MULTIMEDIA UNIVERSITY®

Faculty of Computing and Informatics (FCI)

CDS6324 DATA VISUALIZATION

Trimester: March 2024

Lecturer: Dr. Wong Lai Kuan

PROJECT

Title:

ASEAN Trade Titan: Which Country Leads the Global Trade Market?

Group Members:

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Overview

In the bustling world of international trade, access to accurate and detailed data is crucial. Visualizing and interacting with the trade flows of the ASEAN region enables the identification of market leaders, emerging players, and those lagging behind. The project, titled "ASEAN Trade Titan: Which Country Leads the Global Trade Market?", provides an interactive and animated visualization tool designed to bring clarity and insight into the trade dynamics within Southeast Asia. This dashboard simplifies the understanding of import and export trends, trade imbalances, and resource distribution among ASEAN countries by utilizing a dataset spanning from 2015 to 2022.

The theme of the dashboard is to analyze and compare the economy and growth of ASEAN countries through their trade activities. The visualizations help to identify leading trade nations, observe trade pattern evolution, highlight trade imbalances, and compare resource distribution.

Visualizations Used:

1. Trade Balance Map with Treemap Popup by Year
2. Bar Graph for Total Trade Values by Year
3. Line Graph for Import Growth Over Time (Compare 2 Countries)
4. Line Graph for Export Growth Over Time (Compare 2 Countries)
5. Waffle Chart for Total Resources (Compare 2 Countries)

The visualization aims to answer the following key questions:

1. What are the trade imbalances among ASEAN countries each year?
2. What regions of the world are ASEAN countries exporting to the most and what kinds of resources are ASEAN countries exporting?
3. How do trade values compare across different ASEAN countries as importer in the selected year?
4. How has the export growth of two selected countries evolved from 2015 to 2022?
5. How has the import growth of two selected countries evolved from 2015 to 2022?
6. What are the trends and patterns in import values and export values over the years for the selected countries?
7. Which resources are most dominant for exports in each of the selected countries?

Dataset

Table below shows the attributes from the dataset:

Attribute Name	Description
Exporter	The country exporting goods
Exporter ISO3	ISO3 code of the exporter country
Exporter region	The region to which the exporter country belongs
Importer	The country importing goods
Importer ISO3	ISO3 code of the importer country
Importer region	The region to which the importer country belongs
Resource	The type of resource traded
Year	The year the trade data was recorded
Value	The value of the trade transaction (in USD)
Weight	The weight of the traded goods
Value_ExportTotal	The total value of exports for the exporter country (in USD)
Value_ImportTotal	The total value of imports for the importer country (in USD)
Trade Imbalance	The difference between export and import values, indicating either a surplus or deficit

Source for dataset:

- https://resourcetrade.earth/?year=2018&importer=asean&units=value&autozoom=1

Data Transformation and Patterns

The dataset utilized for this project includes trade data from 2015 to 2022 for ASEAN countries, focusing on various trade attributes such as import and export values, trade imbalances, and resource distribution. To derive meaningful insights from this raw data, several data transformation processes and pattern analyzes were conducted.

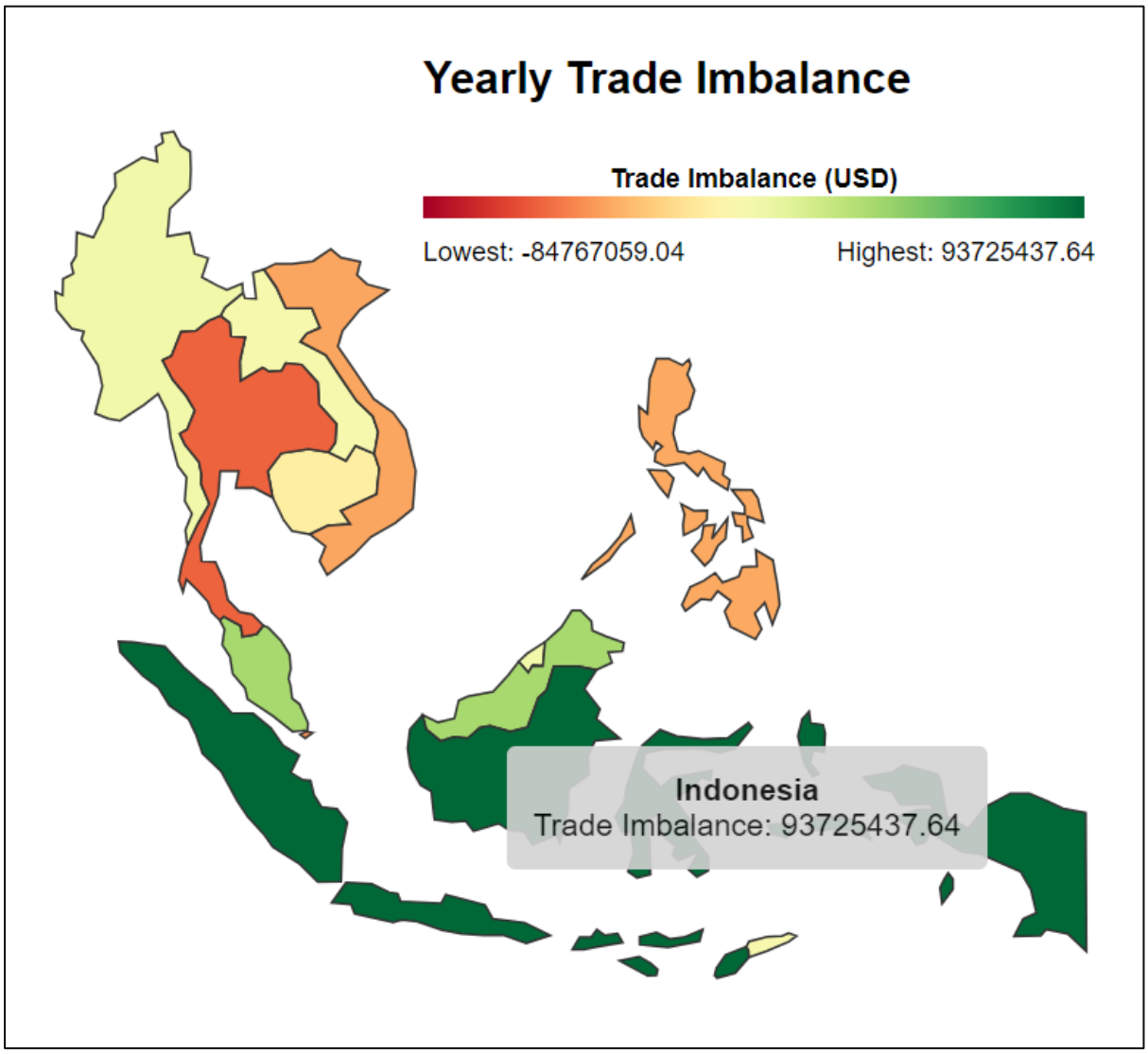
The trade balance is calculated by subtracting the total imports from the total exports. When this value is negative, it signifies that that country has imported more than they exported, meanwhile if it is positive, then that country has exported more than they imported.

The dataset reveals yearly trade values for both imports and exports across ASEAN countries. Analyzing these values over the period from 2015 to 2022 allows for the identification of trends such as growth or decline in trade activities.

The dataset includes various types of resources traded, such as agricultural products, metals and minerals, pearls and gemstones, and fossil fuels. Analyzing the distribution of these resources reveals which resources are most commonly traded.

Description of Visualization Charts

Trade Balance Map



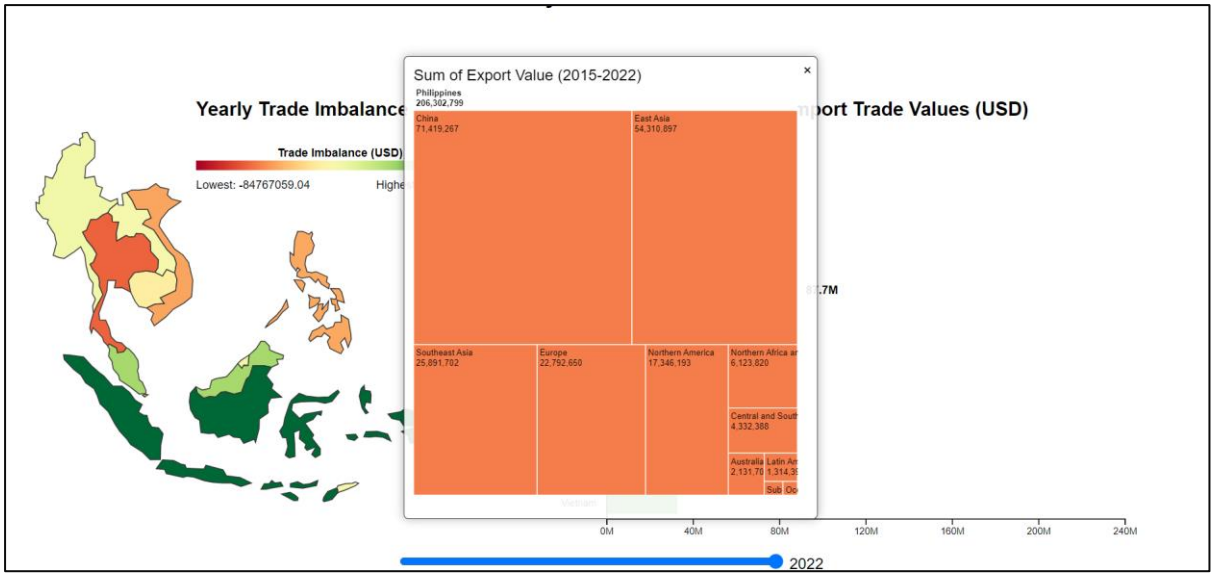
This visualisation uses a choropleth map of South East Asia to visualise the trade imbalance for each South East Asian country for every year. Trade imbalance is calculated by subtracting the country's total import value from its total export value for the given year. When the trade imbalance score is positive, it tells us that the country exports more than it imports, also called a trade surplus. When the trade imbalance score is negative, it tells us that the country imports more than it exports, also called as a trade deficit. A positive trade imbalance score is highlighted in green, whilst a negative one is highlighted in red.

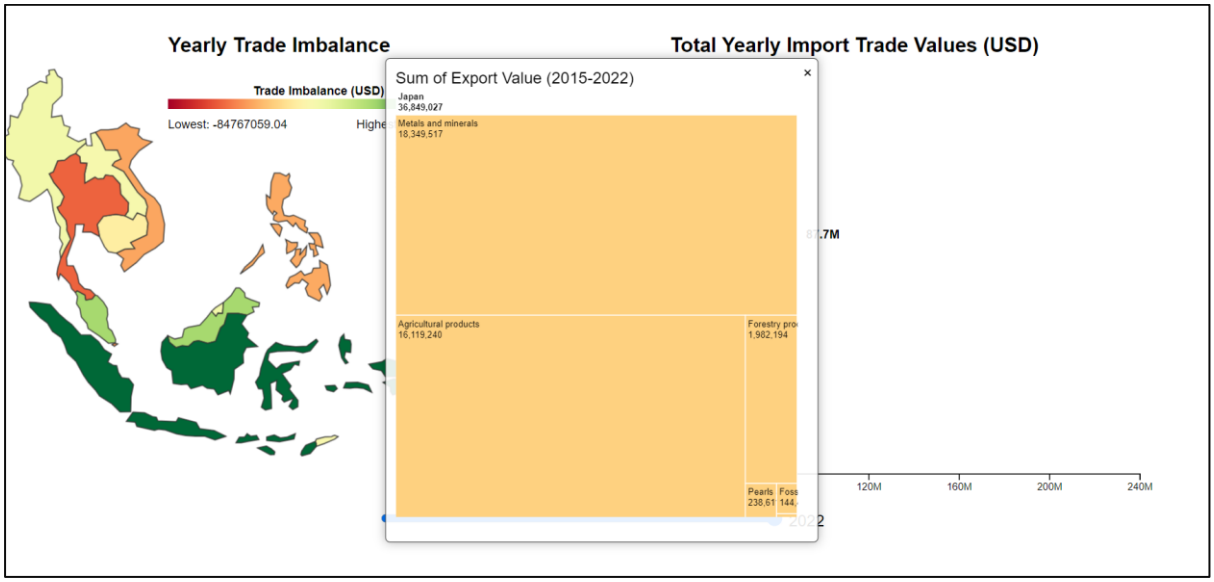
From our graph, we can make a couple of interesting observations. Firstly, Indonesia has consistently had a trade surplus from the years 2015-2022. Countries in mainland South East Asia, such as Thailand and Vietnam tend to import more than they export, from the years 2015-2022. In 2018, Singapore had a very high trade deficit.

From 2015-2017, the trade in ASEAN countries appear to be relatively balanced.

We included this chart, which did not appear in our initial proposal, because understanding trade imbalances is crucial for seeing how well countries manage their trade with others. This visualisation can help us see economic strengths and weaknesses within Southeast Asia and how they change over time.

Treemap Popup





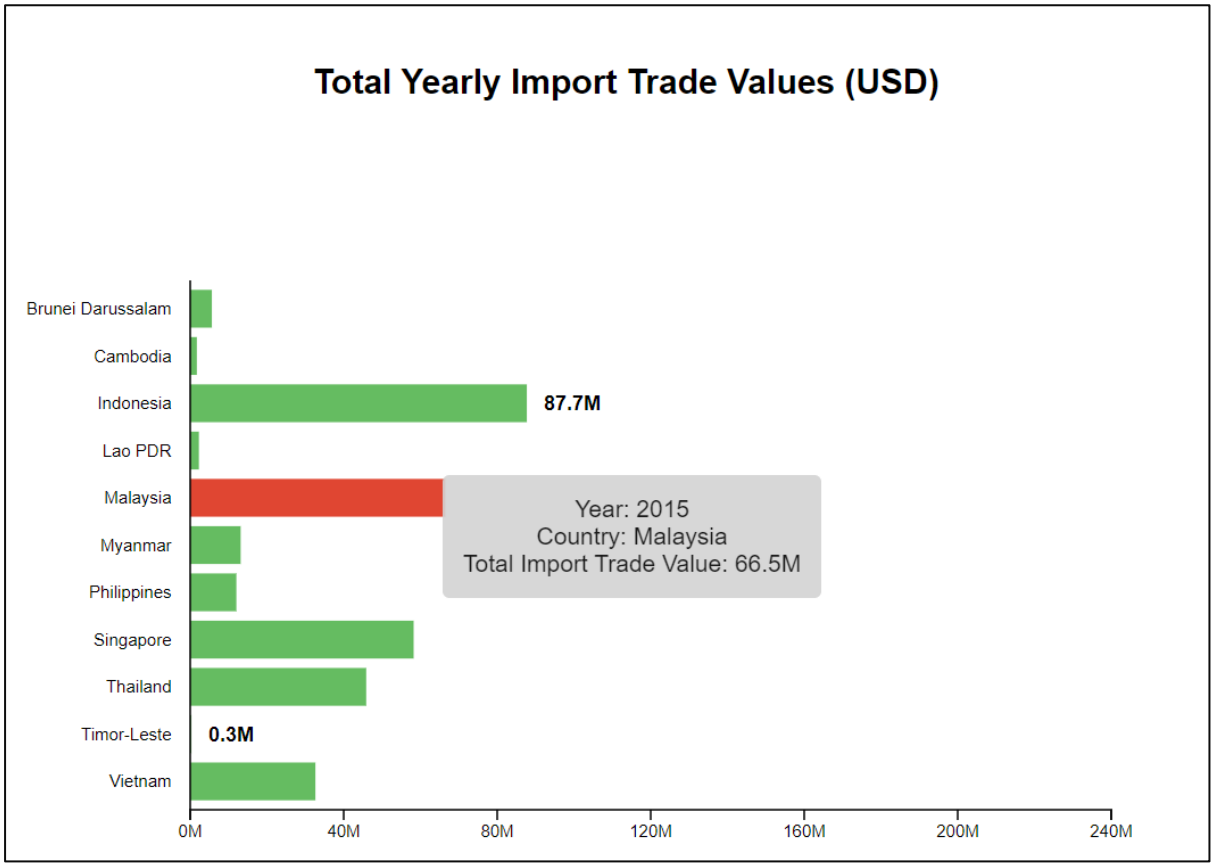
This treemap shows us the sum of export values from 2015 to 2022. Users can double click on a specific country on the map to see the regions, specific countries and resources the chosen country has exported to in a hierarchical manner. Users can go back a level by clicking on the white space in the pop up.

Some key insights that we were able to gain from this is that most of the ASEAN countries have large exports to regions close to South East Asia, such as China (including surrounding countries such as Taiwan, Hong Kong and Macau), East Asia, and South East

Asia itself. Meanwhile regions such as Latin America have lower export values for ASEAN countries, which could be due to how far away it is. What we could take from this visualisation is that the closer the region is to ASEAN, the stronger the economic tie is to the ASEAN region, and hence, more exports. Additionally, although different ASEAN countries export different resources to different countries, agricultural related products appear to be the some of the most exported resource throughout most ASEAN countries, given its high export and high occurrence value. Brunei, one of the largest fossil fuel producers in ASEAN, unsurprisingly exports fossil fuel related resources the most to their trading partners.

This chart was not part of our initial proposal, but was included as part of our second proposal. We included this chart in because visualising which regions, countries and the types of resources that are being exported by ASEAN countries facilitates a deeper understanding into the economic relationships that ASEAN countries have with other countries.

Bar Graph for Total Trade Values by Year



The "Bar Graph for Total Trade Values by Year" visualizes the total import resource values for selected years. Users can select a specific year using a slider that ranges from 2015 to 2022, and the graph updates accordingly to reflect the data for the chosen year. Each bar in the graph represents the total import trade value for a particular country, with the highest and lowest values prominently displayed beside their respective bars for easy reference. Additionally, when users hover their mouse over any bar, a tooltip appears displaying detailed information, including the year,

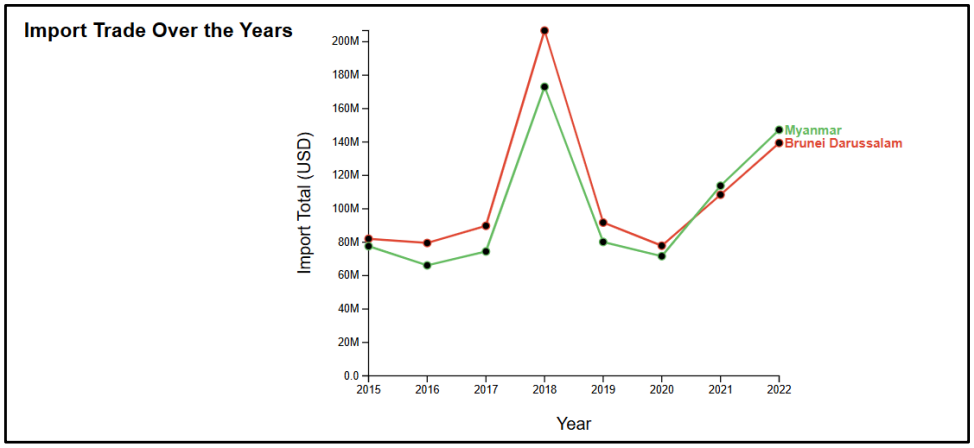
country, and total import trade value. There will be also a color changes (green to red) on the bar that the mouse is hovered to differentiate the country from another. This interactive feature enhances the user's ability to quickly glean insights about the trade values of different countries over the selected time period.

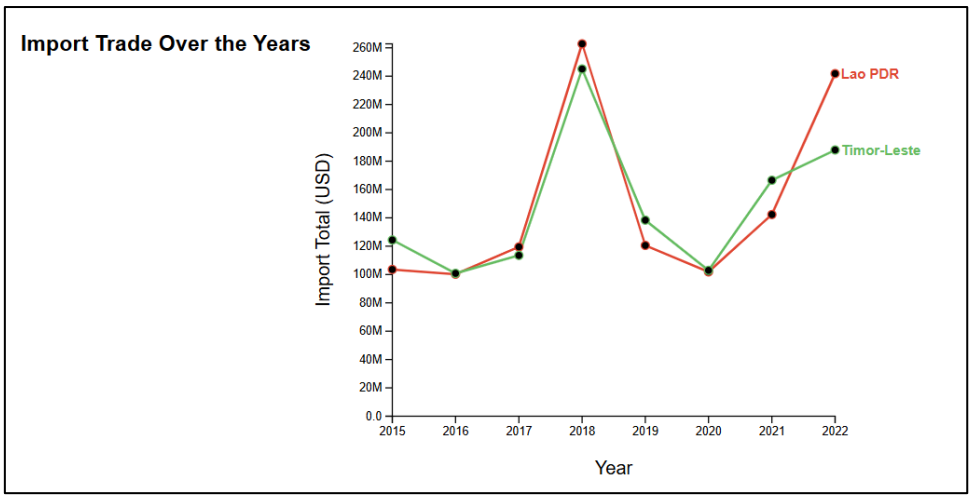
One key observation from the Bar Chart is that, in the year 2015, Indonesia has the highest total import trade value, amounting to 87.7 million, indicating its significant import activity compared to other countries. In contrast, Timor-Leste shows the lowest total import trade value, at 0.3 million, reflecting its smaller scale of imports. Other notable values include Singapore with substantial imports, Malaysia and the Philippines with moderate levels, and smaller import values for countries like Brunei Darussalam, Cambodia, and Lao PDR. This stark difference highlights the varying scales of import activities among ASEAN countries.

In the year 2022, one key observation is that Indonesia had the highest total import trade value, amounting to 194.0 million, indicating its significant import activity compared to other ASEAN countries. Malaysia also had a high import trade value, reflecting its substantial import operations. Conversely, Timor-Leste had the lowest total import trade value at 0.4 million, suggesting a much smaller scale of import activities. Singapore, Thailand, and Vietnam also displayed notable import values, whereas countries like Brunei Darussalam, Cambodia, and Lao PDR had relatively lower import figures.

This chart differs from the initial planned chart in the proposal. The proposed chart was a dot plot titled "Exchange Rate Value in ASEAN Countries in 20##," designed to compare exchange rates across countries. In contrast, the final chart is a "Bar Graph for Total Import Trade Values," focusing on the total import trade values of ASEAN countries for a specific year, with an interactive slider for selecting the year and tooltips for detailed information. This shift provides a broader economic perspective, emphasizing trade values over exchange rates and enhancing user interaction and data exploration.

Line Graph for Import Growth Over Time (Compare 2 Countries)





The "Line Graph for Import Growth Over Time" offers users a dynamic and interactive way to compare the import growth of two Southeast Asian countries from 2015 to 2022. The graph utilizes data filtered specifically for these years (2015-2022) and focuses on countries within Southeast Asia. For each year, average import values are calculated to provide a clear and accurate representation of trends. Users can select their desired countries from dropdown menus, triggering the graph to update dynamically and display the relevant import growth. Tooltips enhance the user experience by providing detailed information when hovering over data points, including the country name, year, and import values in millions of USD. Labels at the end of each line help users easily distinguish between the two selected countries. The graph's interactive nature, complemented by smooth animation transitions, ensures that the lines are drawn dynamically from 2015 to 2022 each time the country selection changes. This feature significantly enhances the user experience by facilitating easy identification and analysis of import trends over time.

Key observations from the graph indicate that most countries experienced a decline in import values in 2019 and 2020, followed by a gradual increase in 2021 and 2022. This trend is primarily attributed to the impact of the COVID-19 pandemic, which disrupted global trade and affected import totals.

For example, Brunei Darussalam's import values show significant fluctuations, with a notable peak in 2018. This peak could be due to a surge in demand for imported goods driven by economic expansion, infrastructure projects, or changes in consumer behavior. The sharp

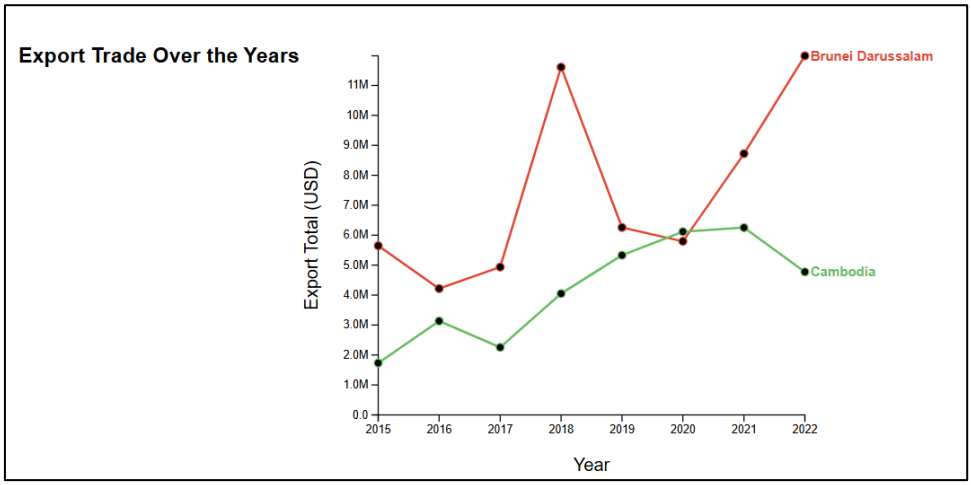
decline in 2019 reflects the broader economic challenges faced during that period. In contrast, Myanmar's average import total in 2021 is higher than Brunei's, indicating a faster recovery from the pandemic. This suggests that Myanmar was able to adapt and bounce back more quickly than Brunei Darussalam in terms of import growth.

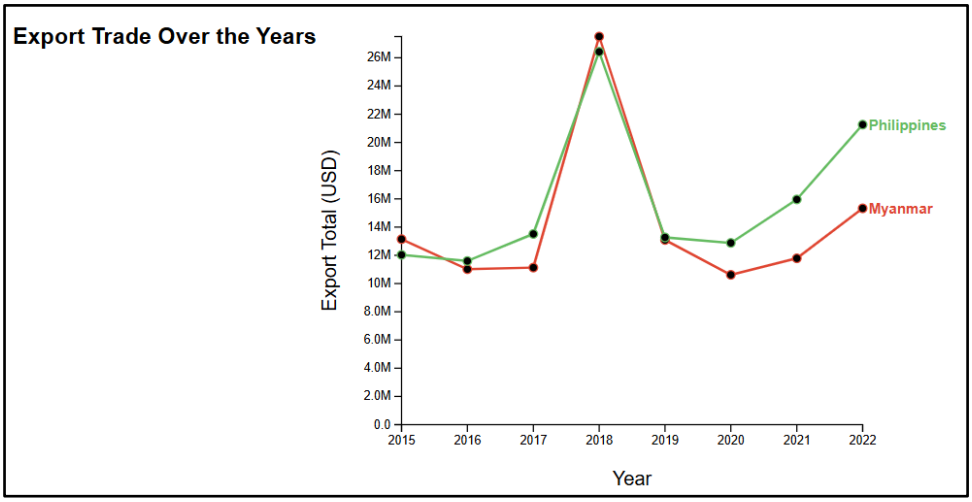
The import values for Lao PDR and Timor-Leste from 2015 to 2022 reveal significant economic trends and competitive dynamics. Lao PDR's import values peaked sharply in 2018 at around 240 million USD, likely driven by economic expansion or infrastructure projects. The subsequent decline in 2019 saw imports drop to around 100 million USD by 2020. However, a strong recovery began in 2021, with imports rising to 140 million USD, and continuing to increase in 2022.

In contrast, Timor-Leste also experienced a peak in 2018 but faced a decline to around 190 million USD by 2020. Despite this, Timor-Leste's imports rebounded more sharply than Lao PDR's, reaching 170 million USD in 2021. By 2022, Timor-Leste's import values closely aligned with Lao PDR's, both showing strong growth trajectories.

This graph is exactly as planned in the proposal. It dynamically compares the import growth of two Southeast Asian countries from 2015 to 2022, with interactive features and animations for detailed analysis.

Line Graph for Export Growth Over Time (Compare 2 Countries)





The "Line Graph for Export Growth Over Time" offers users a dynamic and interactive way to compare the export growth of two Southeast Asian countries from 2015 to 2022. The graph utilizes data filtered specifically for these years (2015-2022) and focuses on countries within Southeast Asia. For each year, average export values are calculated to provide a clear and accurate representation of trends. Users can select their desired countries from dropdown menus, triggering the graph to update dynamically and display the relevant export growth. Tooltips enhance the user experience by providing detailed information when hovering over data points, including the country name, year, and export values in millions of USD. Labels at the end of each line help users easily distinguish between the two selected countries. The graph's interactive nature, complemented by smooth animation transitions, ensures that the lines are drawn dynamically from 2015 to 2022 each time the country selection changes. This feature significantly enhances the user experience by facilitating easy identification and analysis of export trends over time.

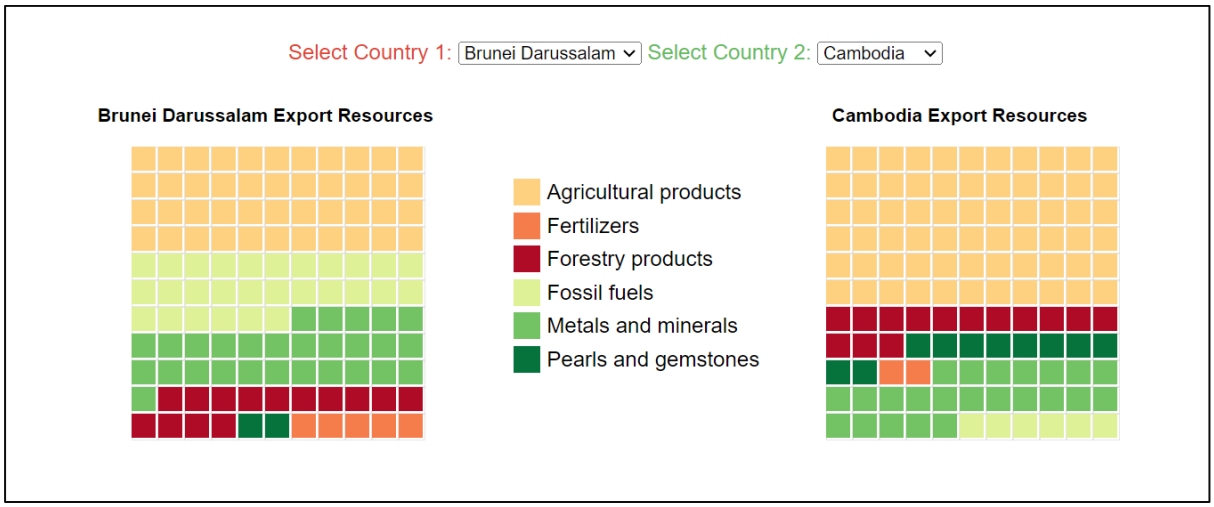
One key observation is that the export growth graph for Myanmar and the Philippines from 2015 to 2022 reveals significant economic trends and competitive dynamics. Both countries experienced a sharp peak in export values in 2018. Following this peak, both countries saw a decline due to global economic disruptions and the COVID-19 pandemic, with Myanmar's exports dropping more steeply to below 11 million USD by 2020, while the Philippines' exports fell to around 13 million USD. From 2020 onwards, both countries demonstrated a steady recovery, but the Philippines exhibited a more robust and faster rebound, with export values surpassing 21 million USD by 2022, compared to Myanmar's 15 million USD. This comparison highlights the Philippines' stronger recovery and competitive positioning in the global market.

Another important observation is seen when comparing the export growth of Brunei Darussalam and Cambodia from 2015 to 2022. Brunei's exports are marked by significant volatility, with sharp peaks and troughs, indicating a higher sensitivity to external market conditions and potential reliance on specific commodities. This volatility is evident with a notable decline around 2020 due to the COVID-19 pandemic, followed by a strong recovery in subsequent years, showcasing Brunei's resilience and robust growth trajectory. On the other hand, Cambodia's exports exhibit a steadier and more consistent growth pattern up until

2021, suggesting greater stability. However, Cambodia faced challenges in sustaining this growth, as seen in the decline in 2022. Notably, in 2020, Cambodia's export value was higher than Brunei's, but Brunei made a strong comeback in 2021.

This graph is exactly as planned in the proposal. It dynamically compares the export growth of two Southeast Asian countries from 2015 to 2022, with interactive features and animations for detailed analysis.

Waffle Chart for Total Export Resources (Compare 2 Countries)



The Waffle Chart for Total Export Resources is a dynamic visualization that allows users to compare the export resources of two selected countries. Users can choose the countries from dropdown menus and the chart updates accordingly. Each coloured square in the chart represents a specific type of export resource, with the following colour coding: blue for agricultural products, orange for fertilizers, green for forestry products, red for fossil fuels, purple for metals and minerals, and brown for pearls and gemstones. The chart is interactive, and hovering over any block reveals the resource name and the total resource count, providing detailed insights into the export composition. There is also an animation where the waffle chart will fade in when the user changes their country selection.

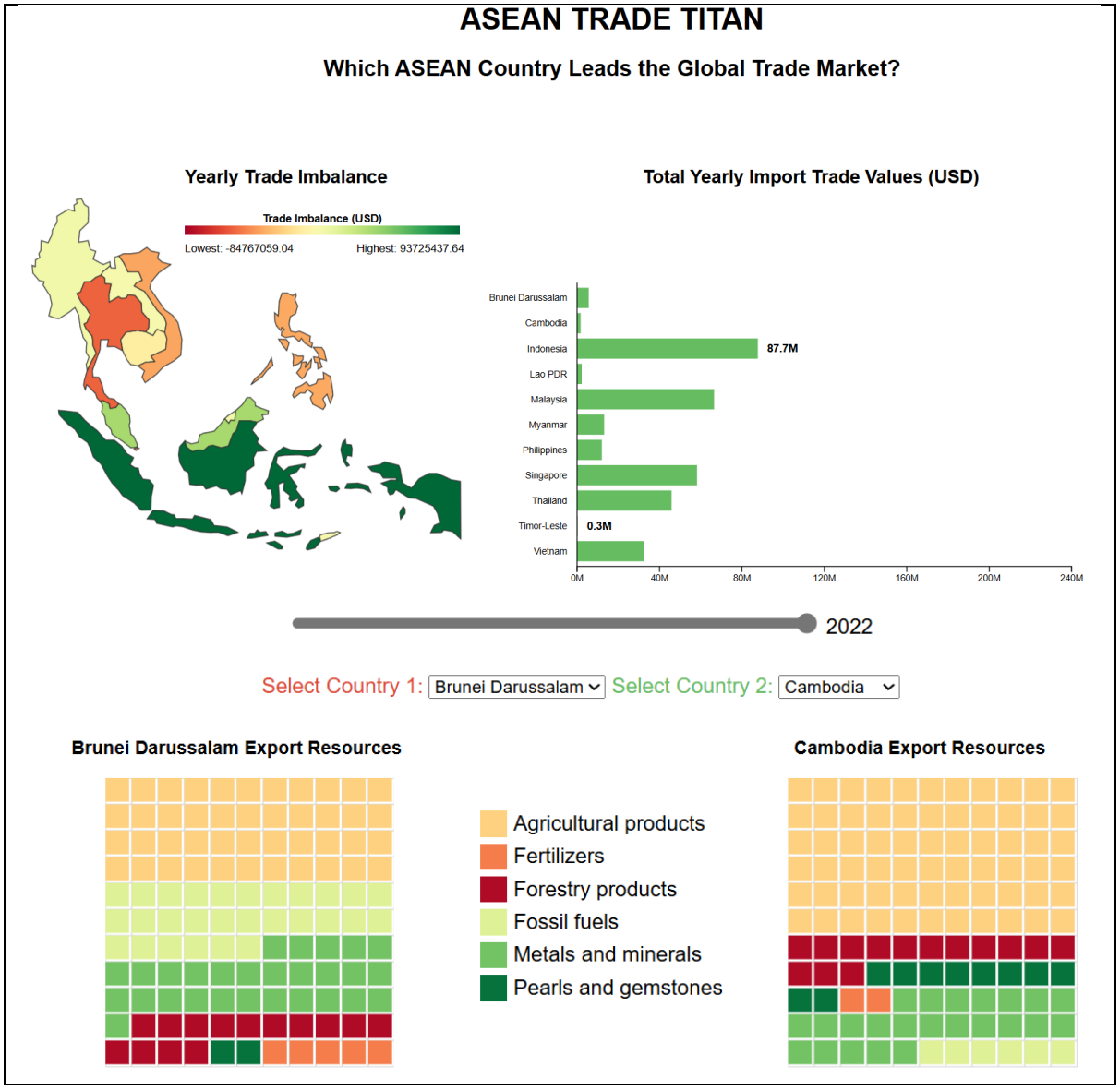
One of the key observations from the Waffle Chart is that from 2015 to 2022, agricultural products consistently had the highest export counts across all countries, while fertilizers and pearls and gemstones had lower export counts. Specifically, both Malaysia and Thailand exported the highest number of agricultural products, with counts of 1806 and 1853, respectively. Malaysia's lowest export was in pearls and gemstones, with a count of 290, likely due to limited natural resources or industry focus in this area. Similarly, Thailand had lower exports in fertilizers, with a count of 452, possibly reflecting a lesser emphasis on fertilizer production and export compared to its robust agricultural sector.

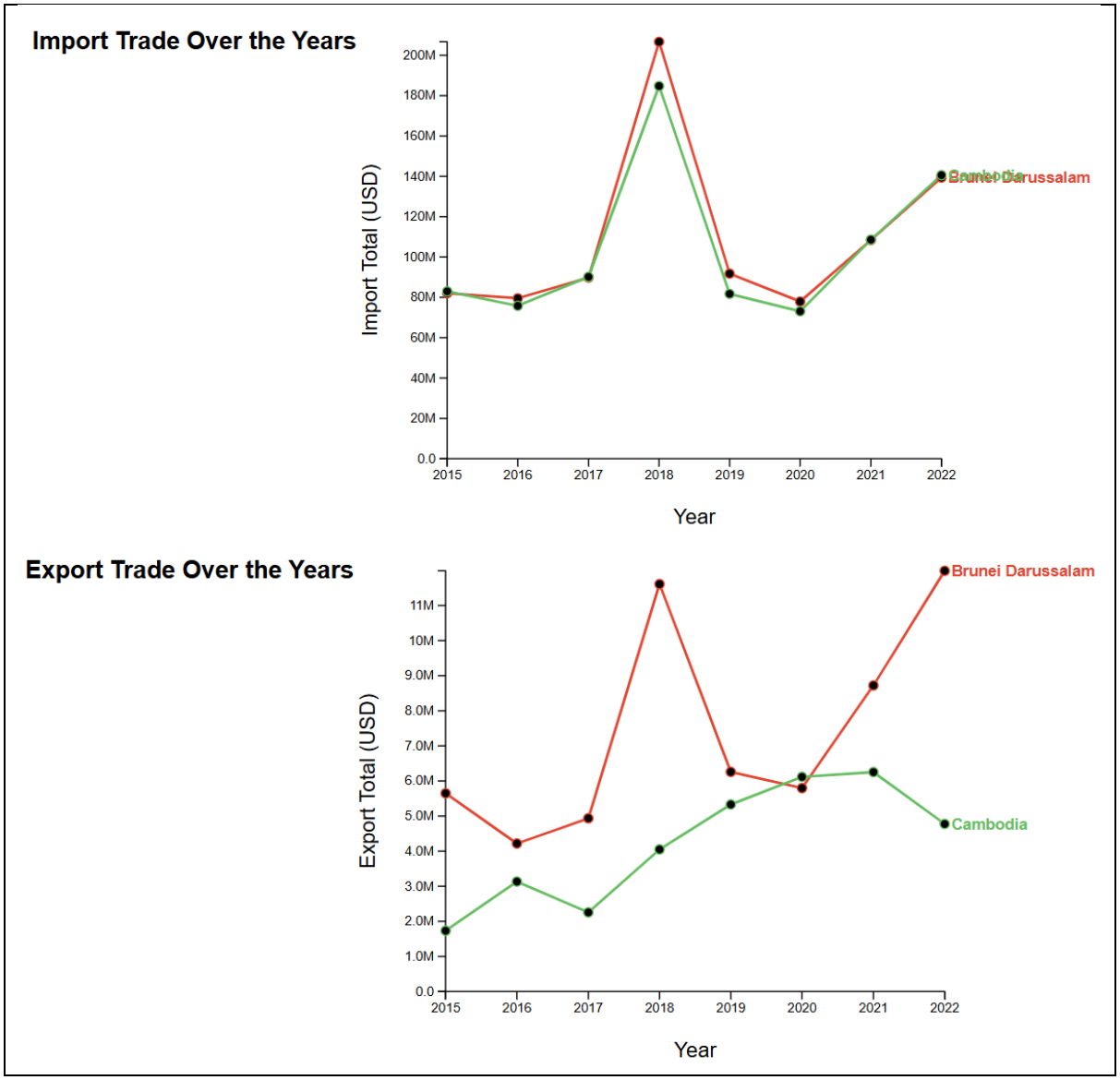
Another observation from the Waffle Chart is that Lao PDR and Indonesia have the highest exports for agricultural products, with counts of 568 and 1786 respectively. Lao PDR has the lowest export in fossil fuels, with a count of 62, likely due to its limited fossil fuel

resources and reliance on other energy sources. Meanwhile, Indonesia has the lowest exports in pearls and gemstones, with a count of 436, possibly because Indonesia's economy is more focused on its abundant agricultural and mineral resources, rather than the pearl and gemstone industry.

This chart differs from what was outlined in the proposal. Initially, we planned to visualize the weights of the resources comparing two countries using a waffle chart. However, in the final chart, we opted to display the total count of resources exported from the countries instead. This change provides a clearer and more direct comparison of the export volumes, making it easier to understand and analyze the data.

Overall Dashboard





In the fast-paced and interconnected world of international trade, having access to precise and comprehensive data is vital for making informed decisions. The project titled "ASEAN Trade Titan: Which Country Leads the Global Trade Market?" aims to address this need by providing an interactive and animated visualization tool that offers clarity and insight into the trade dynamics within the Southeast Asian region. This dashboard is designed to simplify the understanding of import and export trends, trade imbalances, and resource distribution among ASEAN countries from 2015 to 2022.

The overall dashboard includes two filters: one for year and one for country. The Trade Balance Map, Treemap Popup, and Bar Graph for Total Trade Values are filtered by the year slider. This slider can be moved from left to right to select the desired year.

Meanwhile, the Line Graph for Import Growth Over Time , Line Graph for Export Growth Over Time, and Waffle Chart for Total Resources use country selection as the filter. These visualizations allow users to compare data between two selected countries.

Users can hover their mouse on the Bar Graph, Line Graph for Export and Import Growth and Waffle Graph to get more insights about the data. For example, the Bar Graph shows the Year, Country and Total Trade Value after it is hovered. The Line Graph shows the Country, Year, Import and Export Total while the Waffle Chart displays the Resource Name and Count when the mouse is hovered. As for the Map, the users can double-click on a specific country and a treemap will pop up. Users can gain more insights regarding the trade imbalance through the pop up.

The Map Visualization for Yearly Trade Imbalance presents the trade imbalances of ASEAN countries through an intuitive color-coded system, with red indicating deficits and green indicating surpluses. Users can select specific years using a year slider, with the map dynamically updating to reflect the trade imbalances for the chosen year. Hovering over each country reveals a tooltip with detailed trade imbalance values, while double-clicking on a country opens a treemap pop-up that breaks down the export resources into categories such as fossil fuels, agricultural products, metals and minerals, pearls and gemstones, and forestry products. This interactive feature enhances user engagement by providing a comprehensive view of each country's trade dynamics and export composition.

The Bar Graph for Total Import Trade Values is designed to present the import values of ASEAN countries in a clear and concise manner. By selecting a specific year using the year slider, users can quickly view the total import trade values for that year across different countries. The highest and lowest values are prominently displayed beside the bars, making it easy to identify the leading and lagging countries in terms of imports. Additionally, the interactive feature allows users to hover over each bar to get detailed information, including the year, country, and total import trade value. There will be also a color changes on the bar that the mouse is hovered to differentiate the country from another. This interactivity ensures that users can gain deeper insights into the import trade dynamics with just a simple hover action.

The Line Graph for Import Growth Over Time and the Line Graph for Export Growth Over Time are designed to be not only informative but also engaging through the use of animation. When users select different countries to compare, the line graphs animate the transition between the data points. This smooth animation helps users visually follow changes and understand how the import or export values evolve over time.

The Waffle Chart for Total Export Resources is an intuitive and engaging visualization that compares the export resources of two selected countries. Users can choose the countries from the dropdown menus, and the chart will update to reflect the selected countries' data. There is also an animation each time the user changes the selection of country where the chart will fade in and visualize back. Each colored square in the chart represents a different type of resource, such as agricultural products, fertilizers, forestry products, fossil fuels, metals and minerals, and pearls and gemstones. When users hover over any square, a tooltip displays the resource name and total resource count, providing detailed insights into the export composition. This feature makes the data exploration process more interactive and informative, allowing users to understand the distribution and scale of export resources effectively.

Development Process and Team Contribution Breakdown

Members	Sarah Shahmina	Theasika	Diksha
Contribution	> Trade Imbalance Map by year > Treemap Popup by year > Combine graphs for year comparison > Combine overall dashboard > Report	> Line Graph for Import Growth Over Time (Compare 2 Countries) > Line Graph for Export Growth Over Time (Compare 2 Countries) > Combining Graphs for Countries Comparison > Report	> Bar Graph for Total Trade Values by Year > Waffle Chart for Total Resources (Compare 2 Countries) > Combining Graphs for Countries Comparison > Report
Time Spent	Few Days	Few Days	Few Days
Aspects that took the most time?	Combining the overall dashboard	Building the graphs and combining graphs	Building the graphs and combining graphs

Data Visualization Design Principles and Implementation

Our data visualizations were guided by **Shaffer's 4Cs:** Clear, Clean, Concise and Captivating

Clear

Clarity in visualization means presenting information in a straightforward and unambiguous manner. This is achieved using well-defined labels, legends, and color schemes to ensure that users can quickly and easily understand the data. The dashboard achieves clarity with each of its visual elements. The map illustrating the yearly trade imbalance employs a clear color gradient to represent different levels of trade imbalance, making it easy to distinguish between countries with varying trade statuses. The bar chart for total yearly import trade value uses well-defined bars and clear labels, allowing for quick identification of import values across countries. The line charts for import and export trade trends over the years are equipped with labeled axes and distinguishable lines for each country, ensuring users can easily follow the trends. The waffle chart for export resources employs a straightforward color-coding system to represent different categories of exports, making it intuitive to understand the composition of exports for each country.

Clean

Clean visualizations are free from clutter and unnecessary elements, ensuring that the presentation is aesthetically pleasing and easy to navigate. This involves using ample white space, minimizing non-data ink, and ensuring that all elements serve a clear purpose. The dashboard maintains cleanliness by presenting information in an organized and visually appealing manner. The map of yearly trade imbalance uses a simple design with a clear legend, free from extraneous details that could distract from the main data points. The bar chart for total yearly import trade value is cleanly designed with evenly spaced bars and a minimalist style, ensuring the focus remains on the data. The line charts for import and export growth over time use smooth lines and minimal grid lines to avoid visual clutter. The waffle chart for export resources is neatly arranged with each square clearly representing a different export category, making it easy to understand without being overwhelming.

Concise

Conciseness involves presenting information in a way that is direct and to the point, avoiding unnecessary complexity or clutter. This ensures that only essential data supporting key messages or insights is included, making the visualization easy to understand and interpret. The dashboard maintains conciseness by focusing on the most critical data points. The map of yearly trade imbalance succinctly presents the trade status of each country without additional distractions. The bar chart highlights the import values of key countries, omitting less relevant data to keep the focus sharp. The line charts for import and export trends over the years present a clear comparison between selected countries without overloading the viewer with too much information. The waffle chart efficiently summarizes the export resources, providing a high-level overview that is easy to grasp at a glance.

Captivating

A captivating visualization grabs and holds the viewer's attention using interactive elements, attractive colors, and balanced layouts. This engages users and makes the data exploration process more enjoyable. The dashboard captivates users with its interactive features and visually appealing design. Interactive elements, such as the ability to select different countries and different years, add an engaging layer to the data exploration process. The use of vibrant colors and well-balanced layouts across all visualizations enhances their visual appeal, drawing viewers in and encouraging them to explore the data further. The clear distinctions and interactive options make the dashboard both informative and enjoyable to interact with.

By applying these principles, our visualizations not only present data in a clear and concise manner but also engage users with interactive and visually appealing elements, while providing the necessary context to understand the data's significance. This approach ensures that our data stories are effectively communicated and easily understood.