Data Visualization Project Report
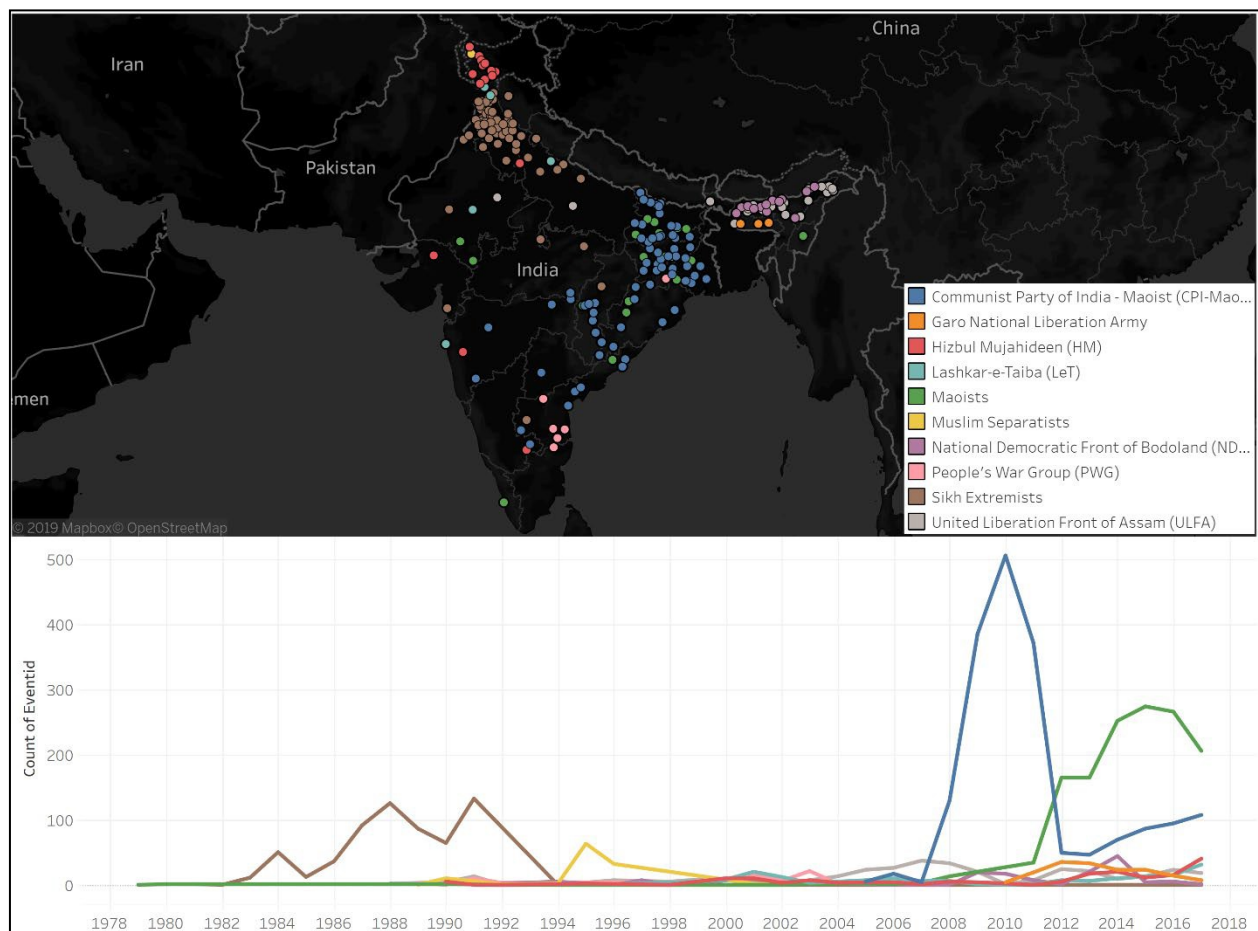# CPSC 8040

Visualizing Global Terrorism and Its Impact

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- **Project type:**

Software tool for a dataset visual exploration (Type 1)

- **Description/Motivation:**

"Terrorism", a word that instills fear in every man, woman, and child in this world. We all want to escape it, we all want to live a peaceful and happy life, but every country suffers from it. The fight against terrorism is the one fight that keeps the world on a united front. What really is terrorism? - "the unlawful use of violence and intimidation, especially against civilians, in the pursuit of political aims."

The Air India flight bombing in 1985 in Canada by Babbar Khalsa, 1990 massacre in Sri Lanka by LTTE, September 11 attacks in 2001 in the United States by al-Qaeda, the 2008 Mumbai attacks in India by Lashkar-e-Taiba, the Camp Speicher massacre in Iraq by Islamic State of Iraq and the Levant, to name a few are some of the biggest terror attacks the world has seen. Different locations, different organizations, different timelines, different motives, different religions, but all done with one aim and that is to terrorize and cause fatalities and loss to property.

How do we stop it? Can the next terror attack be predicted? Is there enough data that can be used to visually map the extent of damage and the locations and understand the motives using pre-historic data? These are some of the questions we are trying to answer with this project.

- **Objectives:**

It has been a week since the massive easter bombings in Sri Lanka, taking the lives of 300 innocent civilians many noted to be international tourists, who made their way to the islands to enjoy the peace, food and sandy beaches. Similar to any other terrorist attack, there is always a question of "could it have been prevented?". Throughout the week, we learned that the Sri Lankan government had access to intelligence provided by the Indian intelligence agencies predicting a massive terrorist strike, the report including the name of the leader Zahran Hashim. The series of suicide bombings occurring in churches across Sri Lanka came in wake of the deadly shootings in Mosques across New Zealand which clearly maps a relationship between the attacks. The above instance is just one incident where two attacks within a time frame are linked together and could have potentially been prevented.

The idea behind this project involves being able to find relations between various different terrorist attacks also providing deep insight on all previous attacks, notorious organizations and some of the countries that are affected the most by these deadly attacks. The following are some of the vital questions that we are trying to answer using our visualizations:

1. How has terrorism evolved over the years? - Visualized through animations
2. What regions of the world are the most affected? - Facilitates drawing a comparison between 2 regions, for example North America and South America.
3. What are the most notorious organizations on a global scale and what countries have these organizations terrorized?

4. What are the worst 40 attacks in the world, which organization claims responsibility and during what year did the attacks occur?
5. What is the most common type of attacks and weapon of choice?
6. What is the nationality of the target?
7. Which country has the highest number of casualties?
8. Visualization of the terrorist attacks that remain unclaimed over the years

The above questions are just a few questions that are outlined in the report, the visualizations itself provide a lot more information as you interact with them, using various filters which modify the results.

● Literature Review:

[1] provides a complete overview of the nature and evolution of international as well as local terrorism since 1970. GTD includes more than 180,000 terrorist attacks from around the world. It explains how the smallest of attacks create a massive impact on the attitude and policies towards terrorism. GTD, an annually updated database is funded by the Study of Terrorism and Responses to Terrorism (START). [2] describes the efforts employed in data collection for GTD along with the strategies applied to improve the quality and thoroughness of the data.

Due to the size and complexity of the data available on GTD, identifying trends and patterns of these terrorist attacks poses a great challenge. [3] provides a visual analytics system that answers the main temporal and geospatial questions pertaining to the attacks as well as the organizations behind the attacks. Similarly [4] visualizes the events by grouping them on a certain criterion, to find underlying individual and accumulated patterns over time. Furthermore [5] considers the spatiotemporal characteristics of the attacks to create a profile for each terrorist organization by establishing relationships between the location, time, magnitude and target of each attack.

● Description of the dataset:
▪ **How to obtain:** The dataset that we are using for our analysis is The Global Terrorism Database (GTD): https://www.start.umd.edu/gtd/

▪ **What:** GTD is an open-source dataset that is funded by the Study of Terrorism and Responses to Terrorism (START). The dataset consists of information regarding terrorist attacks around the world from 1970-2017, it currently includes 180,000 attacks.

▪ **Size:** GTD consists of 181691 rows and 135 attributes which will be discussed below. Most attributes consist of missing values and are not directly relevant to the aim of the project and as a result, will be dropped to reduce the dimension of the dataset. Analysis and visualizations will be produced with respect to vital information provided by the dataset including year, month, day, country, region, city, longitude, latitude, multiple attacks, suicide attacks, success/failure, target, type of attack, nationality, terrorist organization, weapon type, number of fatalities, and number of wounded. As we progress through the project, there is potential to incorporate more attributes. During the initial analysis, we found that an approximate of 40 attributes will be considered for our analysis. More details

of how these attributes will be incorporated can be found in the final deliverables section of the proposal.

● Software artifacts:

- **Python:** Python will be used extensively throughout the project to handle missing data and transform the large dataset into smaller datasets for analysis purposes. A few visualizations will be produced with Python using libraries such as Matplotlib, seaborn and plotly.
- **Tableau:** Tableau will be used to design the dashboard and most of our visualizations including heatmaps, animations and much of our histograms and pie charts.

● Challenges:

- The offsets between the highest value and the second highest are large, and the values are too important to be excluded, hence used logarithms instead of actual values to normalize the differences (For height and color).
- Creating maps and coloring areas with organizational influence led to overlapping colors, hence hiding important information. Fixed this by using animations
- Most attributes in the dataset consist of unknown values as the terror attacks remain unclaimed, or target nationality is sometimes unknown, motive and weapon used are unknown, hence giving way to a new category called unknown.
- While designing a map using location data, we encountered a challenge which was null values, some of the locations had faulty longitude and latitude data which prevents tableau from creating a map and marking the location.

● Design Choices and Results:

The main motive was to portray the evolution of Terrorism attacks throughout the years and how it has been increased or decreased with time. The dataset is handled in 3 different views, first, in a global point of view, and other two concentrating on India and USA separately.

The following screenshots will explain the work in detail:

I. The upper half of the dashboard represents a plot of count of attacks for each year. Color shows details about Region. The view can be filtered on Region, and the bottom graph shows Top 10 countries from the selected region. The color of the bars represents the count of attacks meaning the higher the count, the darker the color.
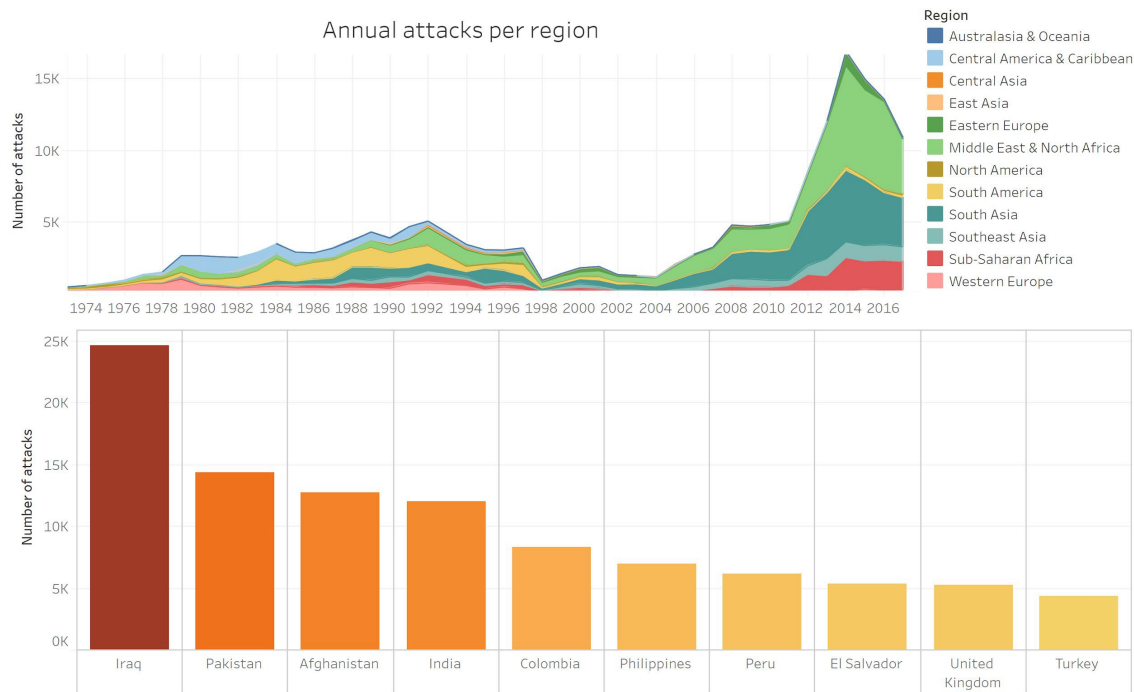
II. The red circles in the upper half of the dashboard represent the attacks on country over the years and the size of the dot shows the sum of casualties.
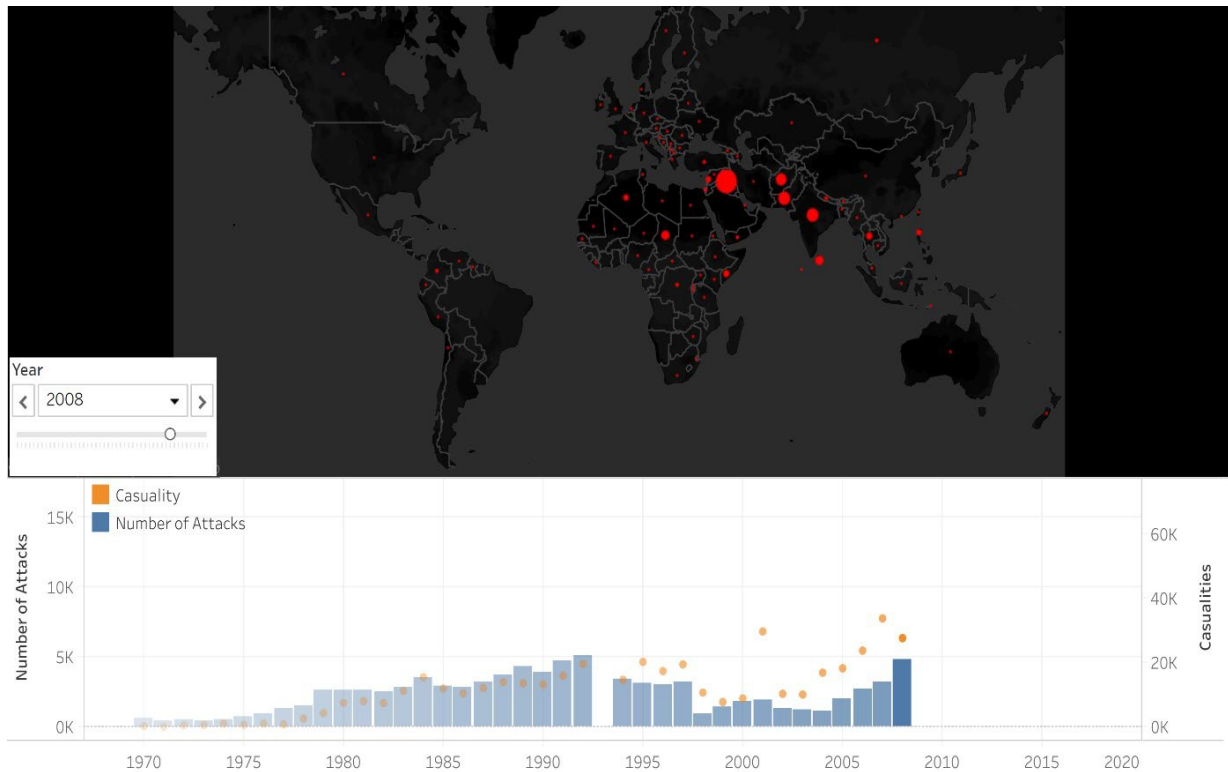

III. The below dashboard represents the trend of number of attacks by year carried out by top 10 organizations around the world. Each color represents a terrorist organization.
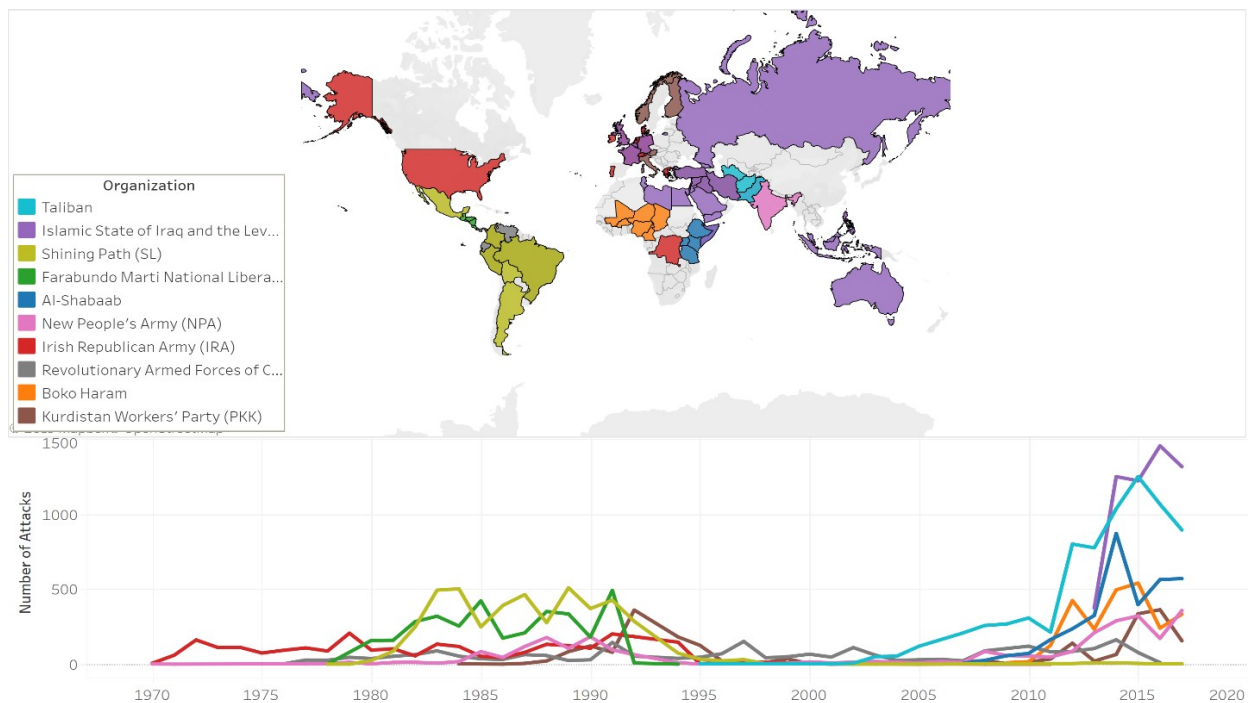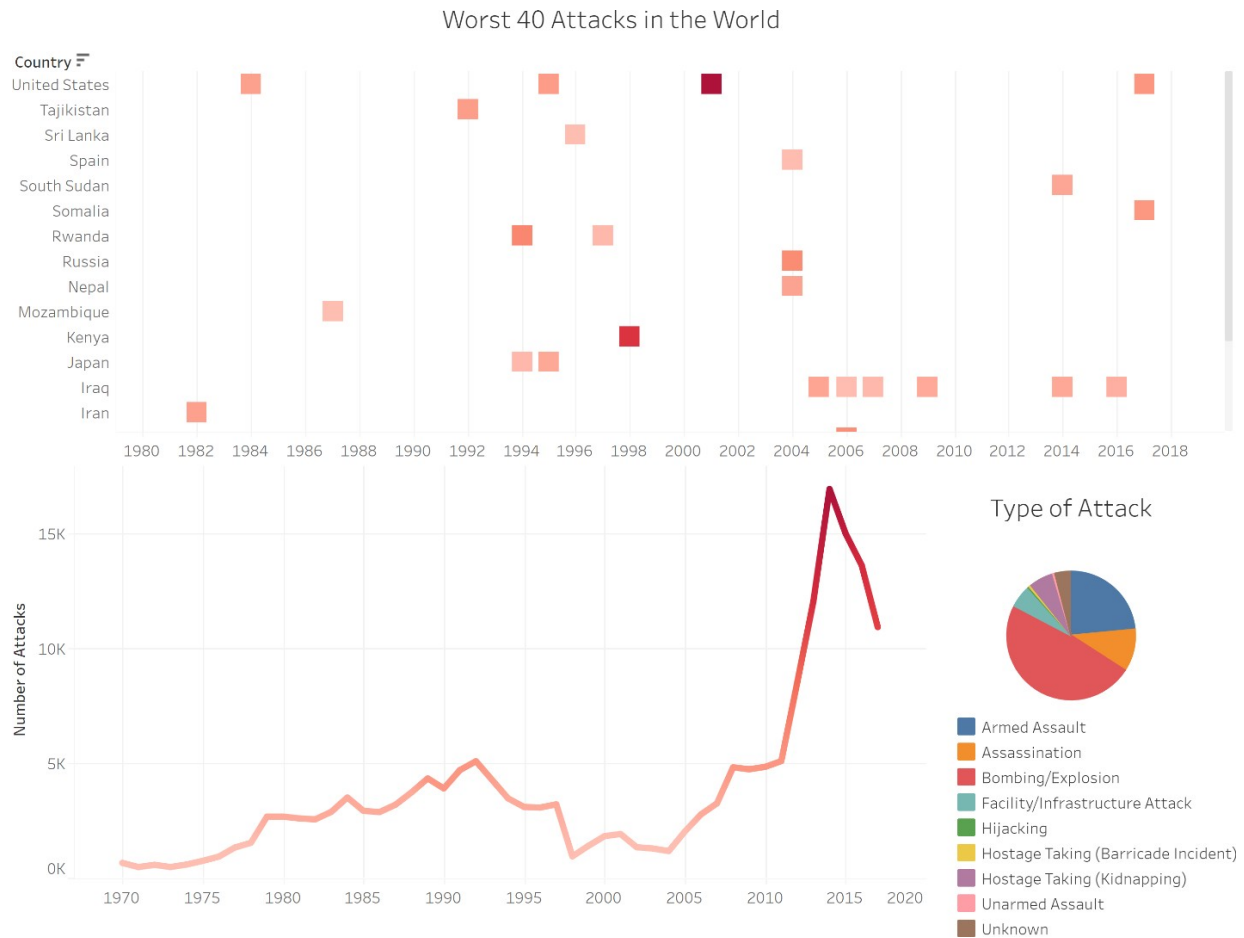
IV. The below dashboard is an improvement from the previous one, where the trend of count of attacks is concentrated on cities attacked over the years. The bar graph shows the trend between number of attacks carried out and the causalities occurred.
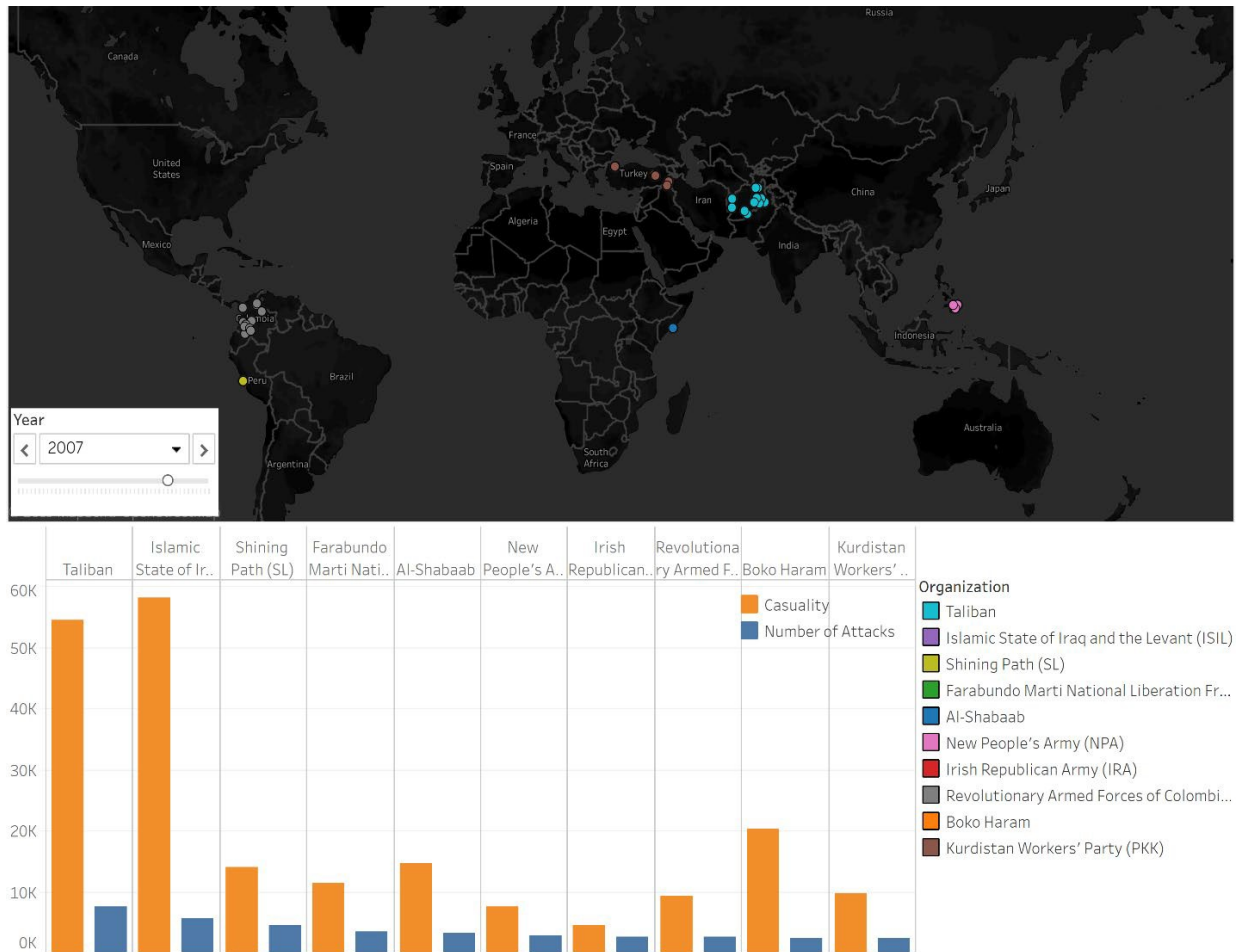
V.   During the analysis, we noticed that a substantial number of the terrorist attacks go unclaimed by the organizations. These attacks are recorded under "Unknown" organization, the below dashboard represents the trend of such unclaimed attacks in countries and shows the worst 10 attacks carried out by such organizations.
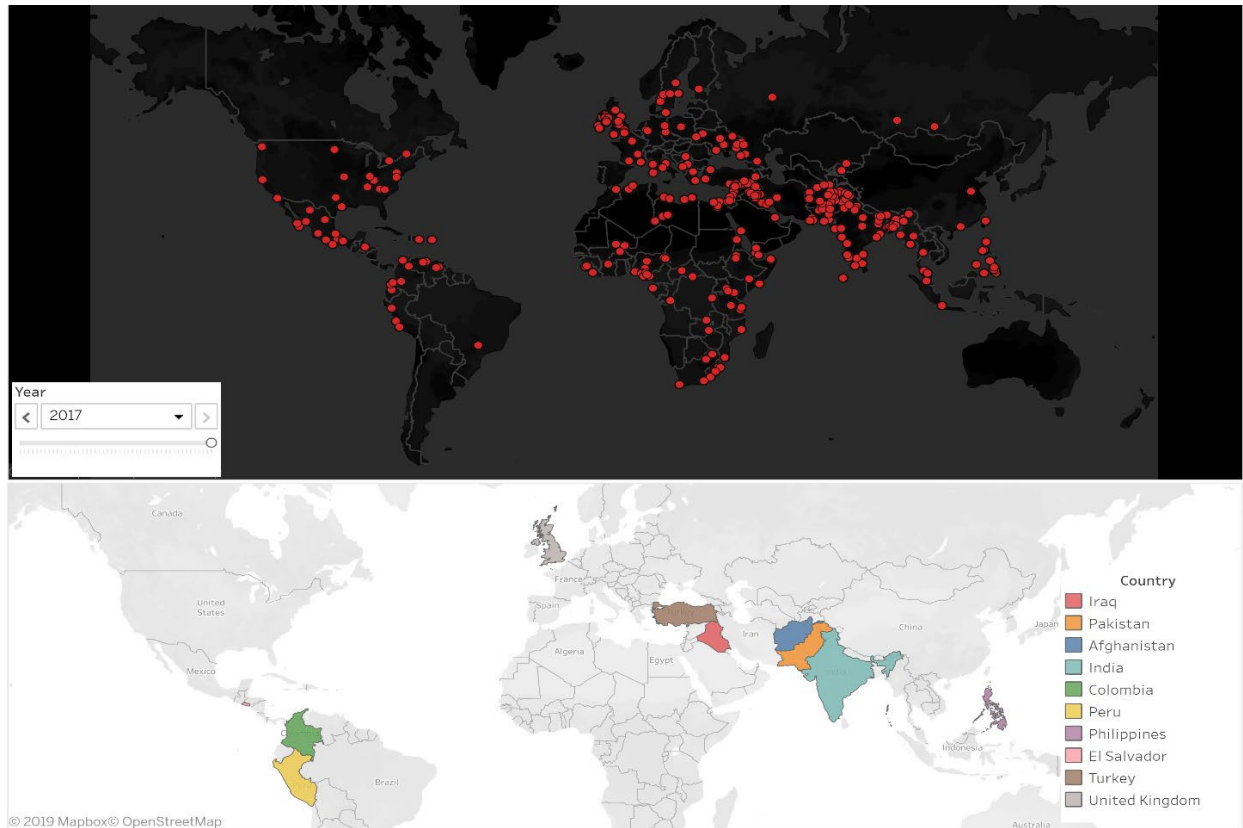
VI.   The dashboard concentrates on the worst 40 attacks countries around the globe have faced throughout the years, we also get to study the type of attack used for the events. The filter is set on the attack type, each selection gives the 40 worst attacks detailed with color, the darker the color, the higher the fatalities.

Worst 40 Attacks in the World

Type of Attack

- Armed Assault
- Assassination
- Bombing/Explosion
- Facility/Infrastructure Attack
- Hijacking
- Hostage Taking (Barricade Incident)
- Hostage Taking (Kidnapping)
- Unarmed Assault
- Unknown

VII.   The below dashboard sheds light towards most nationalities of the target that were subjected to these attacks. The section of country from the Tree graph will show in which country the target was attacked. The trend of weapon type used for the attacks is also addressed below.
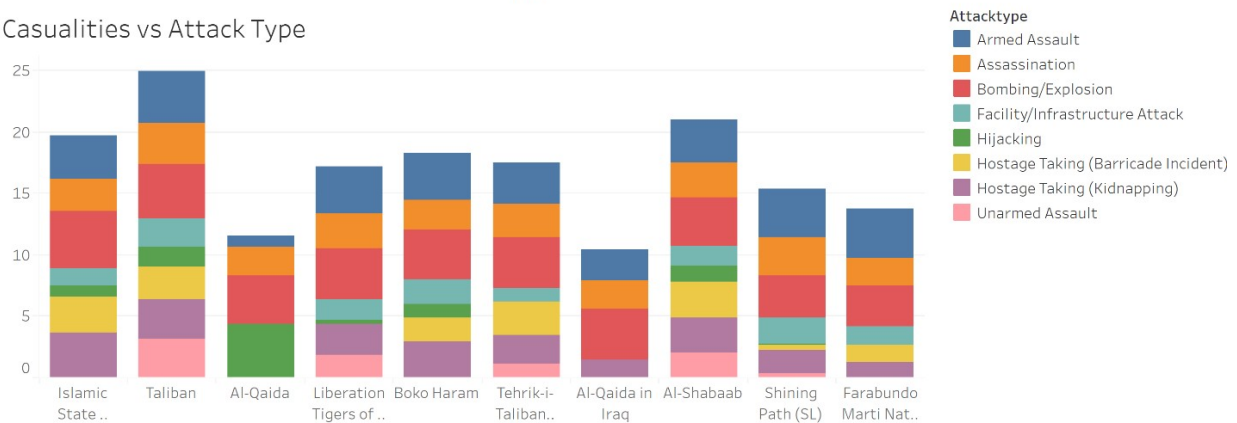

Top 4 Countries : Max Casuality per Year
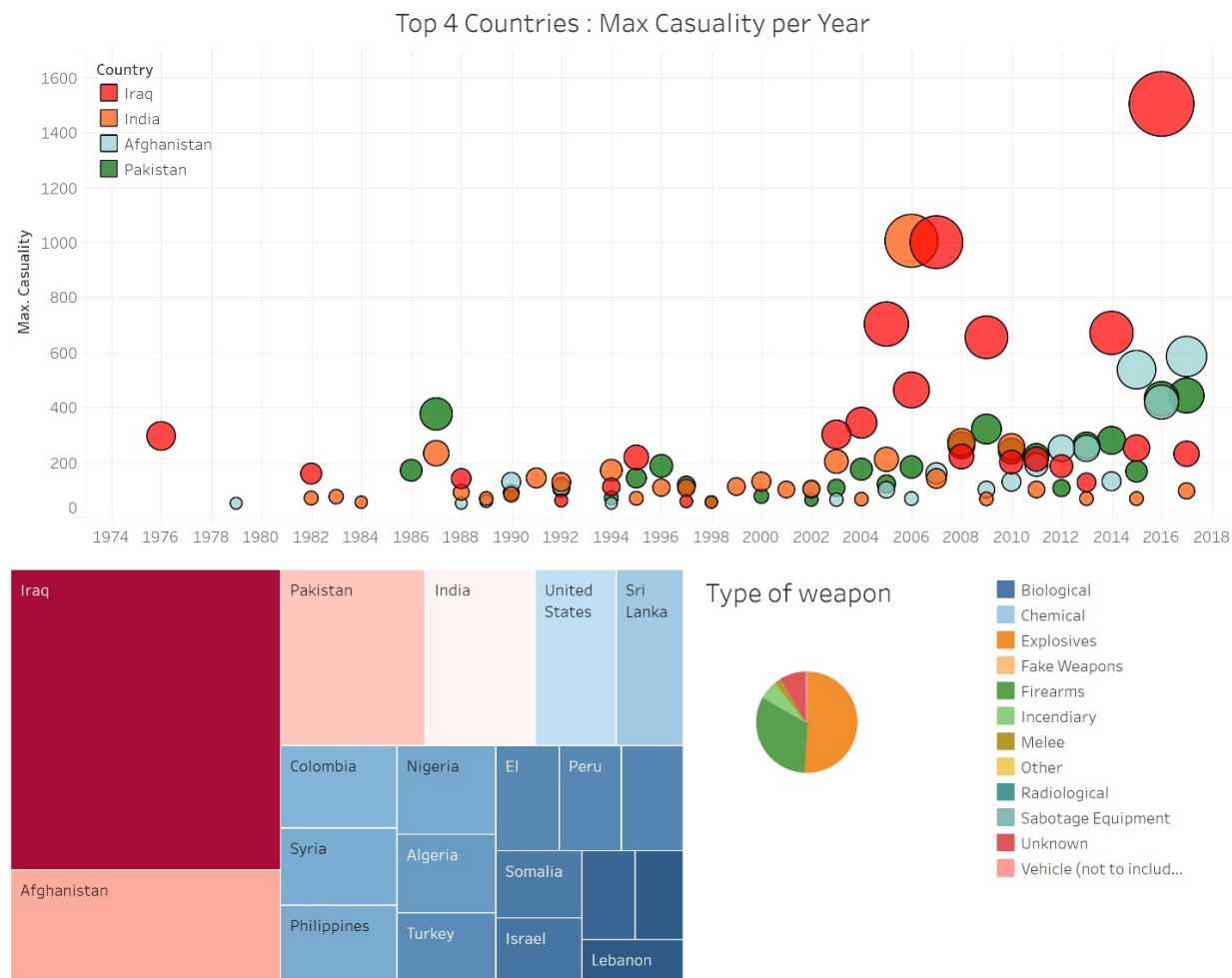
VIII.   The below dashboard sheds information on the 10 most notorious terrorist organizations around the world. It is sorted on organizations that caused the most fatalities, and sheds lights on what type of attack was used for the event.


Most notorious organizations - Top 10
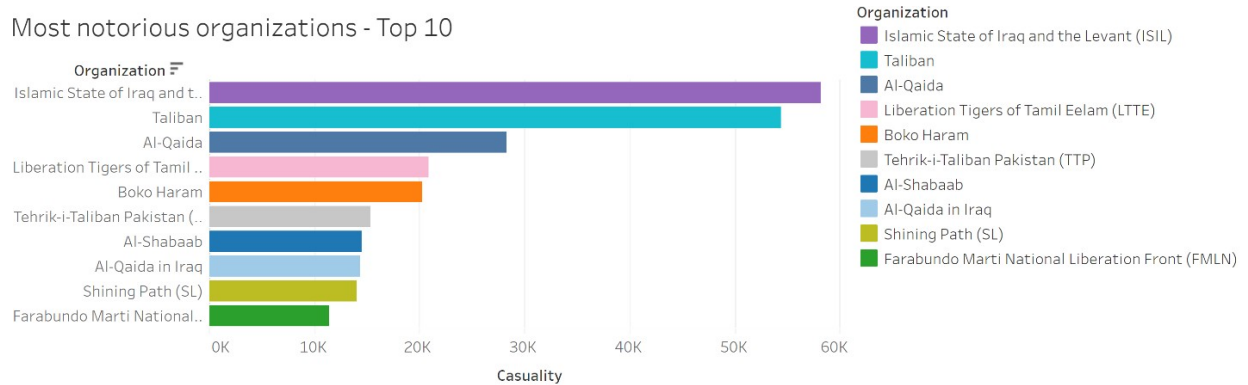
Casualities vs Attack Type

To analyze the impact of terrorism attacks on individual countries we chose to invest our focus on India and the USA.

India:

I.   The dashboard shows the trend of casualties over the years and the details are shown for State and cities. The bottom animation shows the trend of number of attacks and number of casualties that have occurred over the years.
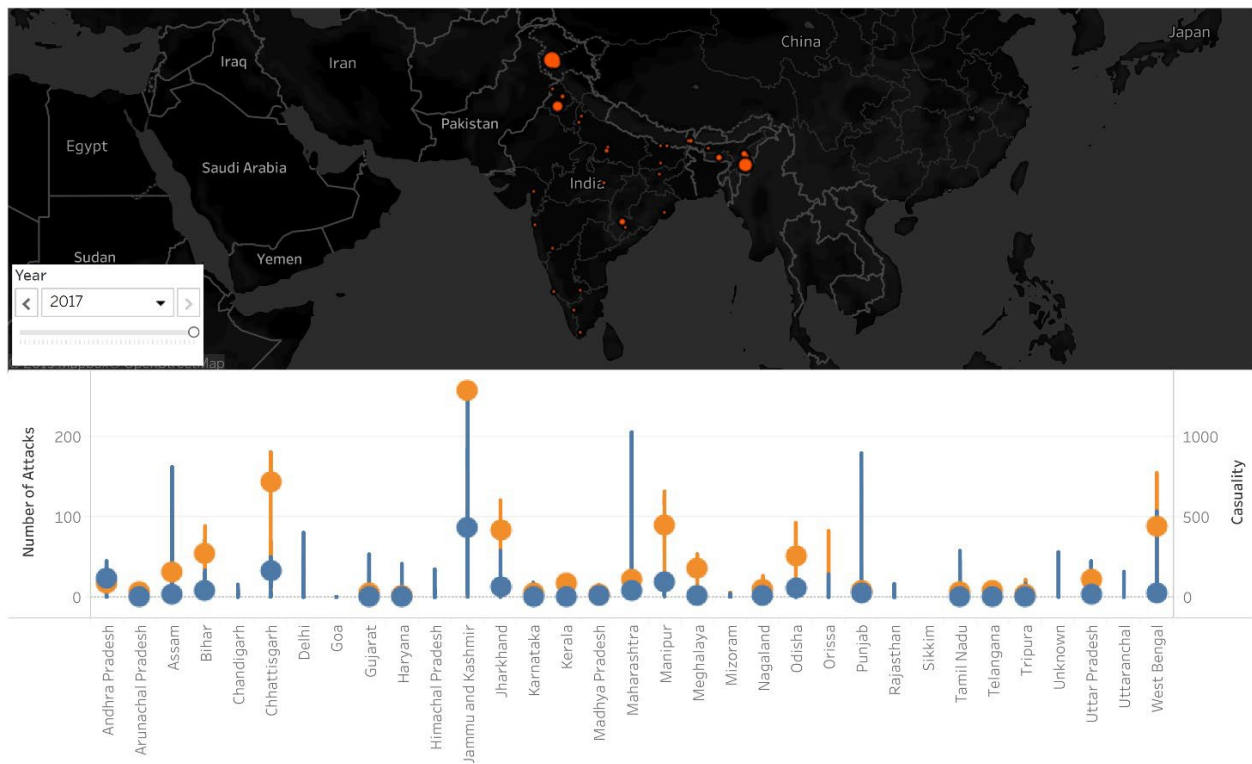
II.   The below dashboard represents the trend of number of attacks by year carried out by worst 10 organizations in India that have the highest number of events. Each color represents a terrorist organization.
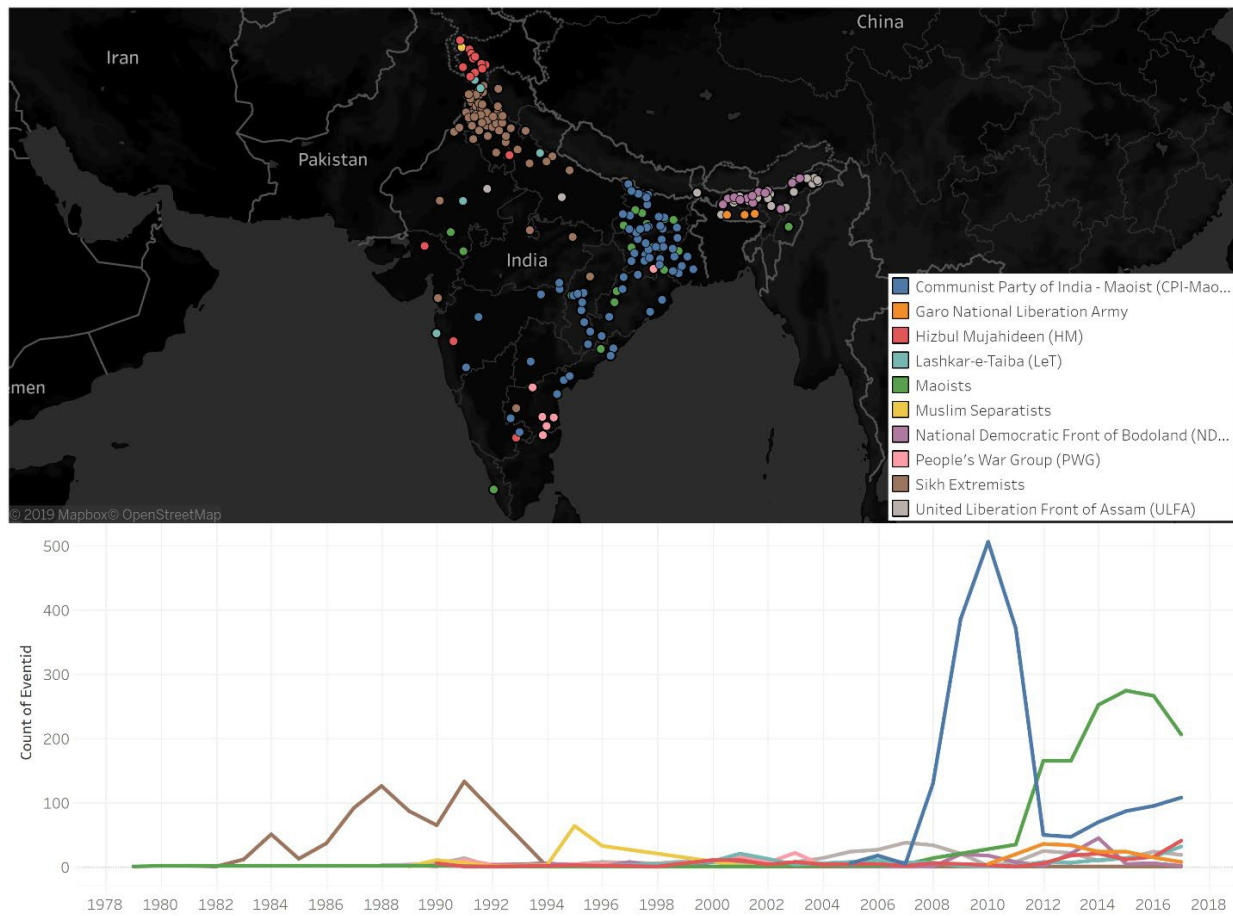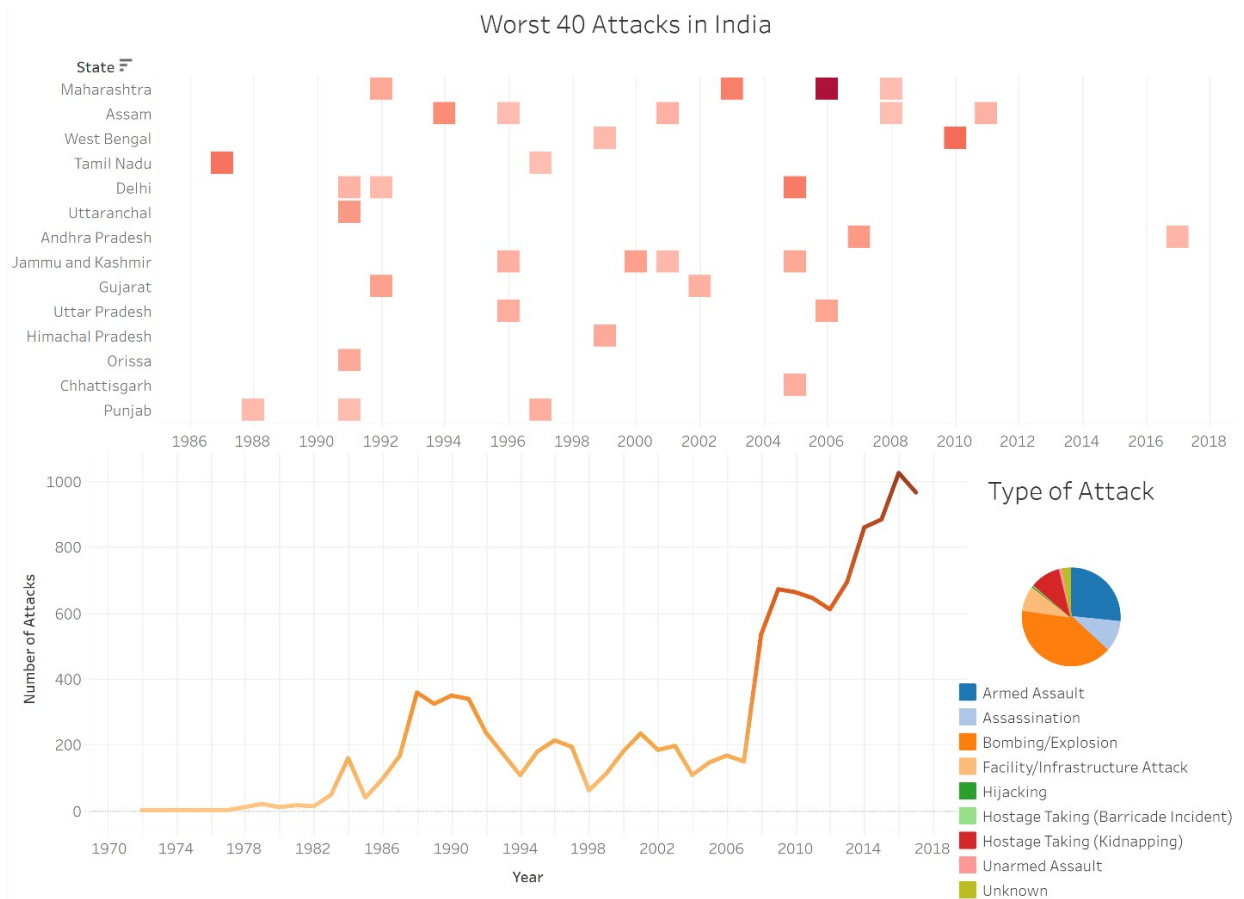
III.   During the analysis, we noticed that a substantial number of the terrorist attacks go unclaimed by the organizations. These attacks are recorded under "Unknown" organization, the below dashboard represents the trend of such unclaimed attacks in countries and shows the worst 10 attacks carried out by such organizations over the years.
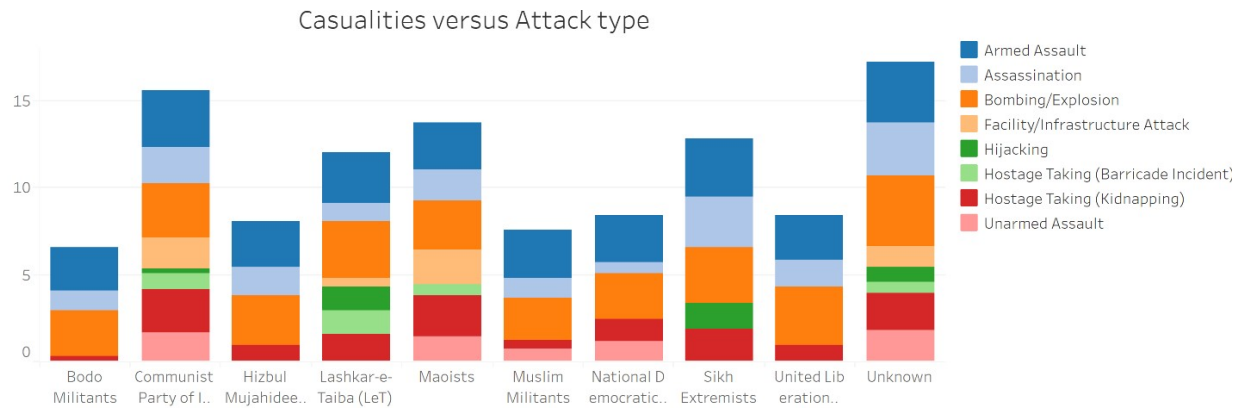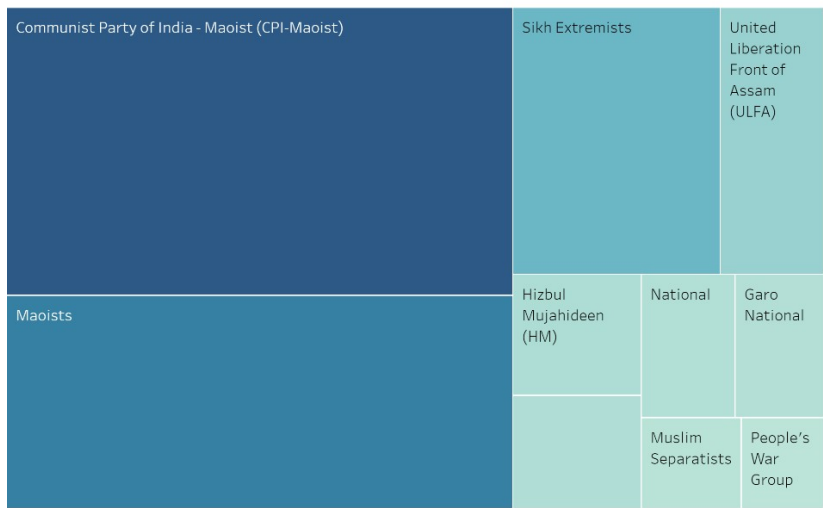

Attacks by Unknown organizations
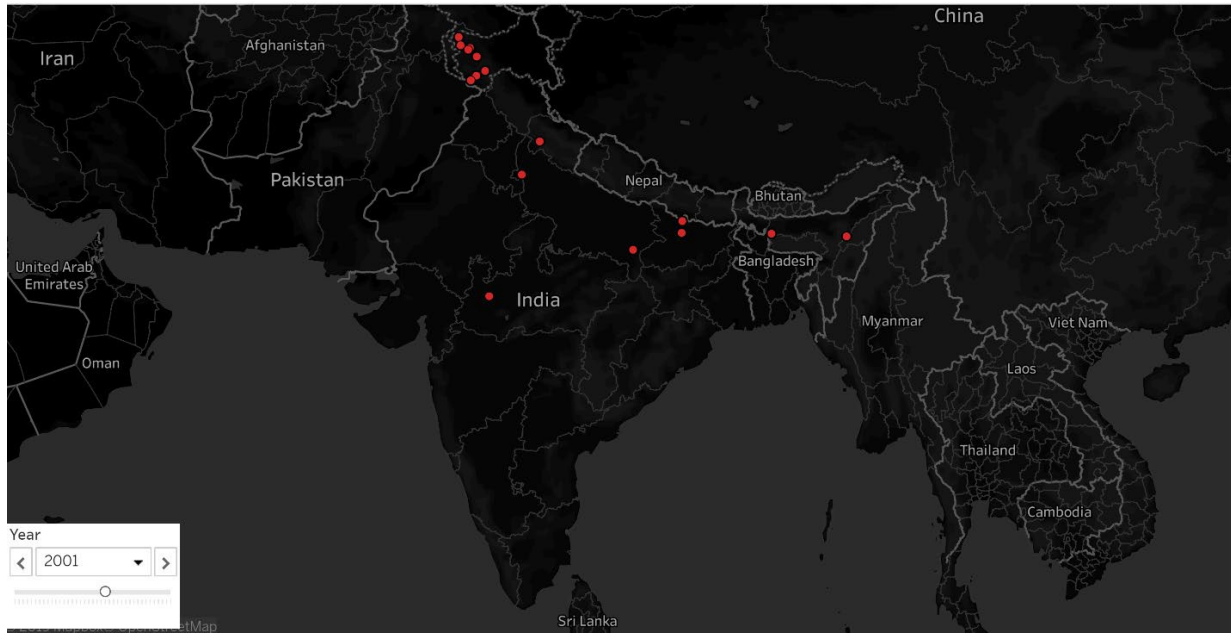
IV.   The dashboard concentrates on the worst 40 attacks, the states in India have faced throughout the years, we also get to study the type of attack used for the events. The filter is set on the attack type, each selection gives the 40 worst attacks detailed with color, the darker the color, the higher the fatalities.

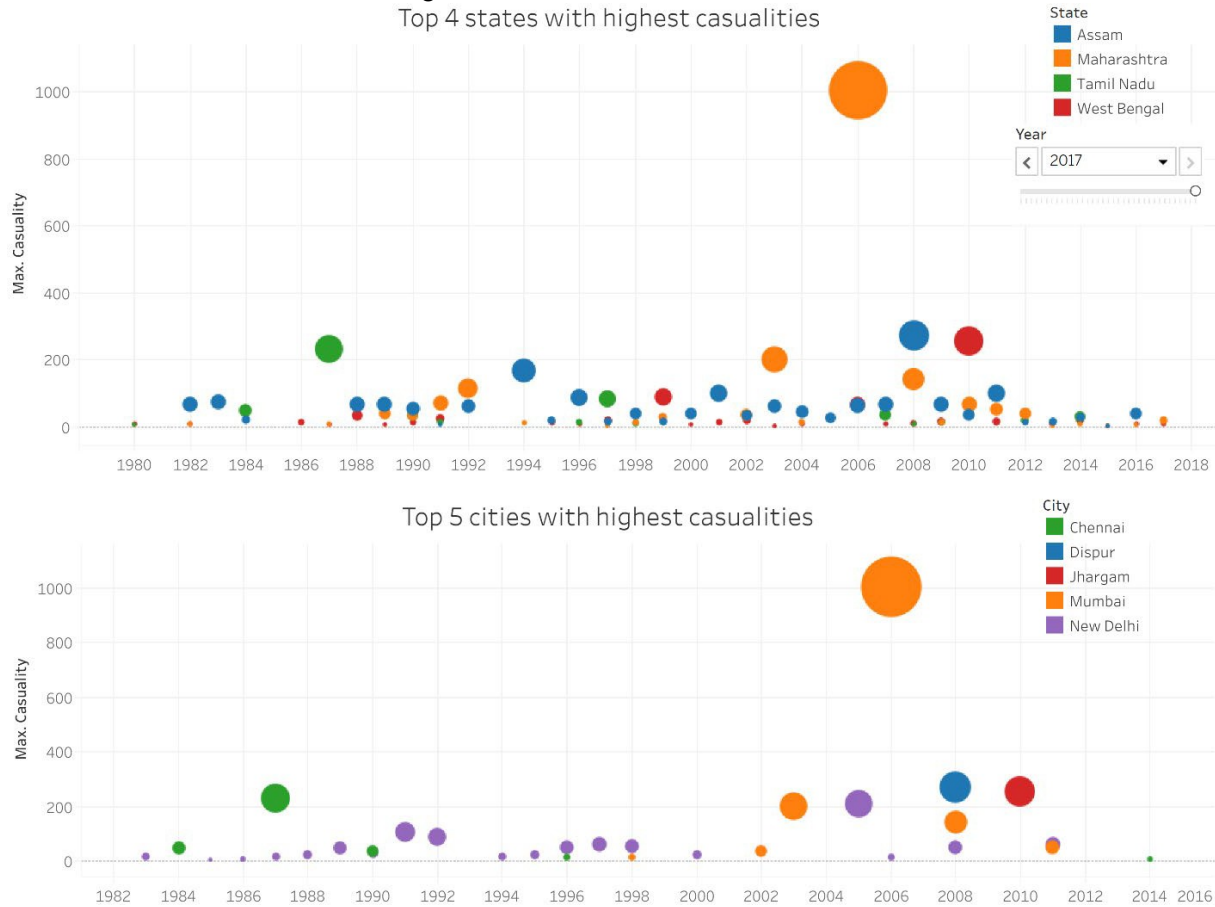Worst 40 Attacks in India

Type of Attack

V. The below dashboard sheds information on the 10 most notorious terrorist organizations that have attacked India. It is sorted on organizations that caused the most fatalities, and sheds lights on what type of attack was used for the event
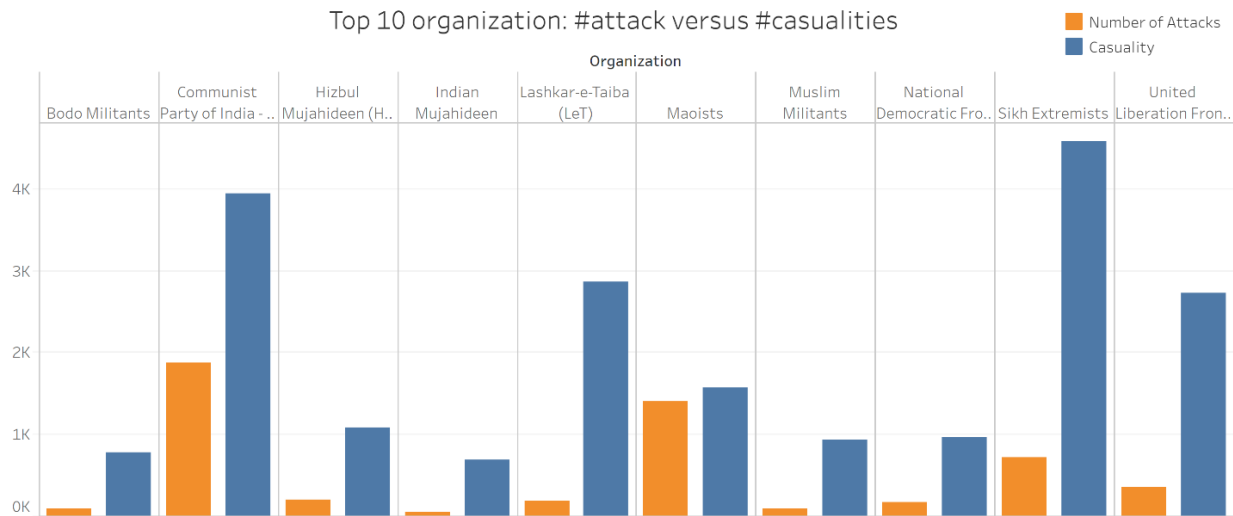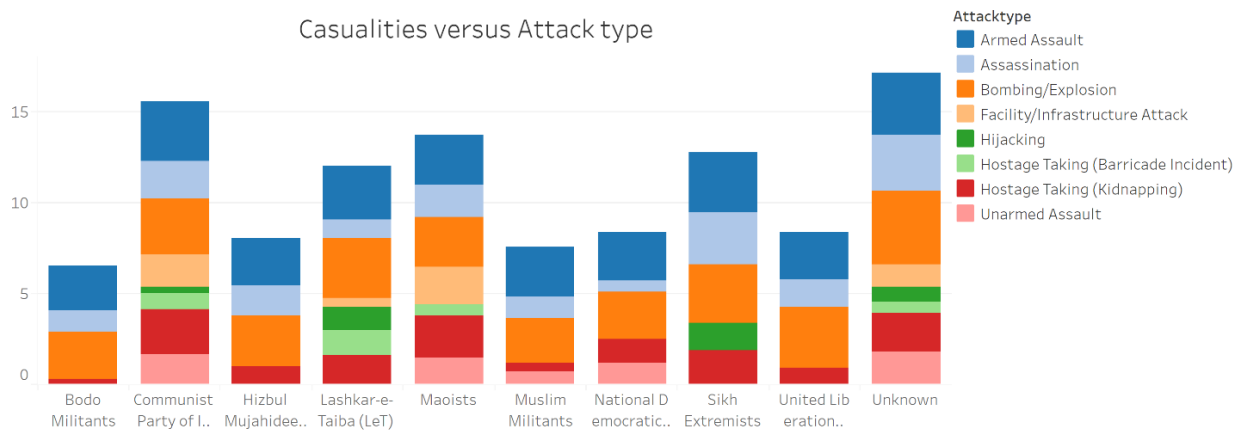

Casualities versus Attack type

Legend:
- Armed Assault
- Assassination
- Bombing/Explosion
- Facility/Infrastructure Attack
- Hijacking
- Hostage Taking (Barricade Incident)
- Hostage Taking (Kidnapping)
- Unarmed Assault

Top 10 most notorious organizations

Communist Party of India - Maoist (CPI-Maoist)
Maoists
Sikh Extremists
United Liberation Front of Assam (ULFA)
Hizbul Mujahideen (HM)
National
Garo National
Muslim Separatists
People's War Group

VI.   The upper visualization represents the 4 worst states in India with maximum of Causality over the years. The color and size of the circle represents the state and the size of causalities. The bottom visualization represents the 5 worst cities in India with maximum of Causality over the years. The color and size of the circle represents the cities and the size of causalities. In addition, the color of the state and the cities it belongs to is coordinated to be the same.

Top 4 states with highest casualities

State
■ Assam
■ Maharashtra
■ Tamil Nadu
■ West Bengal

Year
< 2017 ▼ >

Top 5 cities with highest casualities

City
■ Chennai
■ Dispur
■ Jhargam
■ Mumbai
■ New Delhi

VII.   The below dashboard sheds information on the 10 most notorious terrorist organizations that have attacked India. It is sorted on organizations that caused the most fatalities, and sheds lights on what type of attack was used for the event. Along with visualizing a trend with number of attacks to number of fatalities.
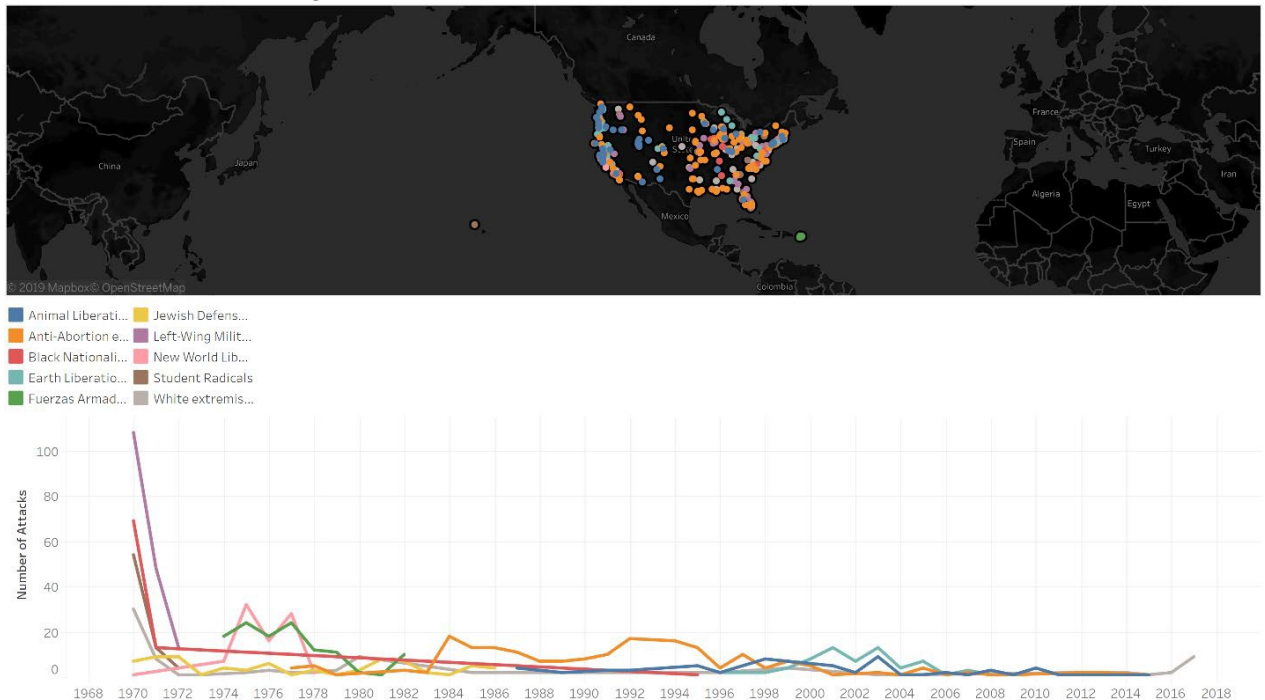

Casualities versus Attack type

Attacktype
- Armed Assault
- Assassination
- Bombing/Explosion
- Facility/Infrastructure Attack
- Hijacking
- Hostage Taking (Barricade Incident)
- Hostage Taking (Kidnapping)
- Unarmed Assault

Top 10 organization: #attack versus #casualities

- Number of Attacks
- Casuality

USA:

I.   The dashboard shows the trend of casualties over the years and the details are shown for State and cities. The bottom animation shows the trend of number of attacks and number of casualties that have occurred over the years.
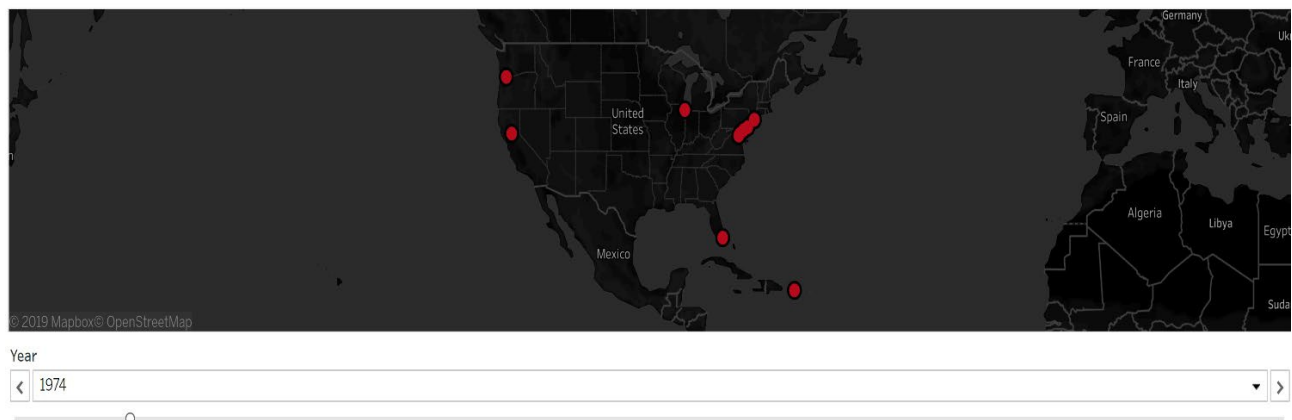
II.   The below dashboard represents the trend of number of attacks by year carried out by worst 10 organizations in the USA that have the highest number of events. Each color represents a terrorist organization.
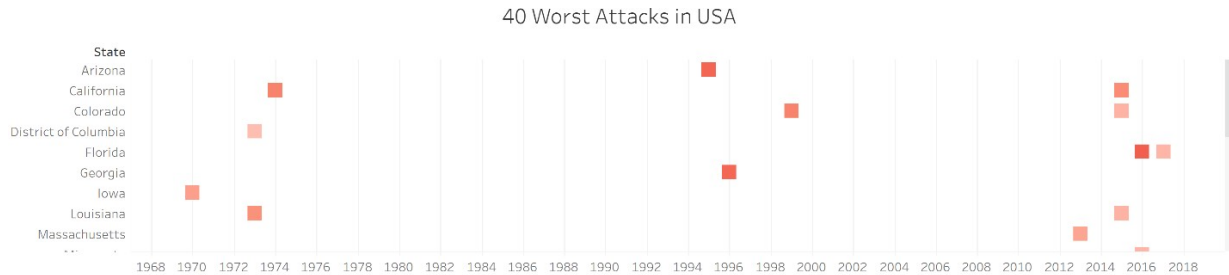

III.   During the analysis, we noticed that a substantial number of the terrorist attacks go unclaimed by the organizations. These attacks are recorded under "Unknown" organization, the below dashboard represents the trend of such unclaimed attacks in countries and shows the worst 10 attacks carried out by such organizations over the years.
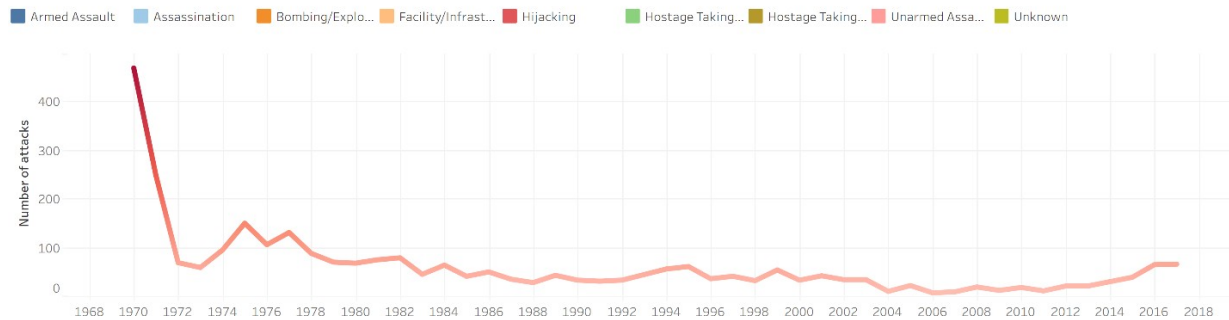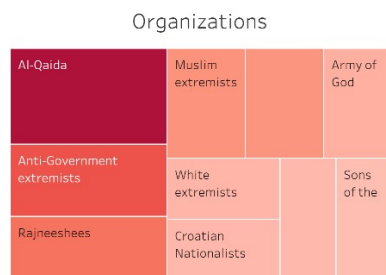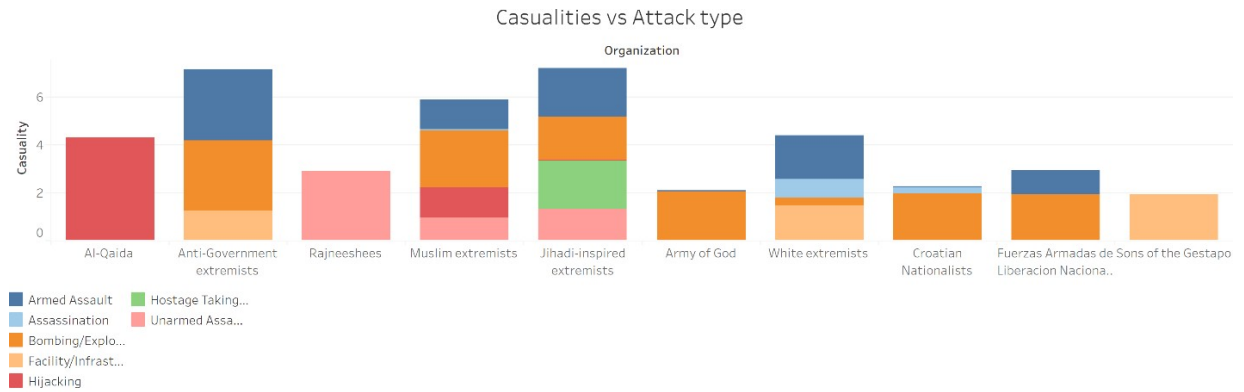
IV.   The dashboard concentrates on the worst 40 attacks in the USA have faced throughout the years, we also get to study the type of attack used for the events. The filter is set on the attack type, each selection gives the 40 worst attacks detailed with color, the darker the color, the higher the fatalities.
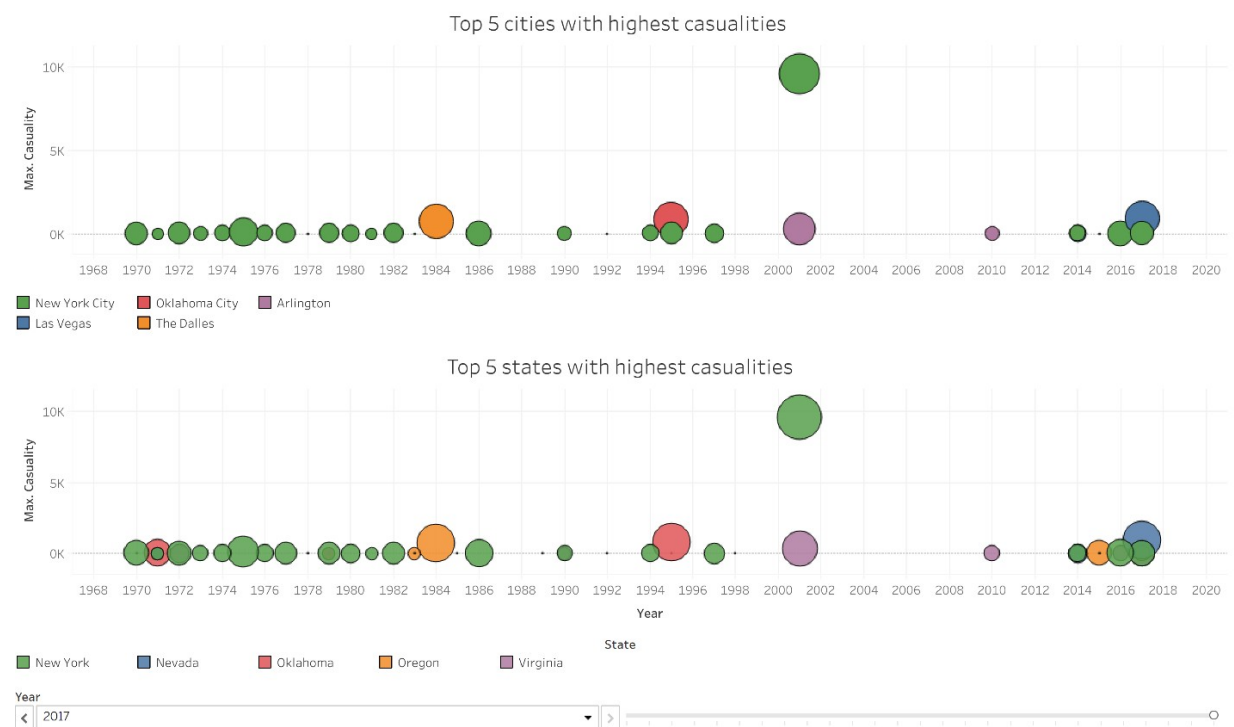

40 Worst Attacks in USA

Type of Attack

V.   The below dashboard sheds information on the 10 most notorious terrorist organizations that have attacked USA. It is sorted on organizations that caused the most fatalities, and sheds lights on what type of attack was used for the event.

Casualities vs Attack type

Organization

Casuality

Armed Assault   Hostage Taking...
Assassination   Unarmed Assa...
Bombing/Explo...
Facility/Infrast...
Hijacking

Organizations

Al-Qaida	Muslim extremists		Army of God
Anti-Government extremists	White extremists		Sons of the
Rajneeshees	Croatian Nationalists		

VI.   The upper visualization represents the 5 worst cities of USA with maximum of Causality over the years. The color and size of the circle represents the state and the size of causalities. The bottom visualization represents the 5 worst states of USA with maximum of Causality over the years. The color and size of the circle represents the cities and the size of causalities. In addition, the color of the state and the cities it belongs to is coordinated to be the same.

VII.   The below dashboard sheds information on the 10 most notorious terrorist organizations that have attacked USA. It is sorted on organizations that caused the most fatalities, and sheds lights on what type of attack was used for the event. Along with visualizing a trend with number of attacks to number of fatalities.
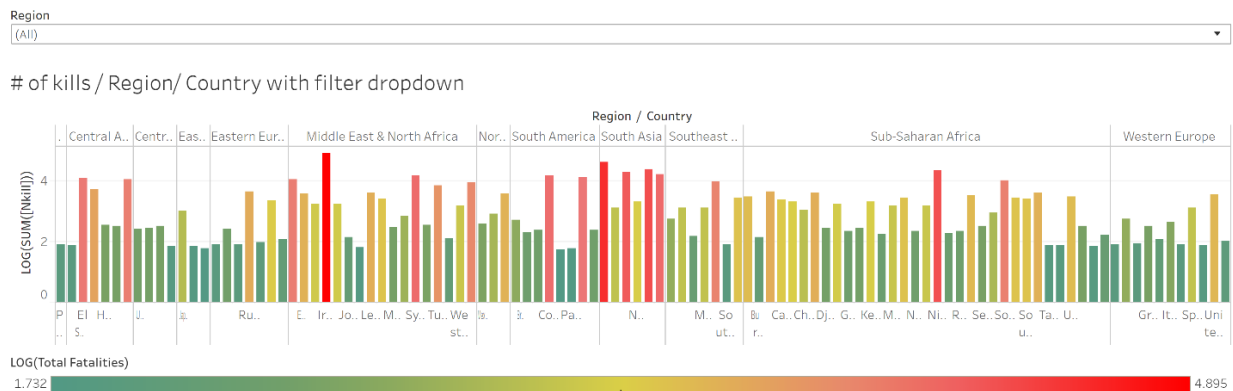

Casualities vs Attack type

Top 10 organization: #attack versus #casualities
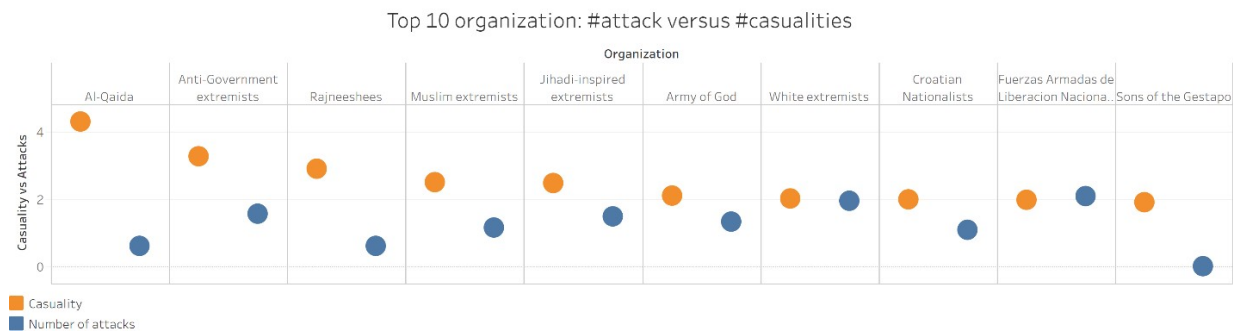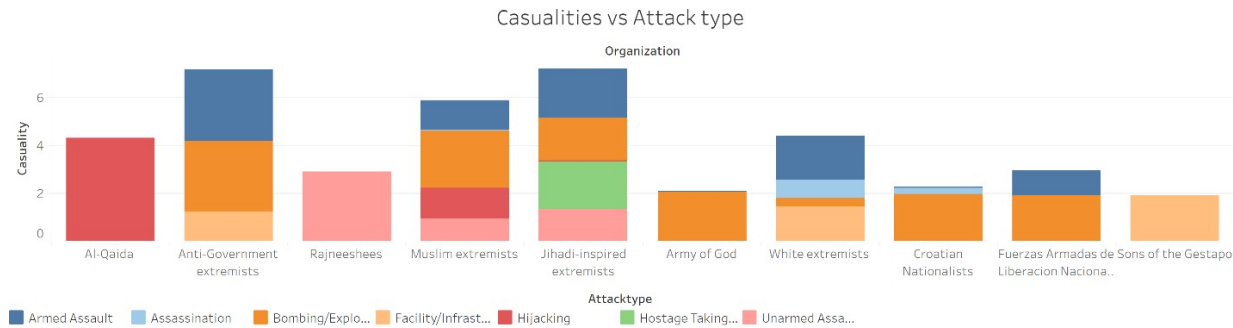
● Discarded Ideas:

I. This is one of the designs that was discarded during the project, the events comparison shows the trend of attacks to casualties' ratio over the years and each group among the worst 20 terrorist groups has a separate global map to show their main countries of target. The reason to discard this idea was that using a filter on the organization name to show their area of destruction instead of having a separate map for each seemed more optimal.
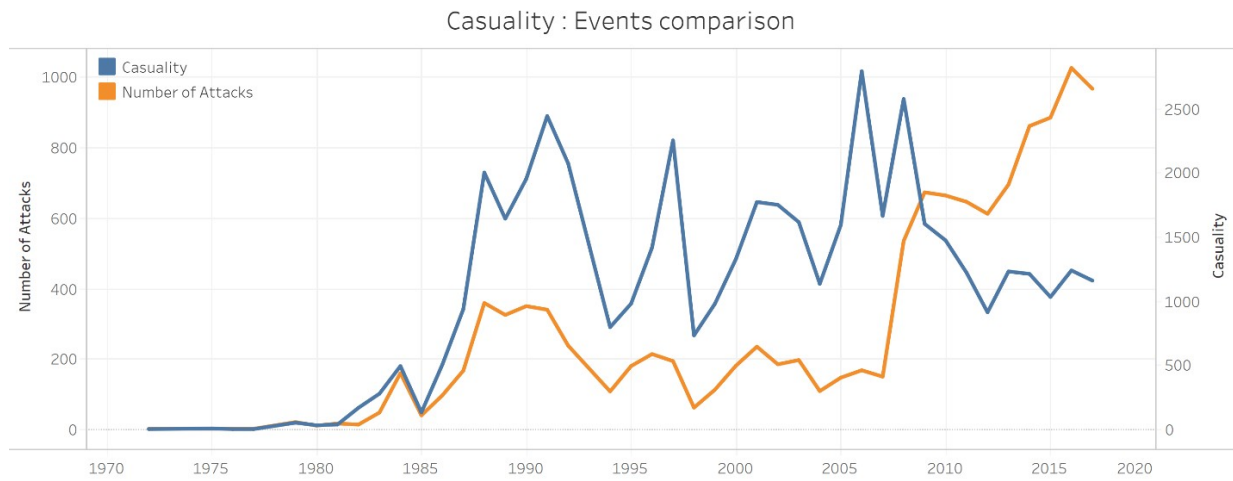

Casuality : Events Comparison

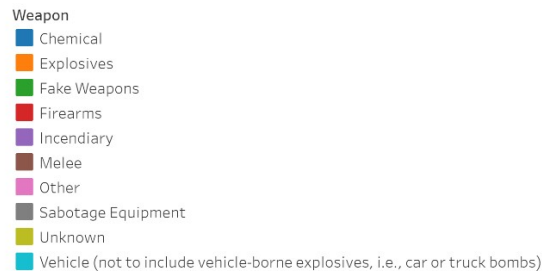Extra - Top 20 organizations based on # of attacks
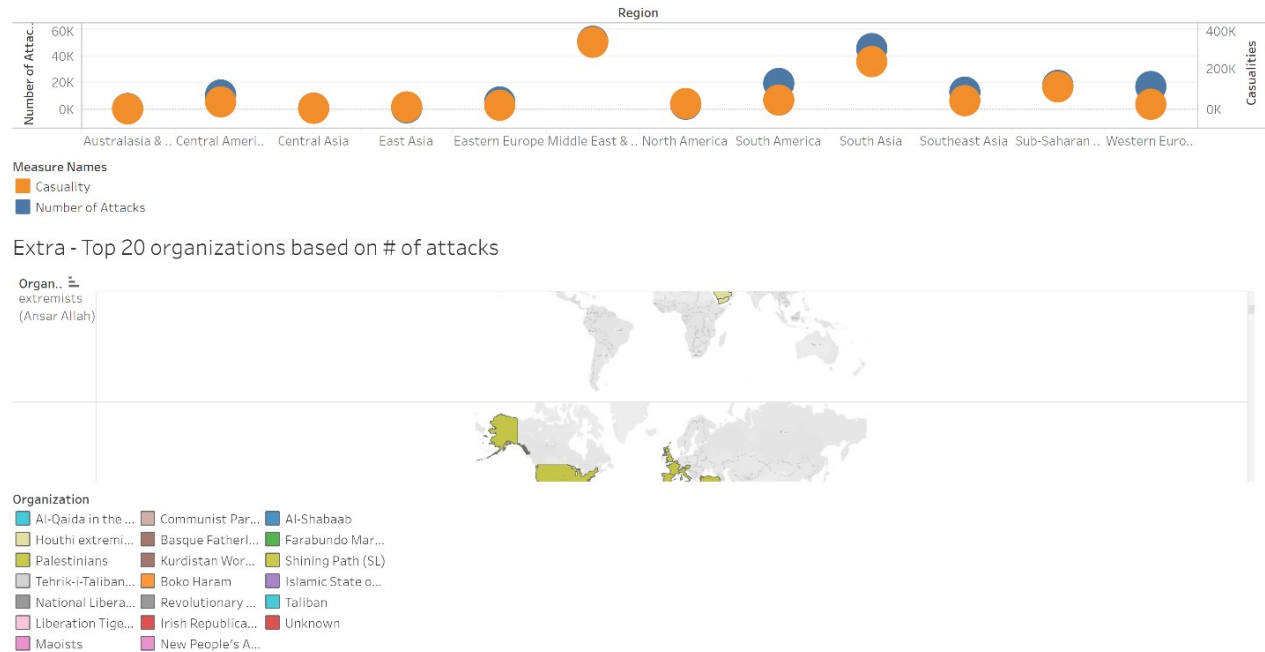
Another discarded idea is shown below where number of fatalities is broken by each country and grouped with each region. Even though a filter was applied region-wise, it seemed like we were trying to portray too much information in too little space, therefore we chose to use the Area (shown in Dashboard1) rather than the bar chart.


# of kills / Region/ Country with filter dropdown

II.   This is one of the designs that was discarded during the project, the events comparison shows the trend of attacks to casualties' ratio over the years and the count of type of weapon used in the attacks.

Casuality : Events comparison

Type of Weapon

Weapon
- Chemical
- Explosives
- Fake Weapons
- Firearms
- Incendiary
- Melee
- Other
- Sabotage Equipment
- Unknown
- Vehicle (not to include vehicle-borne explosives, i.e., car or truck bombs)

III.   This is one of the designs that was discarded during the project, the events comparison shows the trend of attacks to casualties' ratio over the years in USA and the count of type of weapon used in the attacks.

Line_Casuality : Events comparison
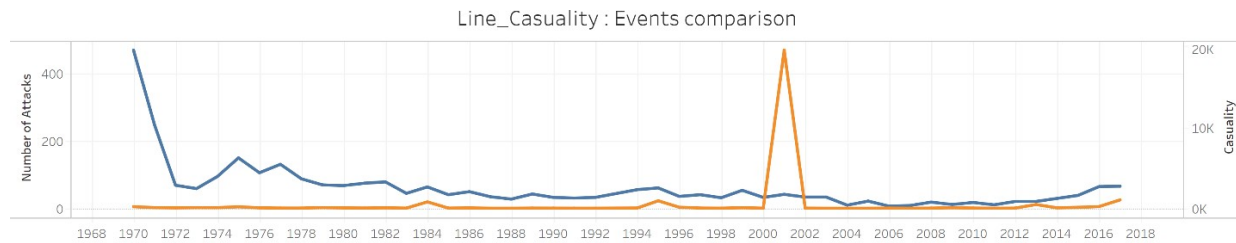
Type of Weapon

Weapon

■ Biological   ■ Chemical   ■ Explosives   ■ Fake Weapons   ■ Firearms   ■ Incendiary   ■ Melee   ■ Other   ■ Radiological   ■ Sabotage Equi...

REFERENCES

[1] LaFree, Gary, and Laura Dugan. "Introducing the global terrorism database." Terrorism and Political Violence 19.2 (2007): 181-204.

[2] LaFree, Gary. "The Global Terrorism Database (GTD) Accomplishments and Challenges." Perspectives on Terrorism4.1 (2010): 24-46.

[3] Wang, Xiaoyu, et al. "Investigative visual analysis of global terrorism." Computer Graphics Forum. Vol. 27. No. 3. Oxford, UK: Blackwell Publishing Ltd, 2008.

[4] Guo, Wenyue, et al. "RESEARCH ON VISUAL ANALYSIS METHODS OF TERRORISM EVENTS." International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences 41 (2016).

[5] Lee, Joong-hoon. "Exploring global terrorism data: a web-based visualization of temporal data." ACM Crossroads 15.2 (2008): 7-14.