Philippine International Airports: Expansion

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(1) Problem Definition & Data Sources

International tourism is a major part of the Philippine economy. In 2023, tourism contributed 8.6% to the country's GDP and employed 6.21 million Filipinos in its industry. [1] However, this is still lower than the peak 12.7% contribution recorded before the COVID-19 pandemic [2]. Despite reaching 80% of the foreign tourist target in 2023 [3], it is acceptable to say that the industry has seen better days.

Multiple dashboards on airports and air traffic of other countries, such as the United States, are commonly found online. In response, we aim to create an application that provides a comprehensive view on international air traffic and airport performance in the Philippines.

Target Audience

For our target audience, we initially had two choices: consumers or stakeholders, such as airport management and investors interested in the aviation sector.

We chose the **stakeholders** as our key target audience since they play a crucial role in the growth of the country's aviation industry. The construction and maintenance of airports, be it for commercial or other purposes, are heavily dependent on them. Additionally, airport concessionaires, or any businessman who is interested in placing their business inside airport premises could serve as a secondary audience.

Though primarily focused on stakeholders in the aviation industry, our visualization also aims to make the provided information to be understandable by the general public who may hold an interest in the subject matter.

Table 1. Visualization Literacy of Target Audience by Priority Level

Audience	**Specific Users**	**Potential Challenges / Level of Literacy**
Airport Stakeholders	Airport Authorities, Government Agencies	1. Airport stakeholders may have varying levels of technical expertise and data literacy. The level of data literacy across airport authorities and government agencies can sometimes be inconsistent. 2. Airport stakeholders need to make sure that data visualizations are simple, useful, and tailored to the needs of the general public.
Airport Concessionaires	Airport Retailers	1. Airport retailers may have a wide range of difficulties in efficiently utilizing and comprehending data visualization as well as varying levels of data literacy based on factors such as size, resources, and technological sophistication.

General Public	Airport Customers, Passengers, and Airlines	1. Airport users may have varying levels of data literacy based on their familiarity with data and their role in the airport. The issue here is that they might not have much experience with data visualization. 2. Passengers may have difficulty comprehending data visualizations that are not self-explanatory. Visualizations have to be clear and useful for the general public.

Visualization Problem

We aim for our planned dashboard to be able to answer the following questions:

1. Air Traffic Insights
    - Which airports in the Philippines handle the highest number of international flights?
    - How does passenger/air traffic vary over time (e.g., peak seasons)?
2. Airport Performance
    - What are the statistics for aircraft movement, passenger movement, and cargo movement per Philippine airport handling international flights?

This visualization will allow stakeholders to quickly identify key airports and routes, assess trends, and make informed decisions on what and where to focus development efforts.

Dataset Description

A summary of datasets to be used in the project is shown on Table 2.

Table 2. Dataset Description

DATASET	**DESCRIPTION**	**COLLECTION PROCESS**	**SOURCE**
Philippine INTL Airports Departures and Arrivals (November 2022 - October 2023)	A dataset consisting of FlightData for Philippine airport international arrivals and departures. The variables are **icao24**, **firstSeen**, **estDepartureAirport**, **lastSeen**, **estArrivalAirport**, **callsign**, **estDepartureAirportHorizDistance**, **estDepartureAirportVertDistance**, **estArrivalAirportHorizDistance**, **estArrivalAirportVertDistance**, **departureAirportCandidatesCount**,	The dataset is available for download on kaggle, which was fetched from OpenSky's LiveAPI.	Kaggle https://www.kaggle.com/datasets/bwandowando/philippine-intl-airport-departures-and-arrivals

	arrivalAirportCandidatesCount, **IsArrival**, **beginWeek**, **endWeek**.		
Airports in the Philippines	A dataset consisting of Philippine airports. The variables are **id**, **ident**, **type**, **name**, **latitude_deg**, **longitude_deg**, **elevation_ft**, **continent**, **country_name**, **iso_country**, **region_name**, **iso_region**, **local_region**, **municipality**, **scheduled_service**, **gps_code**, **iata_code**, **local_code**, **home_link**, **wikipedia_link**, **keywords**, **score**, **last_updated**.	The dataset is available for download on the site.	The Humanitarian Data Exchange https://data.humdata.org/dataset/ourairports-phl?force_layout=desktop&fbclid=IwY2xjawGgS9NleHRuA2FlbQIxMAABHWjf6FTmCHfsOZQZT91LsO1_uNIHAJ0Nc4EaXm53WbJKKMJEb2B2ukV_hA_aem_4q35YsQPFxinADuiIwNrlw
Aircraft, Passenger, and Cargo Movements (2022 & 2023)	A dataset containing the monthly counts of aircraft, passenger, and cargo movements of airline operators in the Philippines for 2023. The variables are **Airport**, **Airline Operator**, and **each of the 12 months in a year**, and **Total**.	The PDF file of the report is available for download on the site.	Civil Aviation Authority of the Philippines https://caap.gov.ph/aircraft-passenger-and-cargo-movements/

The Airports in the Philippines dataset will provide the list of airports and their geographical locations. Note that each airport has a unique ICAO code assigned, which will be used as the reference point to combine datasets. This list of airports will be supplemented by the Aircraft, Passenger, and Cargo Movements dataset to provide further data besides international flights.

Data Dictionary

Table 3 shows the international arrivals and departures at airports in the Philippines from November 2022 to October 2023. The table includes information on variables, data types, descriptions, units, and any remarks associated with the dataset.

Table 3. Philippine Airport Arrivals and Departures (November 2022 - October 2023)

VARIABLE	DATA TYPE	DESCRIPTION	UNIT	REMARKS
icao24	String	24-bit unique number that is assigned to each aircraft	N/A	
firstSeen	Integer	Estimated time of the flight's departure	N/A	Represented in Unix time (seconds since epoch)
estDepartureAirport	String	ICAO code of the estimated departure airport	N/A	Can be null if the airport could not be identified
lastSeen	Integer	Estimated time of the flight's arrival	N/A	Represented in Unix time (seconds since epoch)
estArrivalAirport	String	ICAO code of the estimated arrival airport	N/A	Can be null if the airport could not be identified
callsign	String	Callsign of the aircraft	N/A	● 8 characters ● Can be null if no callsign has been received ● If the vehicle transmits multiple callsigns during the flight, we take the one seen most frequently.
estDepartureAirportHorizDistance	Integer	Horizontal distance of the last received airborne position to the estimated departure airport	Meters	
estDepartureAirportVertDistance	Integer	Vertical distance of the last received airborne position to the estimated departure airport	Meters	

estArrivalAirport HorizDistance	Integer	Horizontal distance of the last received airborne position to the estimated arrival airport	Meters	
estArrivalAirport VertDistance	Integer	Vertical distance of the last received airborne position to the estimated arrival airport	Meters	
departureAirportCandidatesCount	Integer	Number of other possible departure airports	N/A	Airports in short distance to estDepartureAirport
arrivalAirportCandidatesCount	Integer	Number of other possible arrival airports	N/A	Airports in short distance to estArrivalAirport
IsArrival	Integer	Indicates if the airport is designated for arrival	N/A	
beginWeek	String	Beginning of week	N/A	
endWeek	String	End of week	N/A	

Table 4 displays information on the airports in the Philippines. It provides details on variables, data types, descriptions, units, and any additional remarks associated with the dataset.

Table 4. Airports in the Philippines

VARIABLE	**DATA TYPE**	**DESCRIPTION**	**UNIT**	**REMARKS**
id	Integer	Identification number assigned to the airport	N/A	
ident	String	ICAO code of the airport	N/A	
type	String	Type of airport	N/A	
name	String	Name of airport	N/A	
latitude_deg	Float	Latitude coordinate of airport	Decimal degrees (°)	
longitude_deg	Float	Longitude coordinate of airport	Decimal degrees (°)	

elevation_ft	Integer	Height above sea level of airport	Feet	
continent	String	Continent of where the airport is located	N/A	All values are “AS” which stands for Asia
country_name	String	Country of where the airport is located	N/A	All values are “Philippines”
iso_country	String	Initials of country	N/A	All values are “PH”
region_name	String	Region of where the airport is located	N/A	
iso_region	String	Combination of both iso_country and local_region	N/A	
local_region	String	Initials of region	N/A	
municipality	String	Municipality of where the airport is located	N/A	
scheduled_service	Integer	Status	N/A	
gps_code	String	ICAO code of the airport	N/A	Null if airport is either closed or heliport
iata_code	String	IATA code of the airport	N/A	Null if airport is closed or small or heliport
local_code	String	Local code of the airport	N/A	
home_link	String	Link of the airport website	N/A	
wikipedia_link	String	Link of the Wikipedia page regarding the airport	N/A	
keywords	String	Keywords	N/A	
score	Integer	Score	N/A	
last_updated	String	Date updated	N/A	

Table 5 involves the aircraft, passenger, and cargo movements at airports in the Philippines during the years 2022 & 2023. It discusses the variables, data types, descriptions, units, and any additional remarks associated with the dataset.

Table 5. Aircraft, Passenger, and Cargo Movements (2022 & 2023)

VARIABLE	DATA TYPE	DESCRIPTION	UNIT	REMARKS
Airport	String	Name/Location of airport	N/A	
AIRLINE OPERATOR	String	Name of airline/type of flight	N/A	
JANUARY	Integer	Number of aircraft movements in January	N/A	
FEBRUARY	Integer	Number of aircraft movements in February	N/A	
MARCH	Integer	Number of aircraft movements in March	N/A	
APRIL	Integer	Number of aircraft movements in April	N/A	
MAY	Integer	Number of aircraft movements in May	N/A	
JUNE	Integer	Number of aircraft movements in June	N/A	
JULY	Integer	Number of aircraft movements in July	N/A	
AUGUST	Integer	Number of aircraft movements in August	N/A	
SEPTEMBER	Integer	Number of aircraft movements in September	N/A	
OCTOBER	Integer	Number of aircraft movements in October	N/A	
NOVEMBER	Integer	Number of aircraft movements in November	N/A	
DECEMBER	Integer	Number of aircraft movements in December	N/A	

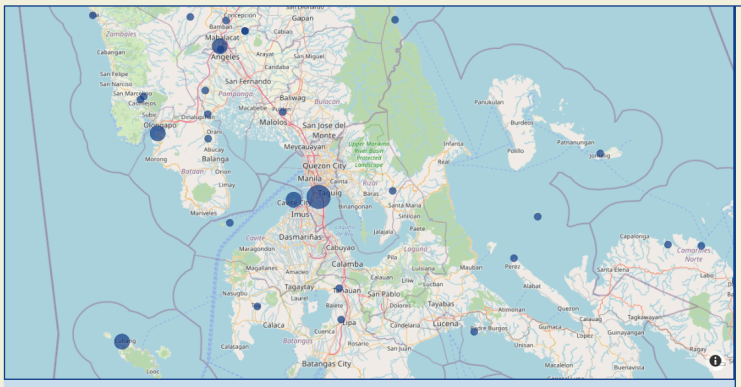
TOTAL	Integer	Total number of aircraft movements for the entire year	N/A	

(2) Storyboard & Visualization Choices

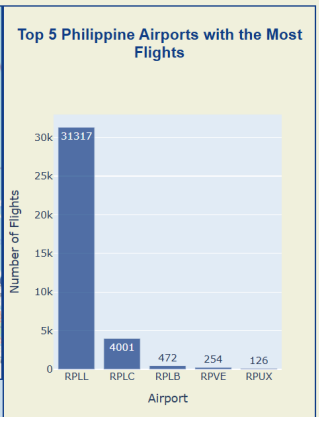
Overall Visualization

Visualization of the Performance of Philippine Airports

International tourism is a major part of the Philippine economy. In 2023, tourism contributed 8.6% to the country's GDP and employed 6.21 million Filipinos in its industry. [1] However, this is still lower than the peak 12.7% contribution recorded before the COVID-19 pandemic [2]. Despite reaching 80% of the foreign tourist target in 2023 [3], it is acceptable to say that the industry has seen better days. This visualization will focus on airports within the Philippines, however, some airports are missing data which will result in blank graphs.



Routes of Selected Airport



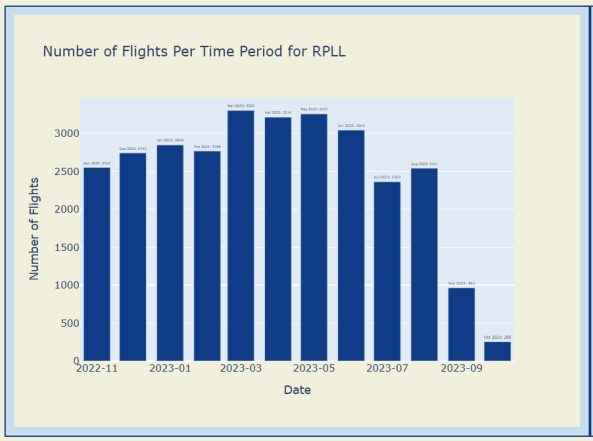
Departure	Arrival	Status
RPLL	VHHH	One-way
RPLL	WMKK	One-way
RPLL	VTBS	One-way
RPLL	VVNB	One-way
RPLL	YSSY	One-way
RPLL	YBBN	One-way

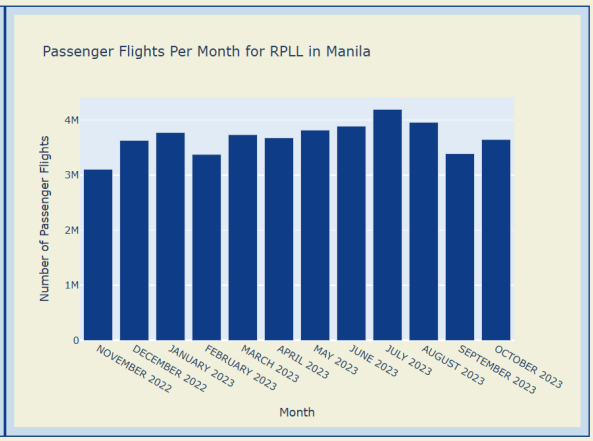
Select Time Period

Nov 2022 Dec 2022 Jan 2023 Feb 2023 Mar 2023 Apr 2023 May 2023 Jun 2023 Jul 2023 Aug 2023 Sep 2023

Select Flight Type

Passenger





Color Palette

Using the map style carto-positron, the points representing the airports will be colored blue to account for possible viewers with color blindness. The histogram will use blue as well to be consistent with the color scheme and the bar graph will use varying shades of blue.

Visualization Choices

Firstly, we would like to display a map of the Philippines with points representing the country's active airports. The points in the map will also have size variations based on airport type (i.e. NAIA is classified as a large airport). It is important for the stakeholders to know the actual location of the airport as there are factors such as if the place is stationed in a densely populated area, runway distance, etc. Each point will display its geographical location such as latitude, longitude, and elevation.

Idiom	Map
Data	Latitude and longitude - Point Location Airport size
Channels	Position - Airport location Point size - Airport size
Task	To visualize the actual locations of Philippine Airports

Another visualization choice which may be implemented is as a bar graph showcasing the top 5 airports with the most flights and comparing the amount of flights they have held since the year 2023. This will be like a quick summary of the map as some stakeholders may only want to know about possible business ventures in specific airports.

Idiom	Vertical Bar Graph
Data	X-axis: Airport Y-axis: Number of flights
Channels	Length for total number of flights in 2023 Will only take the top 5 airports

Task	To showcase the most frequently used airports based on no. of flights

A table including the routes from a selected airport was also added in the visualization. This is to showcase the routes available from the airport for the people to have an idea of the demographic as to which they are trying to appeal to. This will also help airport staff to keep track of which airplanes are scheduled to arrive and depart from the airport.

Idiom	Table
Data	Departing Airport Arriving Airport Route Service
Task	To pinpoint the locations the airport services

A histogram of the number of flights in a certain airport over time may also be used for this. The stakeholders may also want to take note of this because it will give them an idea of how busy these airports will be. This may help with employee scheduling as certain times of the year may require them to station more people for more manpower, others they do not have to station as much in order to save resources.

Idiom	Histogram
Data	X-axis: Time in months Y-axis: Number of Arrivals/Departures
Channels	Length will represent number of arrivals/departures at the specific month
Task	To find the distribution of flights throughout the year

Lastly, is another histogram based on the third dataset, which is mostly similar to the previous histogram, with the exception that the categorical filters are based on the type of flight (passenger, cargo, and aircraft) rather than direction.

Idiom	Histogram
Data	X-axis: Time in months Y-axis: Number of Flights of type Passenger/Cargo/Aircraft
Channels	Length will represent number of flights of certain types at the specific month
Task	To find the distribution of flight types throughout the year

(3) Interactivity Techniques & Justification

App Implementation

The map of the Philippines displaying airport locations will be implemented using Plotly's Mapbox feature taking up a larger area of the dashboard for ease of navigating. The associated information for each airport - name, latitude, longitude, altitude - will be displayed when hovering over the given airport's point. Meanwhile, airport type is represented by the size of the marker.

The bar chart of the top 5 airports by number of international flights will remain static, and analogously take up a smaller portion of the dashboards surface area; just enough to allow reading of the top 5 and their relative ranking at a glance.

The table will simply include a column for the departed airport, the airport arrived at, and the service direction of that route. The airport represented by the table will be selected by the user through clicking the associated point on the map.

The histogram/sequential bar chart of the number of international flights at a given airport over certain periods of time will have two main ways to interact: selecting the airport and focusing on a time period/interval. The airport selection will also be done by detecting the user's mouse hovering over points on the map (in synch with the above table), while focusing on certain time intervals will be done via a double slider, which will also dynamically adjust the granularity of the histogram to be finer on smaller time intervals.

The second histogram/sequential bar chart will have the same kinds of interactions as the previous, except with the separation of by type of flight replacing the time interval selection. This selection is done through a simple dropdown for Passenger, Cargo, or Aircraft flights.

Limitations of the App

Due to limited time and resources, a dataset available for download online is used as the main source for information on flights. The time range for this dataset is January 1, 2018 to November 6, 2023. Thus, we chose to limit our data from November 2022 to October 2023. Also, the specific details of data regarding individual facilities at each airport are omitted due to a lack of a good dataset, under the assumption that any users who need that information already have it available to them for cross reference with our visualizations. Also, international flight routes are unlikely to have the external destination/origin listed or indicated due to the focus on local airports.

Conclusion

Overall, we believe that our dashboard will allow for meaningful analysis of the state of the Philippine aviation industry, mainly in terms of traffic between different airports, seasonal traffic and load, relative scale/development level of each airport, and specializations or types of flights that are common among different routes and airports. We believe this information will be useful for investment decisions for stakeholders, resource allocation and management for retailers, and for general traffic and infrastructure trends for consumers.

References

[1] Philippine Statistics Authority. (2024). *Tourism Posted Highest Growth in 2023, Contributing 8.6 Percent to the Economy.* https://psa.gov.ph/content/tourism-posted-highest-growth-2023-contributing-86-percent-economy

[2] Philippine Statistics Authority. (2020). *Share of Tourism to GDP is 12.7 percent in 2019*. https://psa.gov.ph/statistics/tourism/node/162606

[3] AGBrief Editorial. (2023, September 21). Philippines reached 80 percent of 2023 foreign tourist target. *Asia Gaming Brief*. https://agbrief.com/news/philippines/21/09/2023/philippines-reached-80-percent-of-2023-foreign-tourist-target/

Appendix

Github Link for Source Code and Dataset Files:
https://github.com/Nerdico36/DATANVI-N01-Group-4-Final-Project