Visualising Global Terrorism Acts

Victor Lin, Benedict Then, Kok Jim Meng

Abstract **—** Threats of terrorism are still relevant in today's context as many countries are still taking steps in alleviating the threat of terrorism. However, we believe that more actions can be done by analysing past terrorist activities in order to gain insights to place actions quickly in responding to the worst-case scenario. Hence, we are interested to find out and understand more information about terrorism patterns (eg: frequency, rate, spread) and how development status (i.e. GNI per capita) has a correlation with terrorism occurred in those particular countries.

Keywords **—** *Terrorism, Global, Regions, Countries, GNI per Capita, Weapons, Attack type, Terrorist Groups.*

I. INTRODUCTION

Terrorism has been a salient topic since the 9/11 terrorist attack on New York City's World Trade Center. This terrorist act has altered the security landscape and prompted governments to increase their efforts in tackling the threat of global terrorism. Acts of terrorism have since become more frequent with the formation of certain terrorist groups such as the Islamic State of Iraq and Syria (ISIS) and Al-Qaeda. Even with heavy investments in efforts to eradicate the threat, terrorism remains prevalent, with an ever-increasing threat to our lives. As such, we turn to analyse past data on terrorism to draw insights and potentially identify patterns behind terrorist acts, so that governments can be better able to combat terrorism.

Consisting of nine main sections, this research paper attempts to report the detailed steps taken to propose, design and implement the interactive visualization to help respective agencies identify which countries are prone to terrorist attacks based on the types of attacks, economic development of GNI per capita, and which terrorist groups have performed terrorist attacks successfully. Section I, II provide an introduction, motivation and objectives that will be addressed in the visuals. This is followed by an overview of background works and further elaboration of past works that have aided us in proposing our design. In Section IV, the approach taken to complete this project will be elaborated. Section V and VI will include an explanation on the process of exploring and preparing data required to implement the visualization. Next, key findings and insights that could be derived from the visualization will be addressed in section VII. Finally, in sections VIII and IX, the paper highlights the main technologies used for the application and will conclude by highlighting future direction to the research.

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II. MOTIVATION & OBJECTIVES

This research is motivated by providing meaningful and insightful visualisations on the topic of terrorism by leveraging on big data and also due to the lack of visualisations in discovering possible causes of terrorist attack occurring in different countries. Through our research and development, we hope to build visualisations that can help government agencies visually discover interesting insights that could aid them in reducing the occurrence of terrorist attacks. Furthermore, the visualisations focus on analysing the economic development of countries as a possible cause of terrorist attacks. Through the application of the visualisation tool, it seeks to aid analysts by addressing the following:

1) Gain overall insight on the frequency & spread of Global Terrorism acts

2) Identify any patterns and trends of global terrorism acts among regions

3) Identify any possible linkages, implications or impacts from terrorist acts

4) Understand how global terrorism is affected by various factors
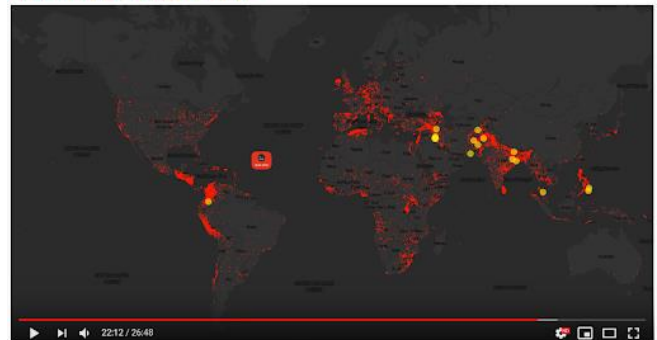
III. RELATED WORKS

Fig. 1. An illustration of related works on terrorism. The figure shows the time lapse for terrorist attacks over 47 years.

Majority of existing visualisation tools are created to visualise the spread, rate, and pattern of terrorist activities worldwide. One interesting example is shown in Figure 1.

Even though the visualisation shows the overview of global terrorism acts, in terms of specifics, it might not be useful for providing low-level visuals.

Taking a look at the informative visualisation as shown below in Figure 2. We can identify the top 10 deadliest terror attacks in history by location where it also shows the number of deaths/injuries as the objective is clear and it directs the user to the locations by using labels and tooltips. However, it only shows the top 10 attacks and disregards other information of the terrorist attacks such as types of attacks.
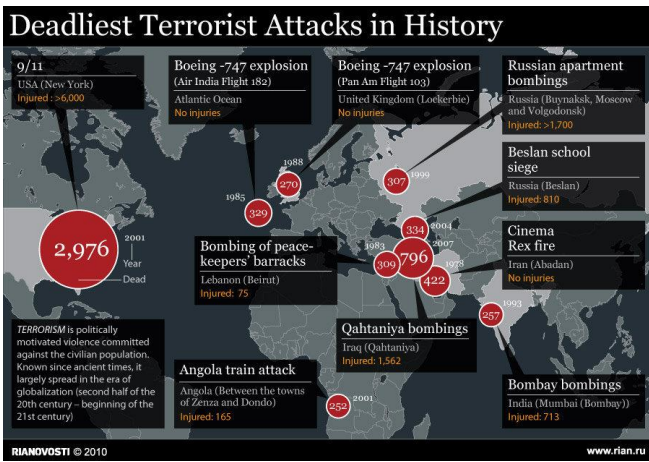
Fig. 2. An illustration of related works on terrorism. The figure shows the top 10 deadliest terrorist attacks in history.

As seen in Figure 3 below, it is a grid map showing profits of the 50 states of America. Compared to Figure 1 and Figure 2, it is minimalistic, clearer and not overwhelming. This inspires us to use this visualization to show the number of deaths, the number of terrorist acts, terrorist groups activeness in which country, etc. However, one downside is that the grid layouts is not an accurate representation of the actual world map which makes it less realistic.
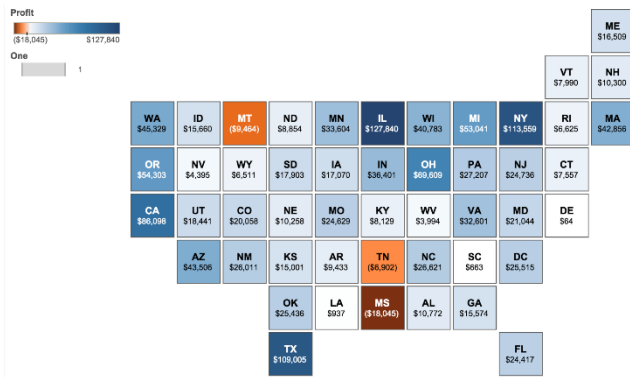

Fig. 3. A grid map showing the profits earned by the 50 states of America.

IV. VISUALISATION APPROACH

Followed by problem identification and addressing objectives, three main phases of activities were conducted to build visualisation. These three phases include the process of 1) Data Exploration and Preparation, 2) Planning and Prototyping the visualisation, and 3) Implementing the Visualisation in R shiny app.

V. DATA EXPLORATION & PREPARATION

The research project starts with gathering the dataset that provides the ability to analyse terrorist attack on a detailed level, such as types of attacks and its geographical location. The Global Terrorism Database (GTD) provides a comprehensive repository of all terrorist events from 1970 to 2017. However, in our analyses, we will be focusing on terrorist events that happened from 2002 to 2017. The reason for selecting that range is due to the rapid transformation of and technology advancement and that, analysing the past 47 years is not a good representation in today's context. Hence, in terms of keeping it relevant we recent, we have decided to analyse data that happened between 2002 to 2017.

VI. DESIGN CONSIDERATIONS

For designing, we used R-Shiny and researched on various visualization ideas and technologies that can inspire and aid us for this project. To explore the different charts that would be suitable for the visualisation, considerations were taken into planning the storyboard based on the clarity of visuals, enhancement of interactivity through the appropriate use of the R libraries and aesthetics for the users' perspective.

At the start of the project, sketches were done as a team to brainstorm and idealize the design layouts of the visualisation. Thereafter, such ideas were further improved and inspired based on the feedback given by Prof. Kam Tin Seong. Furthermore, during the data exploration process, the team members were able to recommend creative approaches that could improve the visualisation designs. All in all, the team has taken the steps in designing the visualisation based on iterative process.

A. Line Chart
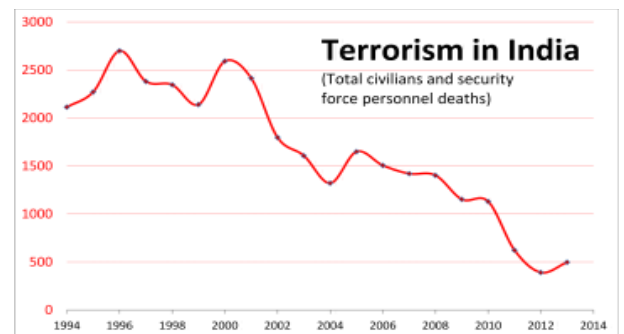
The line chart is an important feature to display the trend, first introduced by Playfair in 1785 [1]. This would be used to show the frequency of terrorist attacks over the years and further categorised by the types of terrorist attacks or regions. The intent of this chart is to provide an overview or a general idea of the pattern/trend and frequency of terrorist acts over time. Furthermore, this would use to show the frequency of terrorist attacks based on the economic development of the countries.

B. Map Visualisation

The map visualization enables to us to display geographical locations of terrorist attacks over the years and further categorized by the types of terrorist attacks and regions. The intent of this chart is to provide an overview or a general idea of when and where all these terrorist acts took place.

C. TreeMap
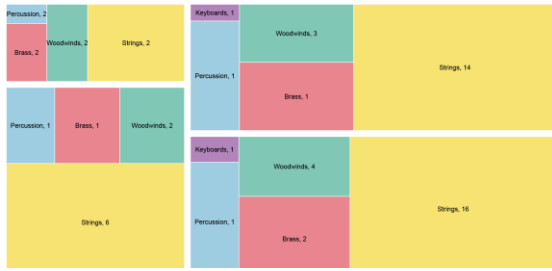
The TreeMap is a method to display hierarchical data using nested figures. It enables us to see the frequency of terrorist attacks based on the target types, weapon types, and attack types. The intent of this chart is to provide an overview or a general idea of which attack types occurred the most, which types of victims were targeted the most, and which weapon types were used by the terrorists the most.

VII. DATA VISUALISATION WALKTHROUGH

A. Overview

Fig. 4. Overview/Home page.

The purpose of the "Overview" dashboard page is to show users a high-level visualisation of Global Terrorism Acts from 2002 to 2017. In this dashboard, users will be able to see: (1) a world map (coordinates/choropleth) containing the locations of the terrorist attack, (2) a bar chart showing the number of terrorist attacks for each region, (3) a line chart showing the frequency of terrorist attacks over the years and lastly, (5) the top 5 most active/dangerous terrorist group ranked by their frequency of attacks.

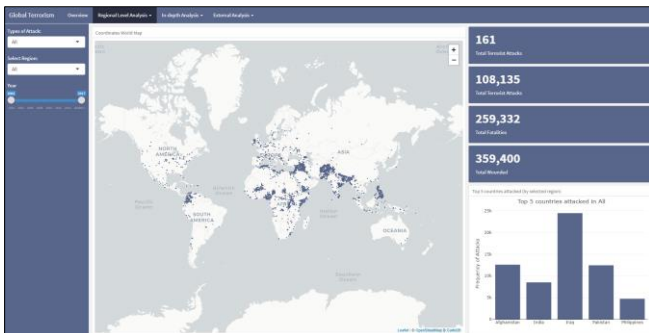### B. Regional Analysis - World Map

Fig. 5. World Map page.

In the "World Map" dashboard page, users will be able to interact with the world map by making use of the filters in the sidebar. The world map will display accordingly to what users selects under the region dropdown, attack type dropdown and

the year slider. For example, if a user selects "Asia" region, the map will change to show only the Asia region map and the locations of the terrorist attacks. In addition, the bar chart of the right will show the top 5 countries with the most terrorist attacks based on the selected region.

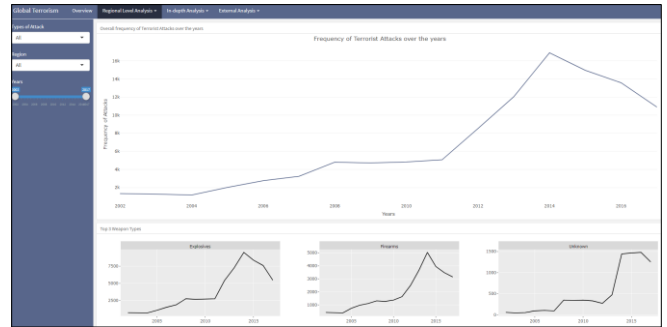### C. Regional Analysis – Time Series

Fig. 6. Time Series page.

In the "Time Series" dashboard page, users can see the frequency of terrorist attacks and the weapons used by terrorists over the years. In addition, users will be able to able to filter the data by region, attack type and the years. At the top of the page, a line chart showing the overall frequency of terrorist attacks is displayed and the top 3 weapon type at the bottom of the page is displayed. The purpose of this is to allow users to do cross comparison between charts.
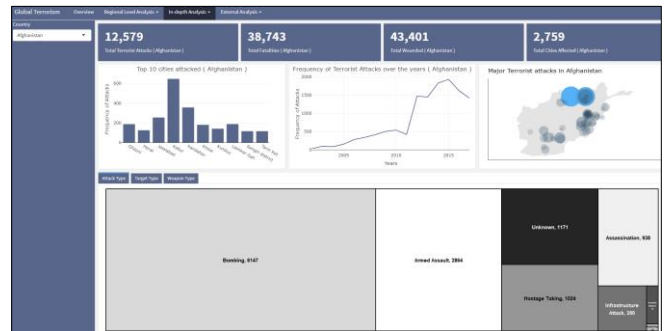
D. In-depth Analysis – Terrorism by Country

Fig. 7. Terrorism by Country page.

In the ""Terrorism by Country" dashboard page, users will be able to view terrorism acts for a specific country. By selecting a country, users will be able to see (1) a bar chart showing the top 10 cities with the most number of terrorist attacks, (2) a line chart showing the frequency of terrorist attack over the years for that country, (3) a country map showing the city locations of major terrorist attacks and lastly, (4) a tree map to show the terrorist attack by attack type, weapon type and target type.
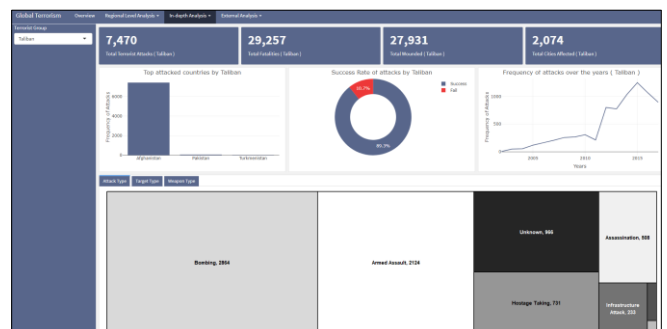
E. In-depth Analysis – Terrorist Group

Fig. 8. Terrorist Group page.

In the "Terrorist Group" dashboard page, users will be able to see the terrorism activities for a specific terrorist group. By selecting a terrorist group, users will be able to see (1) a bar chart showing the top attacked countries by the selected terrorist group, (2) a pie chart showing the success rate of their terrorist attacks, (3) a line chart showing their frequency of attacks over the years and lastly, (4) a tree map showing their frequency of attacks by attack type, weapon type and target type.
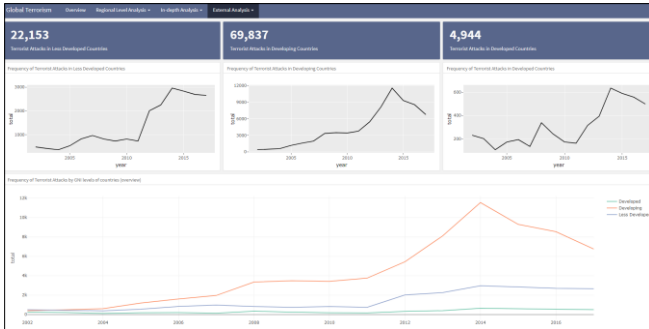
External Analysis – GNI

Fig. 9. GNI page.

The purpose of the "Gross National Index (GNI)" page is to let users visualize the frequency of terrorist attacks in less developed, developing and developed countries. In this dashboard, users will be able to see the frequency of terrorist attacks over the years. In addition, a multi-line chart is displayed at the bottom of the page to all users to compare the difference in frequency of terrorist attacks between the less developed, developed and developed countries.

VIII. KEY FINDINGS & OBSERVATIONS

Through the visualizations in the **"Overview"** dashboard, some of the key findings and observations were derived as follows:

1. Across the years from 2002 to 2017, **161 countries have affected by terrorist attacks.**
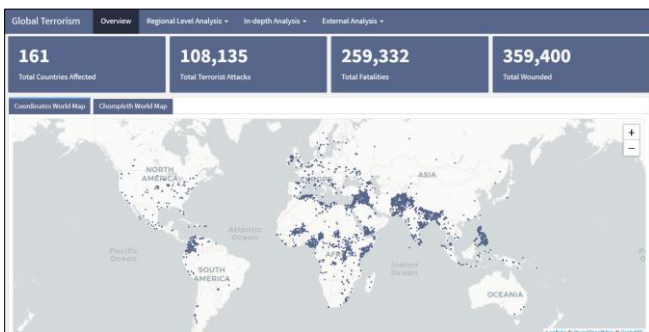

Fig. 10. An overview of the terrorist attacks around the world from 2002 to 2017.

Overall, countries in the **Middle East and South Asia experienced the greatest number of terrorist attacks** during that specific period. From the coordinates and choropleth maps, we can see that the **Philippines, Colombia** and **Parkistan** experienced the most terrorist attack in Southeast Asia, South America and Middle East Respectively.

2. Across the years from 2002 to 2017, **Africa** is the top continent that experienced the most terrorist attacks.
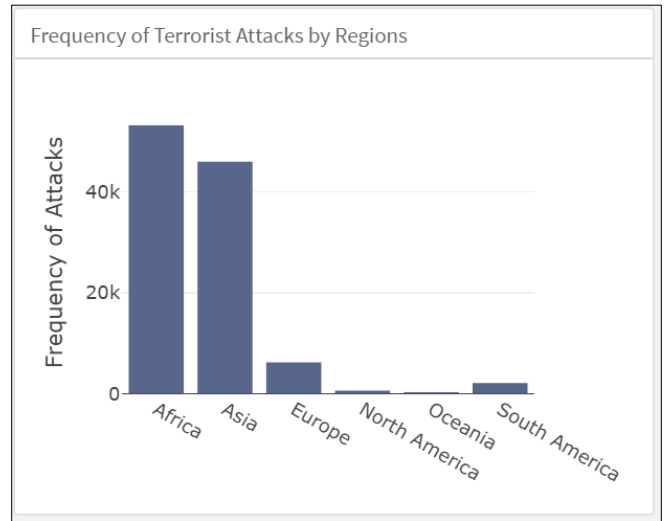

Fig. 11. An overview of the frequency of terrorist attacks by regions.

Both **Africa** and **Asia** are the continents that experienced the most terrorist attacks where Middle East and South Asia are part of the two continents respectively.

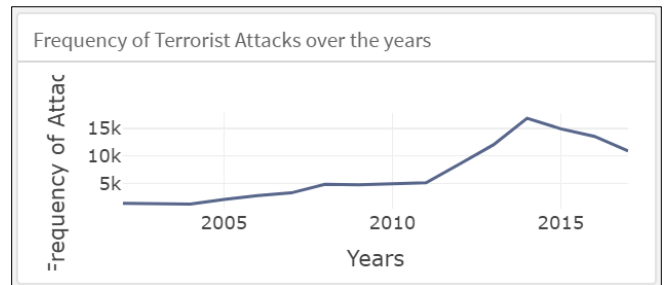3. Since 2002, there is a rise in terrorist attacks.

Fig. 12. An overview of the trend of the frequency of terrorist attacks from 2002 to 2017.

There is a steady rise in terrorist attacks from 2002 to 2011. This is the period which is known as post-9/11 attack era. From 2011 to 2014, there is a sharp increase of terrorist attacks even though the leader of al-Qaeda, Osama bin Laden, who was responsible for the 9/11 attacks was killed in 2011 by the US military. The sharp increase is highly due to the terrorist group known as **Islamic State of Iraq and the Levant (ISIL).** Fortunately, since 2014 during the rise of ISIL, there is a decrease in the terrorist attacks.

4. From 2002 to 2017, **Taliban** is the top terrorist group which contributed the high frequency of terrorist attacks.
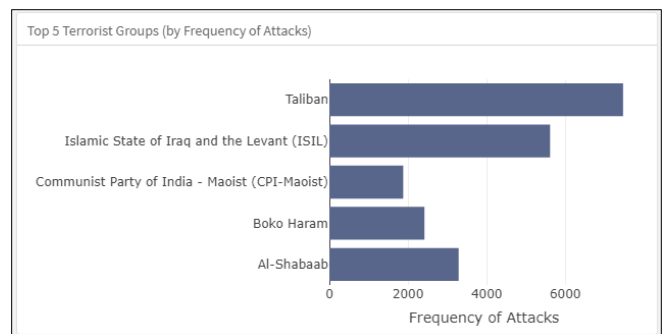

Fig. 12. An overview of the top 5 terrorist groups which contributed to the frequency of terrorist attacks from 2002 to 2017.

Taliban is the key terrorist group that contributed to the high frequency of terrorist attacks followed by ISIL. To many

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people who have watched the news during the 15 years, they believed that either ISIL or al-Qaeda would contribute the most for the number of terrorist attacks. On the contrary, Taliban is the one actually.
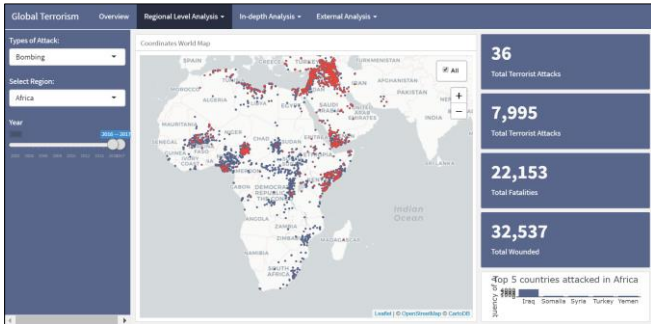
5. Regional Analysis based on World Map

Fig. 13. Regional analysis of bombing attacks in the Africa from 2016 to 2017.

In this example, we are finding out the statistics of the **bombing attacks in Africa** during the Trump Administration which started since 2016 to see if his presidency affects the terrorist attacks in Africa. We can see that, in the map, **Iraq** experienced the most which also included in the top 5 countries attacked in Africa chart.

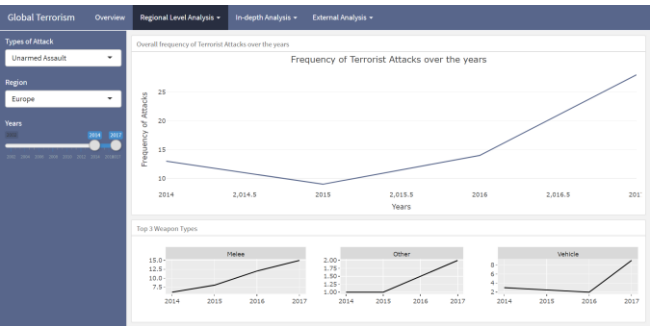6. Regional Analysis based on Time-Series

Fig. 13. A regional analysis of unarmed assault attacks in Europe from 2014 to 2017.

In this example, we are finding out the statistics of the unarmed assault attacks in Europe from 2014 to 2017 as 2014 is the year when ISIL rises and hit-and-run attacks by the terrorists are very common in Europe during the period. However, we can identify that, using **vehicle as a weapon type** is one of the top 3 weapon types used and it only started to rise from 2016. Furthermore, the rise of terrorist attacks in Europe only started in 2015 and not 2014.

7. In-depth Analysis based on Country

Fig. 14. An in-depth analysis of Chile based on attack type.

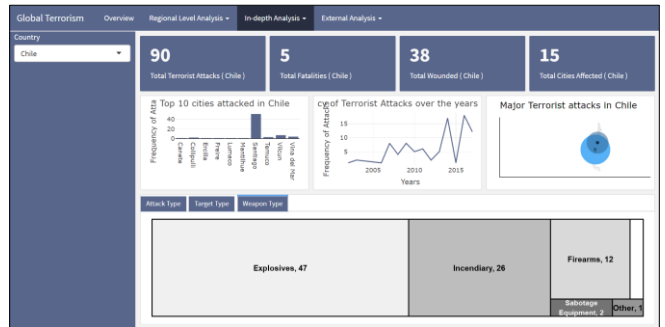Fig. 15. An in-depth analysis of Chile based on target type.

Fig. 16. An in-depth analysis of Chile based on weapon type.

In this example, we are finding out how terrorist attacks affect **Chile**. Majority of the types of attacks in Chile across the 2002 to 2017 is bombings and, hence, the most weapon types used is **explosives**. Majority of the **target is actually businesses**. This is highly due to the fact that Chile is the biggest ally of the US in the South America. Therefore, the terrorists aimed to deteriorate the economy of Chile. **Santiago**, the capital city, topped the charts in the top 10 cities attacked in the country.

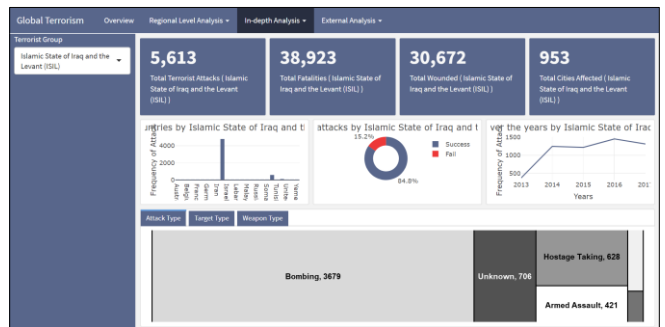8. In-depth Analysis based on Terrorist Group

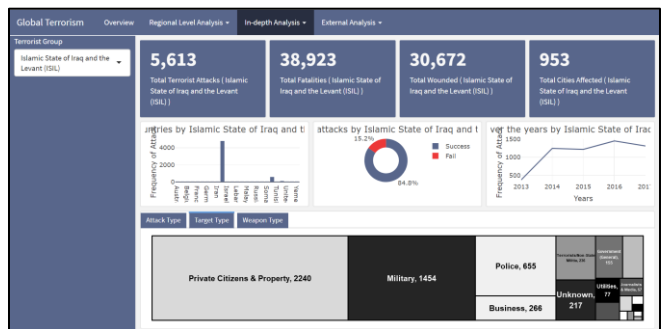Fig. 17. An in-depth analysis of ISIL based on attack type.

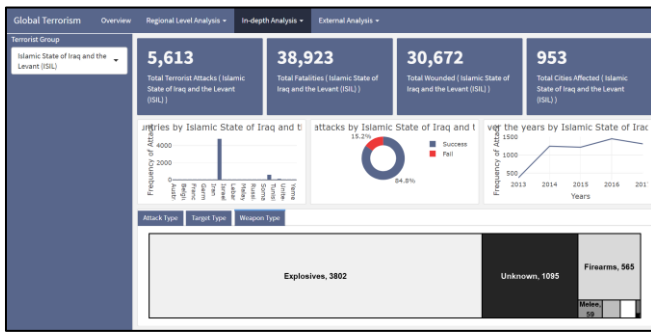Fig. 18. An in-depth analysis of ISIL based on target type.

Fig. 19. An in-depth analysis of ISIL based on target type.

In this example, we analyse on **Islamic State of Iraq and the Levant (ISIL)**. ISIL attacks are mostly consisting of **bombings** and highly used **explosives** as their weapon types. Majority of their targets are actually **innocent civilians**. Globally, the top country it has attacked is **Iraq**. Furthermore, it has a success rate of attacking globally at 84.8%.

9. There are more terrorist attacks in developing countries than both less developed countries and developed countries.

Fig. 20. Frequency of terrorist attacks in less developed countries, developing countries, and developed countries.

Surprisingly, based on the World Bank's GNI per capita classification, majority of terrorist attacks those place in developing countries. This is followed by less developed and developed countries.

IX. CONCLUSION

From the visualizations, we conclude certain overall key findings about Global Terrorism Acts:

1. Across the years from 2002 to 2017, **161 countries have affected by terrorist attacks.**

2. Across the years from 2002 to 2017, **Africa** is the top continent that experienced the most terrorist attacks.

3. Since 2002, After the 9/11 attack, terrorist attacks have been steadily increasing till 2014 with the rise of the terrorist group **ISIL**. Fortunately, we see a drop from 2014 onwards.

4. **Pakistan, Iraq, Philippines, India, Afghanistan** are countries with the greatest number of terrorist attacks.

5. The terrorist group, **Taliban** have the greatest number of claimed terrorist attacks.

6. **Bombing** is the most common form of terrorist attacks.

The threat of terrorism is real and this data visualization aids users to gain overall insight and patterns on the frequency of the terrorist attacks worldwide. Currently, our visualisation serve as an exploratory platform and represent a means to guide users in identifying more information which may otherwise, not be presented in our visualization. Hence, for future research of our visualisation, it can explore other factors that could possibly have an impact on the occurrence of terrorist attacks such as

i) Religious Beliefs

ii) Poverty Levels

iii) Social & Political Injustice

This will help to identify the relation between each of the above factors and the terrorist activities and should be explored in more details.

X. ACKNOWLEDGEMENT

XI. REFERENCES

[1] William Playfair Founds Statistical Graphics, and Invents the Line Chart and Bar Chart. Retrieved from http://www.historyofinformation.com/detail.php?entryid=2929