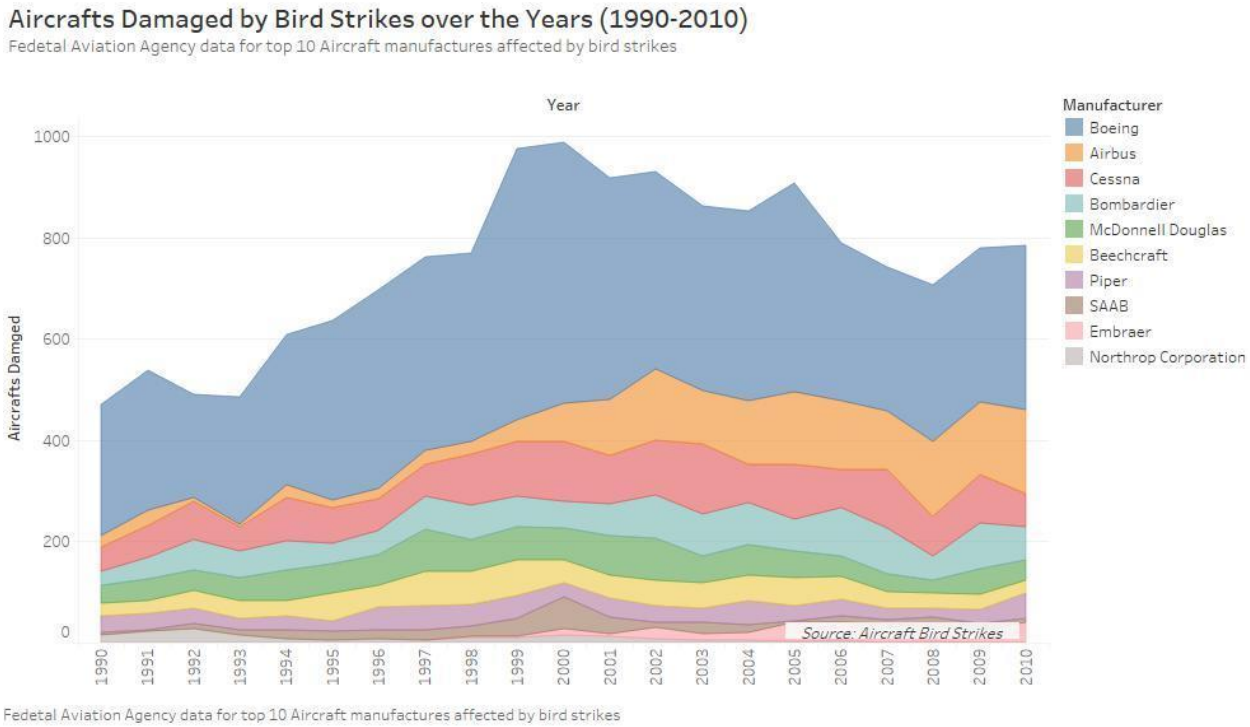


Top 10 makers having high number of aviation incidents.

From the above image, we may conclude, firstly, that the top airports with reported aircraft damage are mostly the ones with maximum migratory bird population, for example, Salt Lake City, Utah. Secondly, it is also evident that Boeing has the maximum number of aircraft damages as compared to its top competitors like Air bus, Cessna and Bombardier.

Visualization 2: Manufacturer Aircraft Damage

Visualization 2 portrays an area map which denotes comparison of the damages to aircraft of various manufacturers due to bird strikes over the time period 1990 – 2014.



From the above image, we observe that even though Air Bus is the top manufacturer of aircrafts, Boeing has suffered maximum loses in terms of damages to aircrafts.

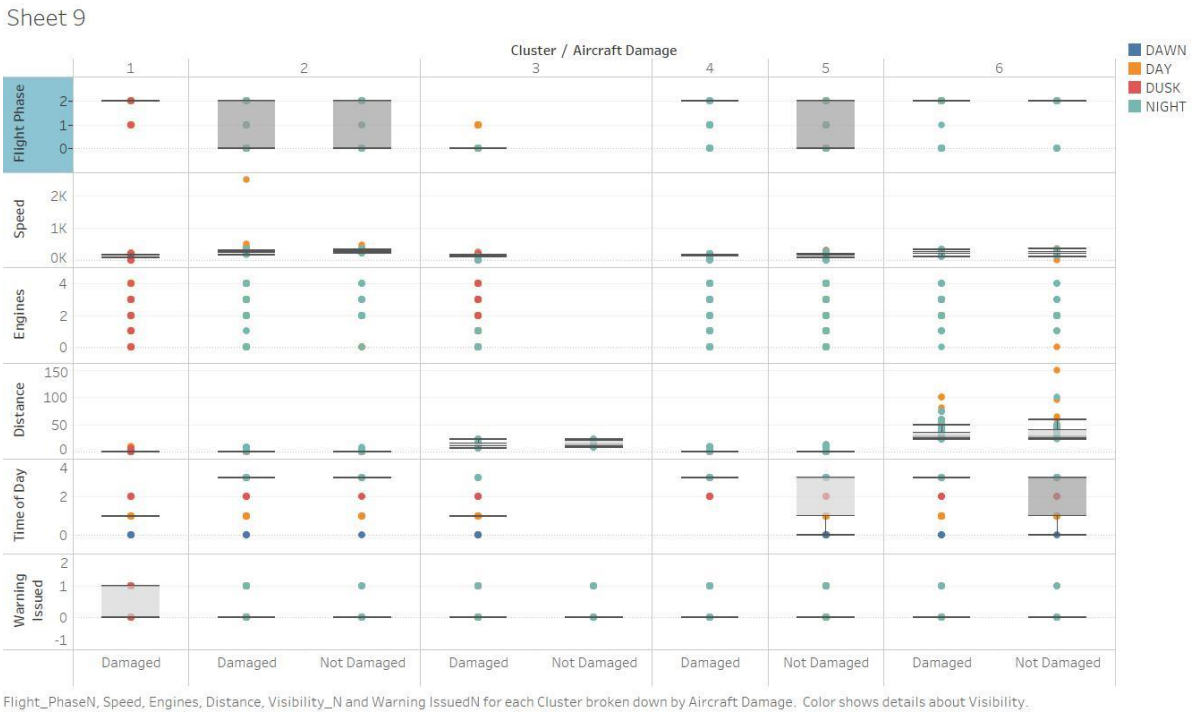
Insight 1:

In spite of being one of the top aircraft manufacturers in the aviation industry, Boeing has suffered maximum damages to its aircrafts when it comes to bird strikes.

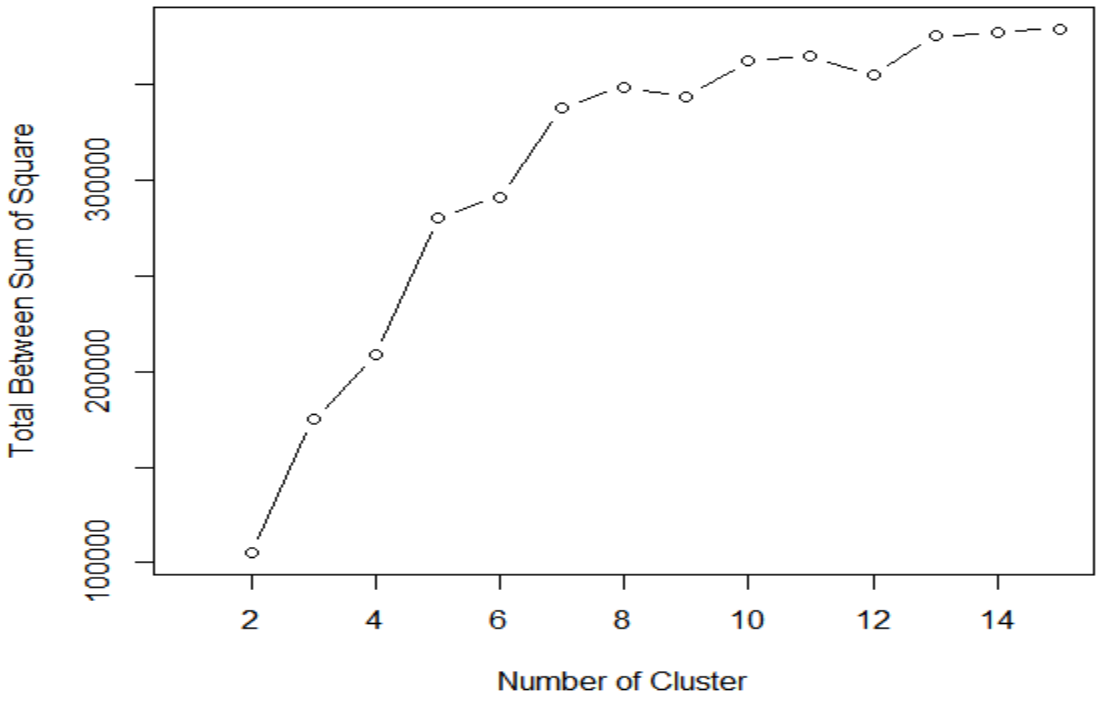
Frame the Business, Create Tension

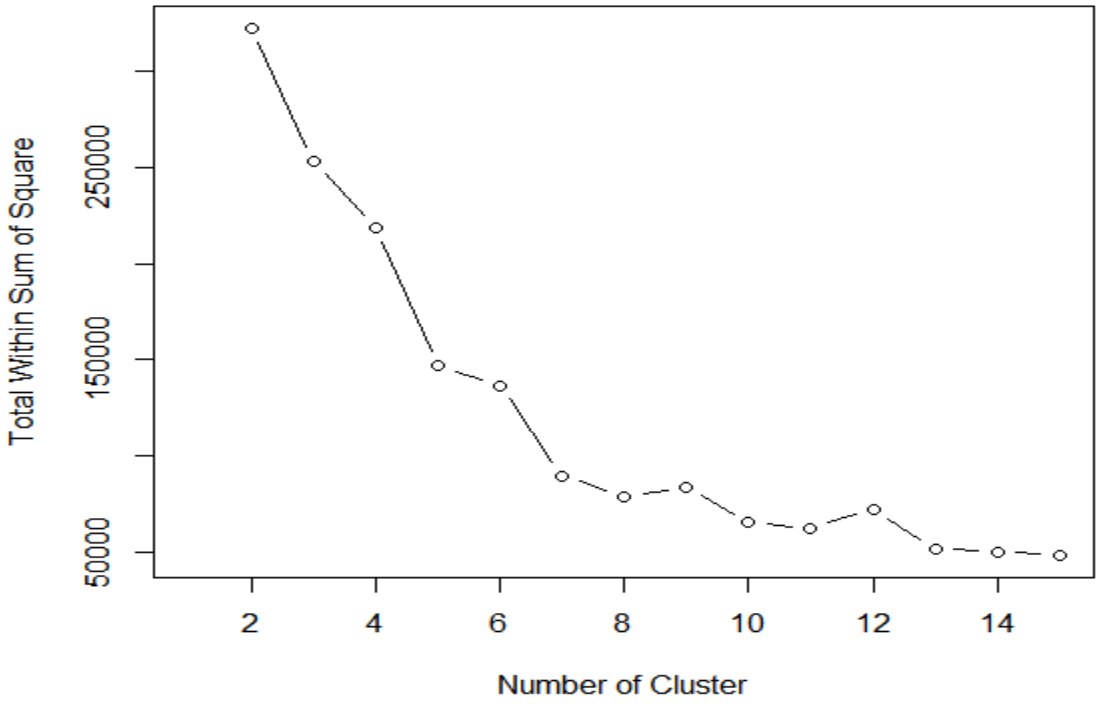
Visualization 3: Cluster

To decide the major factors responsible for the damages caused due to bird strikes, we have created 6 clusters based on following factors like flight phase, speed, visibility, engines, distance and warning issued . We have used a decision tree to form these clusters.



From the above visualization, we observe that, in cluster 2, 4 and 6 there's significant number of aircraft's damaged. Looking at the data from cluster 2 we can say that, Flight Phase is the most important variable for aircrafts damaged as there are significant number of aircrafts damaged reported. This analysis is in line with our findings from the decision tree.

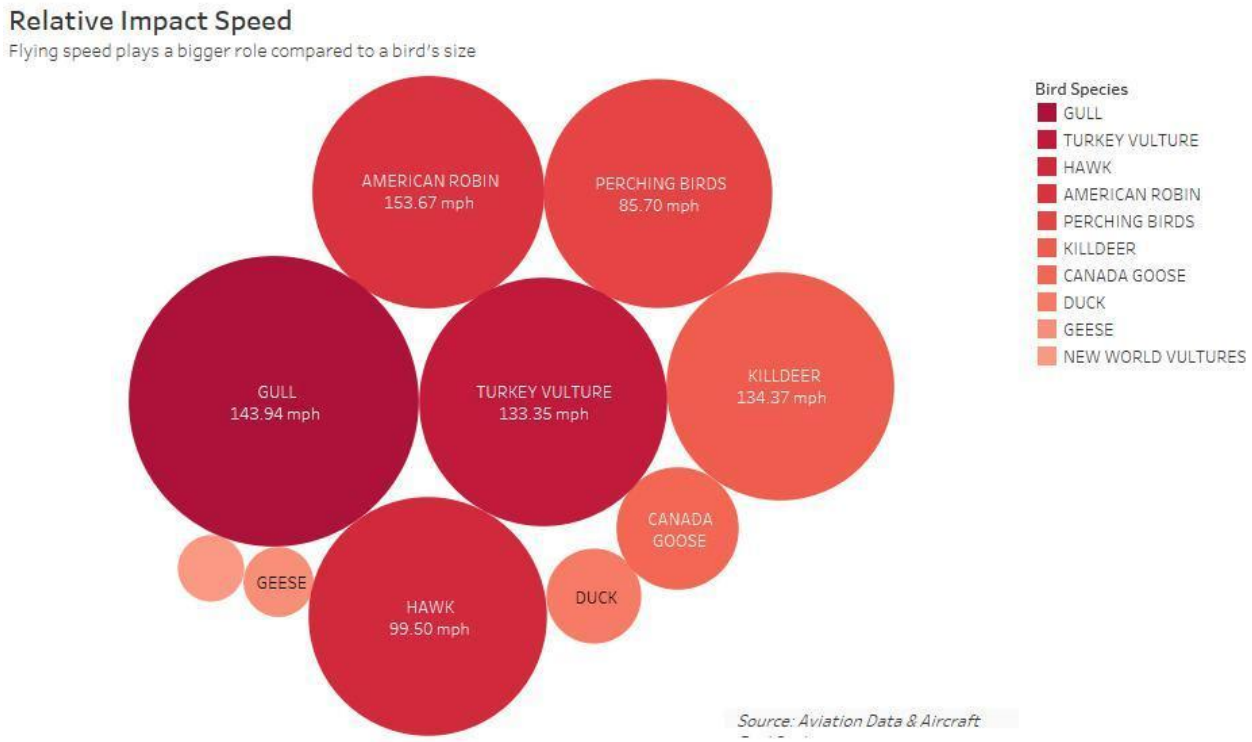

Total Between Sum of Square
100000
200000
300000
2
4
6
8
10
12
14
Number of Cluster


Total Within Sum of Square
50000
150000
250000
2
4
6
8
10
12
14
Number of Cluster

From the plot graph we have selected 6 number of clusters. Since, further addition of cluster won't do much of explanation of the variation. This is also the point where the slope of the curve changes suddenly and gives an angle to the graph.

Visualization 4: Impact Speed

This visualization was formed to depict the impact of various bird species on the aircraft damages. It includes characteristics of these birds such as their speed, name and the number of accidents that they have caused over the years between 1990 – 2010. Color encoding has been used to depict the magnitude in terms of the frequency of airstrikes that have occurred with the darkest color depicting the highest number of airstrikes caused by that bird type.

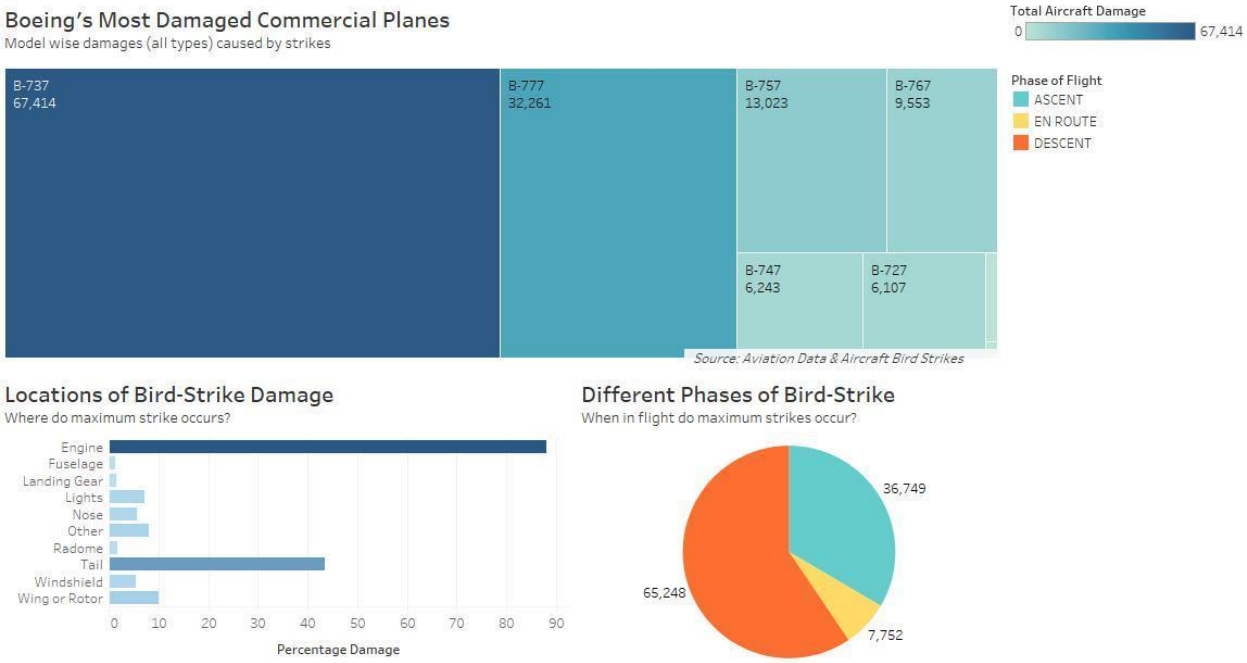


Species Name (group), count of Total Aircraft Damage and average of Speed. Color shows details about Species Name (group). Size shows sum of Total Aircraft Damage. The marks are labeled by Species Name (group), count of Total Aircraft Damage and average of Speed. The data is filtered on Species Name and Make. The Species Name filter has multiple members selected. The Make filter has multiple members selected. The view is filtered on Species Name (group), which has multiple members selected.

From the above image, we can observe that the top 5 bird species responsible for maximum air strikes are, Gull, Turkey Vulture, Hawk, American Robin and Perching Birds. One peculiar observation here is that, even though, anatomically, the Gull is smaller as compared to the Canadian Goose, it causes more airstrikes. Thus, as a conclusion, we figure that it's not the size of the bird, but the speed of the bird that is responsible for maximum air strikes.

Visualization 5: Boeing Commercial Planes

Visualization 5 is a dashboard of various observations in calculating Boeing's most damaged commercial planes. It represents a total of 3 factors – Total aircrafts damaged over the years 1990 – 2010 by the make of the aircraft, which part of the aircraft is impacted the most and in which phase of flight do maximum air strikes occur. We have used area and color encoding to represent the total aircraft damage where the biggest and darkest color indicates the most damaged aircraft model. A filter has been applied to the 'Total Aircraft Damages' which helps us see that for each air craft model, which are the parts that are affected the most and during which phase of the flight.



From the various parts in the above dashboard, we conclude that the model B-737 has reported maximum aircraft damages with a total of 67,414 number of bird strikes, engines, tail and wing seem to be the popular locations where the aircraft gets damaged and finally, as opposed to the common misconception of air strikes occurring during en route, is proved wrong when we see that, the maximum air strikes occur during the ascent and descent phases of the flight.

When Boeing themselves conducted the analysis of the different part of the aircraft that are most impacted due to bird strikes, they came up with the following diagram:

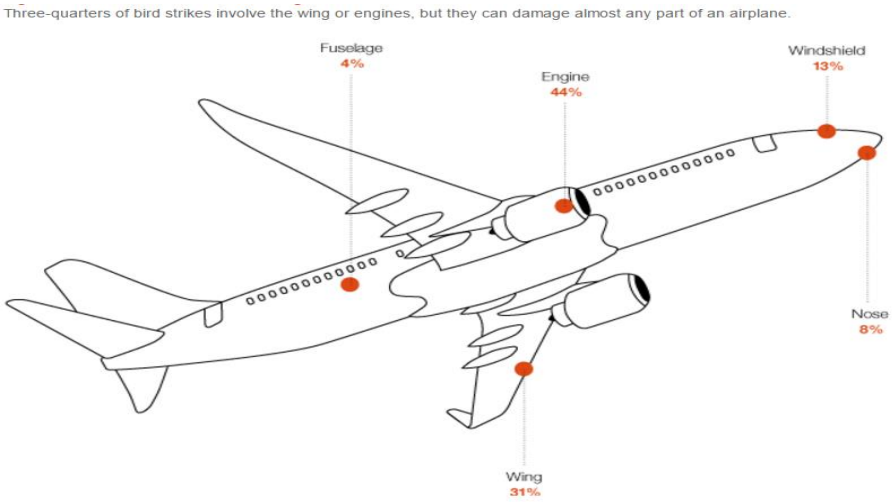


Figure: Locations of bird-strike damage

This diagram acts in support of our independent conclusions as well where in it shows 44% damage of engines which is the highest followed by wing.

Insight 2:

From the above visualizations, we can say that Boeing aircrafts are vulnerable to bird strikes by birds with higher speeds and not size. Their engines and wings are not strong enough to bear the impact of the bird strikes and their pilots need to take extra efforts at being cautious during the take-off and landing of the flights.

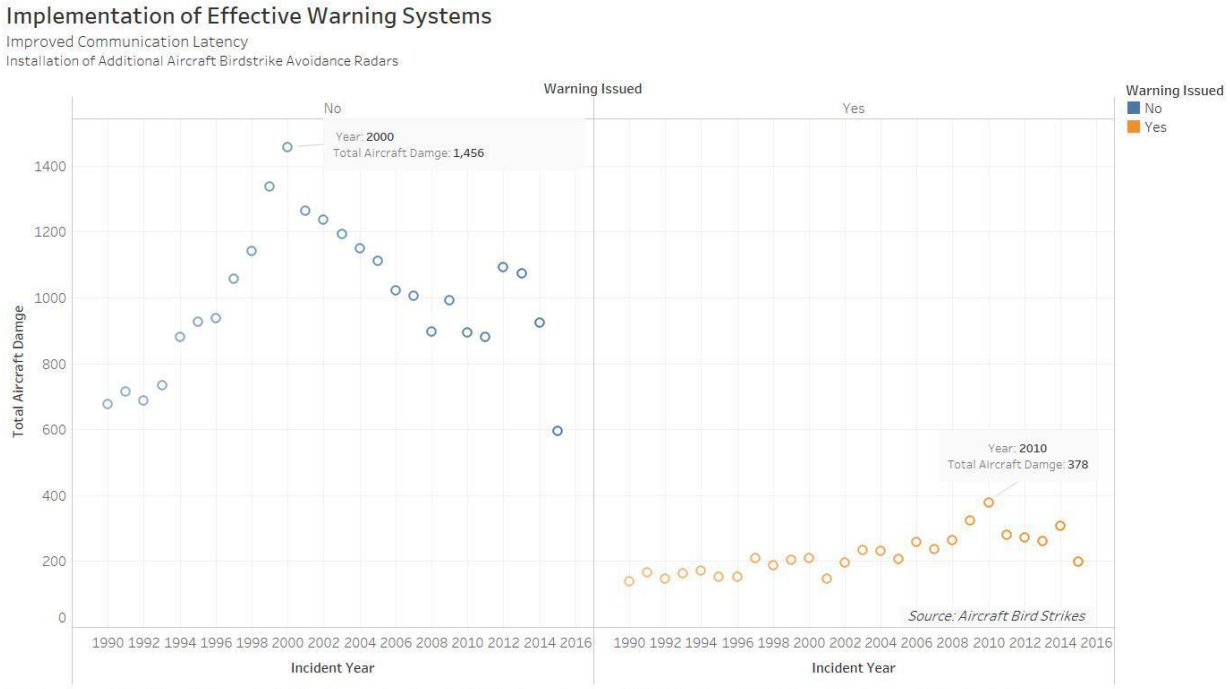
Release Tension

Visualization 6: Warning Impact

All airports in the world follow the protocol of issuing warnings in case of natural disasters, air traffic, bird traffic, fire and so on.

Over the years 2010 – 2014, Boeing has taken measures to reduce the number of aircraft damages with respect to stronger aircrafts builds, better safety measures, heading more cautiously to warnings issued by the authorities.

The following visualization shows how warnings being issued and Boeing in turn heading them with extra care and efforts has impacted their aircraft damage rate.



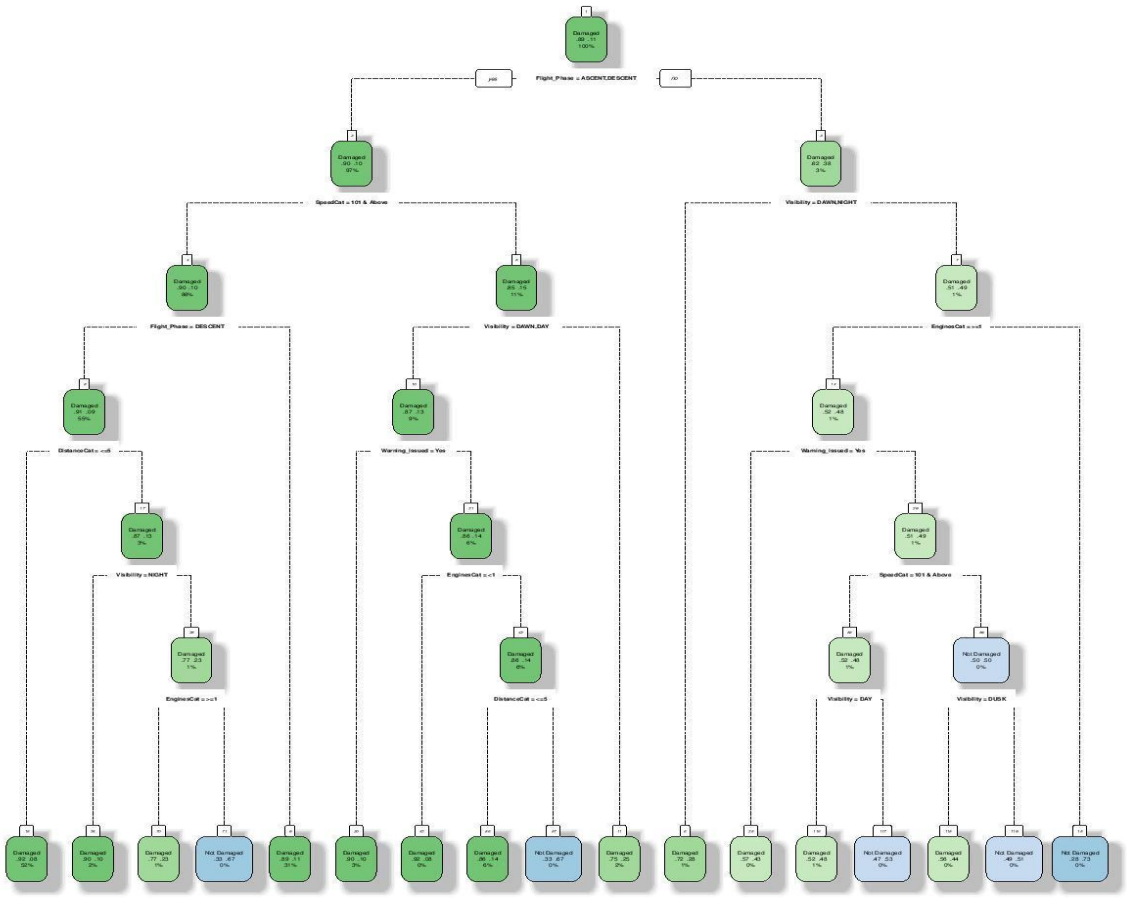
The plot of sum of Total Aircraft Damge for Incident Year broken down by Warning Issued on page 2015. Color shows details about Warning Issued. The view is filtered on Incident Year, which keeps 26 of 26 members.

We can observe from the above image that, over the years 2010 - 2015, whenever a warning has been issued, the air crafts of Boeing damaged due to bird strikes is comparatively and effectively lesser than when a warning was not issued.

Insight 3:

With the aid of warning issued by either the airport authorities, meteorological authorities or any other authorities, Boeing can reduce the number of aircraft damages due to bird strikes as compared to when a warning was not issued.

Decision tree



decision_tree

Firstly, Phase of the flight is the most crucial aspect when estimating whether an aircraft might get damage due to bird strike. From the data we can say that when the flight is **Ascending** it's more prone to bird strike i.e 97% and only 03% while descending. Secondly, the Speed is also important factor in

aircrafts getting damaged. If the relative speed of aircraft and bird is equal to 101 mph. and above than aircrafts getting damaged by the bird increases to 86%.

Important factors starting with order of importance:

1. Flight Phase
2. SpeedCat
3. Visibility
4. EngineCat
5. DistanceCat
6. Warning Issued