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Post Covid-19 Analysis of the Aviation Sector

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Abstract: *Many countries' economic prosperity and strategic development are dependent on the aviation industry, and it plays an indispensable role in the global transportation system. The emergence of a pandemic, which is likely to shatter the sector and disrupt its operations fundamentally, is one of the most common and unprecedented challenges to this industry. Beginning in 2020, the terrible impact of coronavirus (COVID-19) disease, which has evolved into a worldwide pandemic and resulted in a radical reestablishment of society's daily existence, has been faced by aviation. The pandemic has caused a shift in the formerly usual method of air travel. This thesis investigates the ramifications of COVID-19 for the aviation business, as well as the measures employed by this industry in reaction to the crisis and the intention of passengers to travel by air during pandemics. This thesis' literature analysis covers the issues that the airline sector is facing as a result of the global pandemic, as well as the restructured onboard experience, including the new safety measures that have been implemented across the entire aviation network. The report also looks at the new passenger behaviour trends. In April-May 2021, an online empirical experiment using a video advertising as a stimulus in two separate experimental circumstances was done using a quantitative research approach. The impact of aircraft safety measures on travel intention, customer happiness, value for money, and perceived health risk on the general public was investigated. According to the findings, airline safety measures are likely to have a favourable impact on expected consumer satisfaction. At the same time, direct exposure to aircraft safety measures did not lessen their perceived health risk or raise their considered value for money. According to the findings, improving customer satisfaction and expected value for money might have a favourable impact on individual travel intentions. On the contrary, the greater the perception of a health danger, the less inclined people are to fly. This would be a negative scenario for the air traffic sector, whose future development is now difficult to foresee, and the amount of time required to recover is unknown.*

Keywords: Covid-19, Air traffic, Analysis, Python, Pre-processing

I. INTRODUCTION

The global COVID-19 pandemic has left an indelible mark on international travel demand and population movement. Approximately 90% of the population has been impacted by air traffic restrictions thus far. Deep drops in passenger revenue and the number of people working in the aviation industry suggest a massive disruption to economies that rely heavily on air travel (Baker, 2020). Apart from its ability to bring people from different parts of the world together, aviation's key position can be seen in its impact on the success and expansion of other industries. It generates a wide range of job opportunities both inside the sector and in associated disciplines (Air Transport Action Group, 2014). When COVID-19 closed the door on international tourism and exposed the industry to a severe crisis, the aviation system's great connectedness, a wide range of benefits, and other contributions that it provided the globe in the pre-pandemic stage were severely constrained.

Air traffic operations are now either limited or altogether unavailable, depending on the country (Poonam, 2020). Some airlines have been compelled to curtail, partially or completely, their operations. Failure to survive the crisis results in bankruptcy filings, the closure of subsidiaries, and other steps. One of the most common inquiries posed by potential passengers these days is when they will be able to travel without worry once more. Apart from the dread of infection, quarantine laws and the possibility of aircraft connections being cancelled are also sources of stress. As the number of COVID-19 cases in a given region has continuously climbed, the number of flights available in that area has decreased (IATA, 2020). The significant drop in departing planes since the COVID-19 outbreak has nearly reached -52 percent. Indeed, each restriction imposed by a country, such as on border crossing or the acceptance of international travellers, poses a challenge to global aviation's normal operations. Disease outbreaks have been a key disruptor among the several crises that have afflicted the aviation sector (Fig.1). The risk of disease introduction and transmission on a worldwide scale has increased as global connectedness has expanded. The number of passengers, their origin, and their destination all influence the pathogen's transmission.

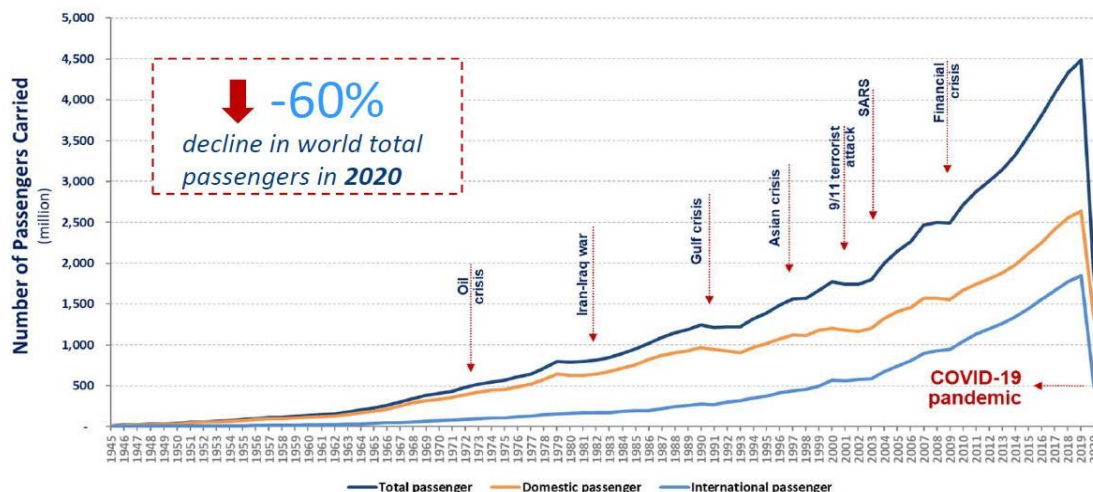


Fig. 1 - From 1945 to 2020, the Global Passenger Traffic Evolution and the Notable Decrease in Air Traffic

The following three research problems are addressed in this thesis:

- 1) *RQ1*: What is the impact of the COVID-19 pandemic on the aviation industry?
- 2) *RQ2*: What solutions is the airline sector employing to deal with the COVID-19 crisis?
- 3) *RQ3*: What effect does a perceived health risk, expected value for money, and customer satisfaction have on passengers' behavioural (travel) intentions?

It is of great importance to understand the kind of threat that the aviation business is exposed to in case of a pandemic by identifying major vulnerabilities. The relevance of this matter is supported by its high topicality, as well as by the direct impact that the COVID-19 pandemic has on the pivotal role of the aviation industry. The topic is considerably new and of high interest in the discussed context, which raises the need for further research.

The present research aims to fill a knowledge gap by providing a deeper understanding of the actual implications that the pandemic has for the air traffic industry. This thesis also aims to explore potential behavioural patterns that have formed as a result of the presence of COVID-19 disease.

The article investigates passengers' attitudes on flying during a pandemic, with an emphasis on what would be a potential driver of their travel intention. It also intends to reflect on the tactics and pathways taken by airlines, particularly the chosen safety measures designed to safeguard passengers and maintain airlines' competitiveness on the market. In order to get valuable data on the examined issue, an online experiment will be designed and circulated through various social media channels. The experiment will analyse respondents' perceived health risk, expected value for money, and customer satisfaction in the presence and absence of safety measures applied in the aviation industry, as well as conduct a causality study. Introduction, literature review, methodology, analysis & results, and conclusion & recommendations are the sections of this work. The objective of the introduction section is to present the discussed topic.

It also includes information about the thesis's purpose, the hypotheses to be investigated, as well as the research methodology, and a complete thesis outline. The literature review begins with an overview of the aviation industry's function in the transportation network and then moves on to the COVID-19 pandemic in the context of aviation. This is followed by a detailed assessment of the issues that the aviation industry is facing as a result of the pandemic's emergence. The next part focuses mostly on the safety measures used across the air traffic industry, with an emphasis on the role of air filters and a description of the most recent onboard experience. This section also discusses the new trends and risks that the aviation sector is facing, as well as the recovery strategies that the industry is pursuing. The conclusion of this section of the thesis includes information on government responses and assistance for aviation enterprises. The thesis continues with a discussion of new behavioural patterns among possible passengers while travelling by air during pandemics. The methodology section discusses the research design and data collection method used, as well as specifics on how the stimuli were manipulated, including survey questions. takeaways. Following that, the topic's conclusions are drawn, along with a section on aviation's chances of recovery and a future forecast.

II. LITERATURE SURVEY

A. *The Aviation Industry's Contribution To Global Transportation*

The aviation industry is a complicated system that is vital to the global transportation of people and goods via scheduled domestic and international aircraft connections. It includes all entities involved in the execution of air traffic, such as airlines, airports, and aircraft manufacturers. Poonam's analysis concluded that the air traffic sector is extremely important (2020). According to his results, this industry not only contributes significantly to economic development, but it also has a significant impact on the performance of associated industries such as tourism. According to the ICAO's 2019 Aviation Benefits Report, the aviation industry generates over 65 million job possibilities. According to the study, the aviation industry contributes roughly 3.6 percent of global GDP on average. Furthermore, the industry is an important component of modern logistical networks. Air transport is greatly sought after for significant freight transit due to its speed, ease, and efficiency. It is the quickest and safest method of moving perishable and high-value cargo over long distances. This transforms the aviation business into a global commerce facilitator by allowing access to international markets all over the world. Aviation also promotes the development of new ideas and helps to boost overall productivity. Since then, the aviation sector has dedicated time and resources to advancing in a variety of areas. (For example, optimising flight routes while minimising environmental effect is a difficulty that the industry is attempting to address. Aviation aspires for continuous progress in the sphere of sustainable operations and climate change prevention, such as reducing its carbon footprint. One of the key principles of aviation, according to the Air Transport Action Group (2014), is the facilitation of time-efficient movements through established route networks. According to data acquired from this industry, the number of individuals travelling by air on an annual basis could approach 3 billion (Air Transport Action Group, 2014). Civil aviation, in particular, plays an important role in diplomatic and political contexts, having a favourable impact on the relationships between two or more countries. Countries' governments can agree to construct air route networks that serve the needs of their citizens while also facilitating the flow of freight. When physical access to a particular place is restricted or impossible, flying provides dependable alternatives. It aids in the development of global connections and the provision of emergency assistance (Air Transport Action Group, 2014). The integration of various regions, as well as increasing air connectivity, are high-priority topics in the aviation sector. According to ICAO (2019), the potential of air traffic to grow is dependent on a number of factors, including earned earnings. The image of an airline or a destination influences a passenger's choice of airline or destination. The degree to which they are regarded as safe might have an impact on travel demand, helping or hindering the increase of air traffic.

B. *Aviation Industry Challenges During The Covid-19 Pandemic*

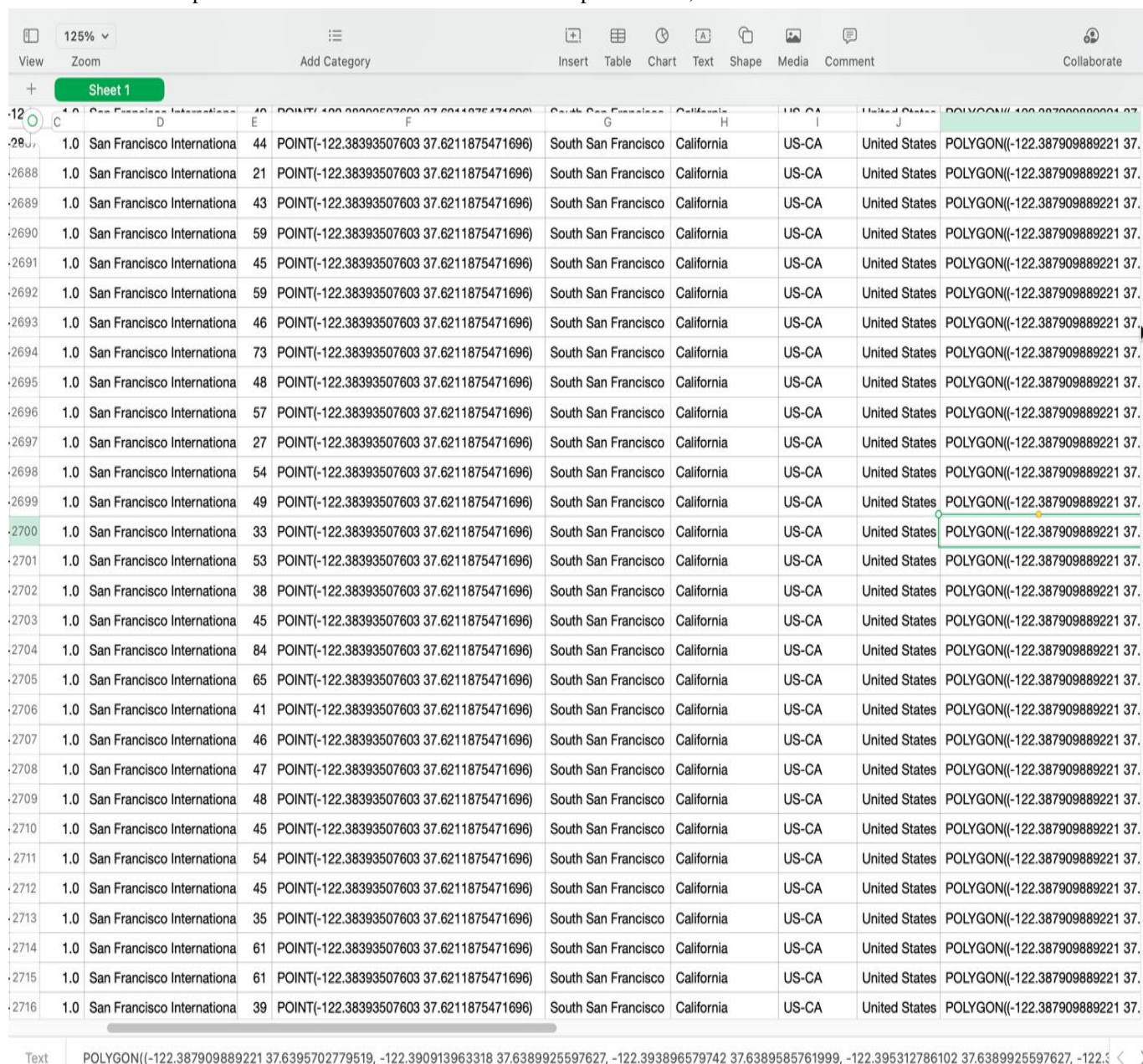
The aviation industry is an inextricable part of the transportation business, and it is vital to all governments. However, the current slowdown in the business is due to the COVID-19 epidemic, and air traffic is seen as a possible means of spreading the disease to other areas. During such a collapse, this industry has extremely few options for continuing operations. It has entered a period of economic vulnerability as a result of the shock. There has been a series of significant events that have shaped the fight against COVID-19's spread by country. To combat the spread of the disease, governments have imposed air traffic restrictions, which have had a direct impact on domestic and international aviation. Many countries that were witnessing a rapid increase in the number of infected inhabitants decided to implement a country-wide lockdown, with flights suspended and airports shutting down. China was the first country to declare a state of emergency after the virus was discovered. Following this lead, several other countries followed suit, and a series of declared lockdowns began. Furthermore, an official warning against travelling outside the United States has been issued. Almost all European Union nations had their formal borders closed as a result of this occurrence. As a result, only EU citizens are permitted to return to their home country, while all other travellers are prohibited. The unexpected slowdown is impeding the aviation industry's further development and expansion. These are some of the conditions that must be met in order to create jobs and boost the economy's overall success (European Commission, 2020). COVID-19 has had a number of consequences for the aviation industry, including capacity reductions, poor demand, and a great deal of uncertainty. The industry is also under pressure from the side of employment. According to Sobieralski (2020), the airline industry's workforce could shrink by -13 percent. According to his findings, airline employees in charge of customer service are the most vulnerable. As a result of the epidemic, a dilemma has arisen in which airlines attempt to maintain their flight routes by continuing to operate flights with no customers, resulting in unfavourable effects. Long-term, such operations are not feasible for airlines. As labour costs fall, so do the incomes of those who work in this industry, as well as the revenue generated by airlines. COVID-19 has been shown to have a negative impact on the benefits that each aviation employment may provide to the entire economy, according to IATA (2020). During the period from 2010 to 2020, there has been a -35% decrease in aviation employment. The crisis has also resulted in a larger reduction in the percentage of gross value added generated by each airline worker (IATA, 2020).

III.METHODOLOGY

Google Scholar, Science Direct, Embry-Riddle Aeronautical University's Hunt Library, and Web of Science were used to conduct an online literature search. The necessary data related to airline success strategies and the impact of COVID-19 on air transport were gathered. The search was restricted to articles published between 2000 and 2021. These online search engines were used to collect, review, and synthesise primary and secondary data from credible sources such as peer-reviewed research publications, industry reports, periodicals, websites, and news articles. The scientific articles relevant to the topic were chosen, and the new knowledge was combined with existing knowledge derived from academic research to extract useful findings.

A. Data

Data was retrieved from Geotab and stored in a.py file and analysis was conducted. During the baseline era, this dataset displays traffic from the Airport as a percentage of total traffic volume. The data for this indicator was collected from April to December 2020 as a baseline. To compare the result for various countries on aeroplane traffic, various visualisations were used.



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Figure 2: Extracted data sample

B. Analysis

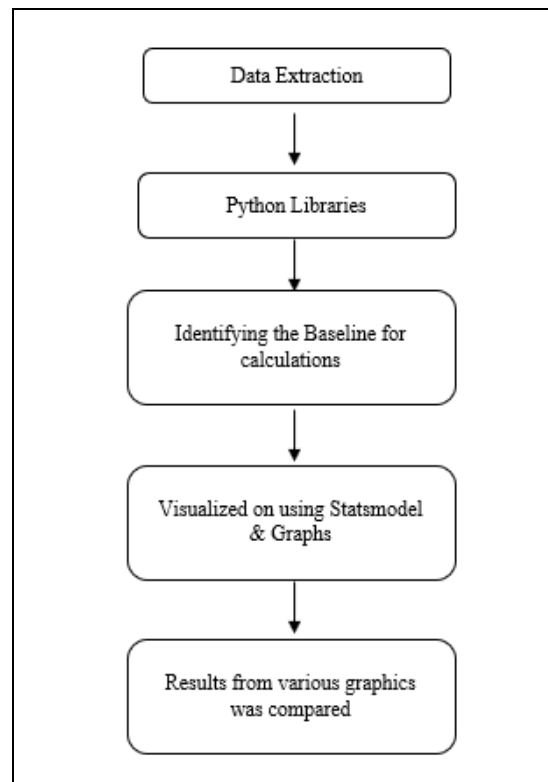


Fig. 2 – Process Flow

Above figure shows the process that was followed to do the analysis. Data over 8 months period was noted and visualized. Data was extracted from Geotab, which had data on the United States and its various airports. In the next level, we implemented filters to execute the analysis in Python. For our research, we considered a total of 17 airports across the United States. We determined the average traffic over a period of eight months. Using the baseline, outputs from various graphs and visualisations were assumed.

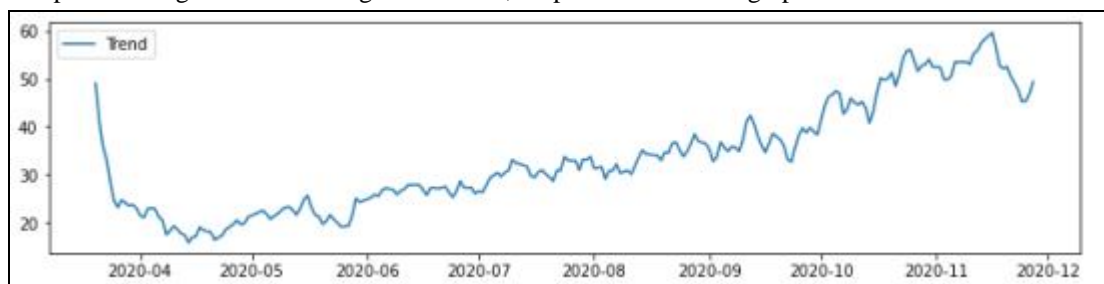


Fig. 3 – Air Traffic data on Line graph over United States

C. Pest Analysis

The study's research strategy is based on PEST analysis. To comprehend any organization's international success and influence, it is necessary to examine its strategic management, which can be accomplished using the PEST analysis. PEST analysis is a method of assessing external factors that may have an impact on a company's profitability. It evaluates the Political, Economic, Social, and Technological variables that affect an organisation and is a valuable tool for evaluating strategic risk. Political factors (P) in an economy relate to a variety of government interventions and political lobbying actions. Economic elements (E) include seasonal concerns as well as macroeconomic situations in the external environment. External social, cultural, and demographic elements are referred to as social factors (S). Technological factors (T) are developments in technology and related activities that have an impact on the environment. By focusing on the application of data analytics and finding chances to establish a plan for future threats, this research study intends to assist and prepare the global airline sector for the Post-COVID-19 era

IV. ANALYSIS & RESULT

It may be determined that the biggest consumption of air traffic occurred in April 2020, with a strong covid influence in the following 2-3 months. Beginning in August 2020, air traffic began to improve gradually.

- 1) *PEST Analysis:* Most airlines around the world are experiencing major financial difficulties as a result of rising operational expenses and declining profitability and margins caused by the global pandemic crisis. The results of a PEST analysis were used to determine the elements that influence the global airline sector, and they are briefly reviewed.
- 2) *Political Factor:* The COVID-19 incident had a significant impact on the airline sector. To prevent the spread of coronavirus, most governments tightened restrictions, and some nations even adjusted travel restrictions on a daily basis based on the number of COVID-19 cases. Governments are worried about residents' safety as a high priority. Governments all across the world have granted financial assistance to airlines that have registered to fly in their territory. Air France (7 billion euros), Lufthansa (9 billion euros), and British Airways (7 billion euros) are the European airlines that have received government help (9.37 billion euros). EasyJet (600 million euros), Norwegian Air (12.7 billion euros), Ryanair (600 million euros), and Virgin Atlantic (600 million euros) are the other airlines that have received government assistance (500 million euros). Alaska Airlines, Allegiant Air, American Airlines, Delta Air Lines, Frontier Airlines, Hawaiian Airlines, JetBlue Airways, United Airlines, SkyWest Airlines, and Southwest Airlines received a bailout from the US Treasury Department in 2020, totalling \$25 billion in grants and loans for cargo carriers. This sum was primarily used to assist these airline firms in paying their employees. Governments and allied regulatory bodies remained focused on contingency planning and preparing the airline industry for the post-COVID-19 era. The governments also agreed to make a temporary change to the laws governing air services in order to assist airlines and airports. Governments, in collaboration with other organisations such as the World Health Organization (WHO), the International Civil Aviation Organization (ICAO), the European Aviation Safety Agency (EASA), the International Air Transport Association (IATA), the Airports Council International Europe (ACI Europe), Euro control, and other related organisations, should begin cooperating to provide a cure for the pandemic. Governments should also examine the data security and legal elements of personal data when doing so.
- 3) *Economic Factors:* The airline industry is facing an economic disaster as a result of travel restrictions and border closures, as the number of passengers has fallen. The aviation industry in Europe lost 100 billion dollars in income in 2020, compared to 88 billion dollars in the United States, 22 billion dollars in the Middle East, and 120 billion dollars in Asia-Pacific. In terms of economic factors, it is suggested that airlines collaborate with governments and other organisations to provide healthy, sanitary travel and related services. It is suggested that they cut any needless costs and maybe restructure their structure to compensate for the losses. Airlines were given the freedom to modify their target destinations, and some even switched to cargo flights in order to increase profits. Delta Airlines expanded its cargo-only flights between the United States and Asia in April 2020 to accommodate the transfer of medical goods. United Airlines' cargo revenue increased by nearly 50 percent year over year to \$422 million in the third quarter, accounting for 17 percent of total sales. Due to the COVID-19 pandemic, passenger travel revenue fell by 84 percent to \$1.64 billion in 2020. In order to survive the epidemic, some tiny carriers are forming alliances with legacy carriers. In May 2020, Virgin Atlantic increased its cargo-only flights and added daily service to Brussels, Beijing, the United States, and India. In addition to the eleven 777 freighters already in service, Emirates Airlines has planned 85 Boeing 777 flights as freighters. Finnair was the first airline in Europe to remove economy-class seats from A-330 cabins in order to enhance cargo room. Under the EASA eight-month exception, Lufthansa Technik executed a temporary cargo conversion of an A380 for an unknown customer.
- 4) *Social Factors:* A social relationship is the bond that occurs between family members, friends, neighbours, co-workers, and other associates. Positive characteristics such as emotional support from others, as well as negative aspects such as stress and conflict, have an impact on the quality of this relationship. Due of travel limitations, the Covid-19 pandemic harmed this social relationship. Families and friends were kept apart due to social distance and travel constraints, causing great disappointment. By enacting curfews and other rules, most countries attempted to reduce or even eliminate contact between people in public spaces. Despite the fact that these measures were designed to protect people from infection, they had unintended consequences, such as an increase in stress, loneliness, and domestic violence among the general public. Loneliness and social isolation, for example, increase stress and have been shown to have harmful effects on a person's mental, cardiovascular, and immune health. The airlines' financial losses during the pandemic can be linked to (i) a drop in client demand, changes in bookings, cancellations, and refunds as a result of travel limitations and personal preference. (ii) an increase in operational costs due to maintenance requirements, available seats, and costs associated with new health regulations such as cabin cleaning and disinfection; and (iii)

a shift in financial position due to existing and new facilities, contracts, and other factors. To protect liquidity, the airlines attempted to control and minimise their operational expenses by asking their staff to volunteer for furloughs, layoffs, delaying either engine or aircraft maintenance, or both, and cancelling purchase orders.

- 5) *Technological Factors*: To prevent the transmission of coronavirus among the general population, it is critical to identify super spreaders and downstream contacts. Both Google and Apple tried to develop a smartphone-based solution, but it was not feasible. Smartphone technology with sensors, external RFID and Bluetooth, video analytics tracking, and access control were all part of the contact tracing technology. Thermal screening, video-based contact tracing, automatic facemask detection, social distancing analytics and "hot-spot" identification, and occupancy sensing and threshold enforcement were all found to be more successful with video systems. Airlines and airports all over the world attempted to implement the most up-to-date technology in order to disinfect and sanitise aeroplane cabins and airports. Since Coronavirus became a pandemic, certain major airports, such as Singapore Changi Airport and London Heathrow Airport, have used robots instead of employees to serve their clients for the sake of everyone's safety.

V. APPLICATION

The Aviation Industry's Use of Big Data Analytics - According to the International Air Transportation Association (IATA), the airline sector had a terrific decade from 2010 to 2019, with 2019 being the most profitable year with a net profit of \$35.5 billion. However, the aviation industry was hit by COVID-19 at an unprecedented level in 2020, with a USD 371 billion loss in gross passenger operating revenues, and the industry as a whole is facing enormous issues. To combat the epidemic, the aviation sector must implement digital transformation projects by investing in new technology, which will open up new doors. Big data analytics is a key new technology that is built on a straightforward concept of data collecting and analysis. Data analysis is required to comprehend the issue that a company is facing. Data analytics aids in the meaningful exploration of data, as well as the organisation, interpretation, and presentation of data into valuable information that offers context for the data. Intelligent, knowledgeable, and experienced people can use data analytics to make better decisions. When used appropriately and effectively, big data has the potential to provide a competitive advantage.

The length of global recovery is largely unclear, as different countries may reopen at different dates and with varying restrictions and preventative measures depending on their recovery status. Normalcy may return soon, and the economy may recover, thanks to the development of vaccines. However, the aviation sector must embrace a higher level of collaboration and partnership to prosper in the post-COVID-19 age. Singapore Airlines (SIA) has begun testing a new digital health verification method based on the International Air Transport Association's (IATA) Travel Pass framework, which will be the first of its kind in the world. Customers will be able to securely retain and present information relating to Covid-19 testing in the future, as well as their vaccination status. It could necessitate "a new degree of collaboration between airlines, airports, air navigation organisations, partners, security agencies, support services, commercial and retail services, regulators, and customers". To recover and prepare for the post-pandemic period, the aviation sector will need to adopt new strategies in areas such as "data collecting and sharing," "digital technology investment," and "agility, adaptability, and innovative thinking in every part of the business."

VI. FUTURE RESEARCH PROSPECTS

Various sources, including flight performance monitoring systems, airline and airport operational systems, and social media platforms, provide a massive amount of real-time data on flight performance, flight information, airport conditions, air traffic conditions, ticket prices, passengers' comments, weather, and so on. Flight demand analysis, flight delay prediction, air transport network management, crisis management on airline overbooking, aviation demand forecasting for airport planning, smart maintenance, reducing operational costs, performance measurements, and customer satisfaction are all areas where the aviation industry must use data science and analytics. Airlines can also utilise machine learning in ground delay programmes and runway utilisation prediction for air traffic management. Data analytics can be utilised in the air freight industry for things like emergency air logistics optimization, aircraft routing with maintenance personnel, and network assessment. Though research is ongoing in these areas, and some components of data analytics are being used by a few airlines, steps must be done to ensure universal adoption and the airline industry's success.

Future research should try I to use descriptive and diagnostic analytics to analyse real-time data to monitor the situation and identify changes in markets and consumer behaviour (ii) to focus on predictive analytics to predict demand and future customer behaviour (iii) to use 'people analytics' with descriptive and diagnostic approach to prepare for the Post-COVID-19 era.

Research should also be conducted to determine (i) whether predictive analytics can be used to plan for the return to work, as well as employee wellbeing and resilience, (ii) whether descriptive and diagnostic analytics can be used to assess the impact of contingent policies, and (iii) whether predictive analytics can provide a better estimate regarding public perception and react.

VII. CONCLUSION

The aviation industry was unprepared for COVID-19's impact and was one of the worst-affected businesses worldwide. The impact of the pandemic on global air traffic and income by air travel operating region, as well as how COVID-19 affected the number of international and domestic passengers in different route groups around the world, were explored in this research study. The statistics revealed that global passenger traffic dropped by a whopping 60%, a record low in the history of aviation. A full PEST analysis was conducted to better understand the impact of COVID-19 on foreign travel. The findings revealed that governments around the world were aware of the dangers of COVID-19 and imposed stricter controls to prevent the virus from spreading. As the airline industry's economy plummeted, most governments stepped in and offered financial assistance to airlines operating in their airspace. Due to travel limitations and social isolation, the COVID-19 epidemic harmed social relationships. These policies were meant to safeguard people, but they also had some bad effects on people's social lives, which harmed their health. In terms of technological considerations, governments attempted to identify the virus's super-spreaders through contact tracing, while airlines and airports disinfected and sanitised aircraft and airports using cutting-edge equipment. The current study also explains how data analytics could benefit the aviation sector in the event of a global pandemic, as well as possible explanations for the findings.

According to the findings, the aviation sector must examine political, economic, social, and technological factors and continue to work to make its ecosystem as safe as feasible. To maintain a healthy and sanitary environment for airline passengers and personnel, governments should collaborate with other organisations. Apart from financial assistance, they must collaborate with other countries to re-establish air transportation, particularly for business travellers and students, using travel bubbles, air bubbles, and corona corridors. Passengers from the agreed-upon nations will be able to enter without having to clear quarantine. India has created bilateral travel bubbles with other countries, allowing airlines from both countries to benefit from the same benefits. Governments should pursue "Multilateral Agreements" even if the essence of the travel bubble is bilateral. In this sense, multi-national institutions such as the EU and ASEAN should be given special consideration. Bilateral travel bubbles can also be joined or expanded to create multi-lateral travel bubbles. This will aid the airline industry's recovery while also providing some social assistance to the general public.

To ensure financial viability, airlines should make extensive use of data analytics technology. The aviation industry's recovery and resilience strategy must include a greater use of data and digital technology. According to the findings of this study, airlines should develop a COVID-19 Airline Recovery Plan by tracking COVID-19 progress and recovery at the global, regional, sub-regional, and country levels, conducting flight demand analysis by identifying reactivated air routes, tracking global air travel demand, and implementing an e-commerce strategy. This necessitates excellent coordination, cooperation, and good communication among various data analytics teams (internal and external), as well as throughout all airline departments and industry stakeholders. This is critical in order to deal with the current unique situation and to prepare the airline sector for the post-COVID-19 period. Furthermore, because the pandemic is still ongoing and new variants such as B-117, B-1351, and P-1 variants are emerging, the sector requires long-term commercial assistance in order to succeed. As a result, it is critical to alter the company so that it can swiftly react to changes, which necessitates effective agile leadership.

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