

NUFFIELD RESEARCH PROJECT

THE IMPACT OF COVID-19 ON THE AVIATION INDUSTRY

Layo Akinola

September 2020



Abstract

Image Source: <http://marcant.com.mx/>

The Covid-19 Virus has completely altered all aspects of modern life, and the aviation industry has experienced a huge variety of consequences as a result. As Covid-19 has spread, and developed into a global pandemic, there have been significant economic losses and unfortunate social costs, which have put many companies within this sector under extreme pressure. In fact, the aviation industry has suffered some of the worst ramifications of the virus, as so many facets within the industry have been halted and changed, to inhibit the spread of the virus as much as possible. This paper will investigate the socio-economic, environmental and wider effects experienced by the aviation and aerospace sectors, as well as explore what recovery may look like.

Table of Contents

| | |
|--|-----------|
| Abstract | 1 |
| Table of Contents | 2 |
| Introduction | 3 |
| Methodology | 4 |
| Research and Results | 6 |
| How has Covid-19 socio-economically impacted the aviation and aerospace sector? | 6 |
| How has Covid-19 environmentally impacted the aviation and aerospace sector? | 9 |
| How will the aviation and aerospace manufacturing industry be affected? | 11 |
| How will the wider aviation and aerospace operators be affected? | 13 |
| How will aviation and aerospace industries recover from the impacts of Covid-19? | 15 |
| Conclusion | 18 |
| Bibliography and Further Reading | 18 |
| References | 19 |
| Acknowledgements | 21 |

Introduction

Covid-19 is an extremely dynamic phenomenon, and there are changes and progressions to its societal presence on a daily basis. The same is true when one looks specifically at the aviation industry, thus, it is important to consider a variety of sources and subtopics to gain a sufficiently thorough insight into all the aspects concerning Covid-19 within aviation and aerospace. The first thing to discuss is what the actual impacts have

been, as these ultimately form the root of all the other themes and ideas to be included. Evidently, this global pandemic has created radical disturbances within the industry, none of which could have been predicted before January 2020. To compound this, an event of this magnitude isn't a familiarity of contemporary society, thus initial adaptations were difficult and tentative, as they had to ensure both safety of the global population, while maintaining as much economic productivity as possible. These two concepts were, and continue to be, extremely difficult to balance perfectly, and the IATA published an estimate on the 14th April 2020, predicting that passenger revenues would decrease by US\$314 billion in 2020, from the value in 2019.¹ Such losses have caused staggering effects throughout the aviation industry, and it is difficult to forecast how long these effects will linger. This highlights another key point, as Covid-19 has completely altered our perception of the future economy, making economic forecasting even harder than it already is. Therefore, in these unprecedented circumstances, industries have been trying not only to mitigate the virus' detrimental effects, but have also begun implementing plans for the future, detailing how they can evolve their responses over the next few years. Though, from these ideas, it seems that the virus has brought about solely negative effects, there have been environmental benefits, which may not have occurred if not for the virus. With air traffic having decreased appreciably over the past few months, carbon dioxide emissions have plummeted by record levels, yielding huge improvements in air quality across the globe, allowing aviation and aerospace companies to consider incorporating environmental sustainability into their plans for the future. This project collates information from a variety of articles, research papers and seminars, to provide an expansive insight into 'The Impact of Covid-19 On The Aviation Industry'.

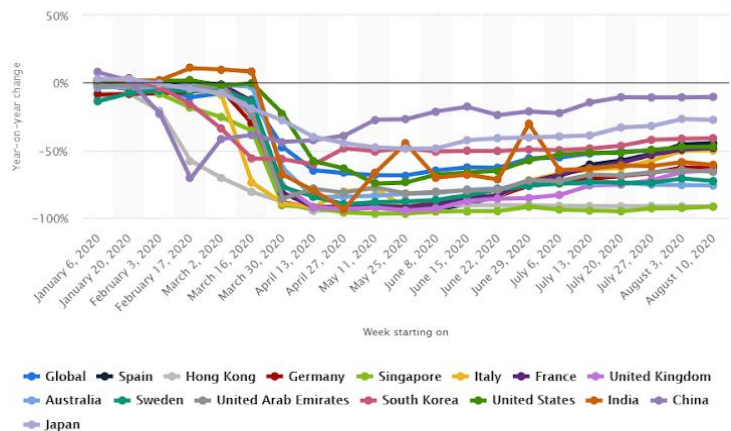


Figure 1: A graph depicting the fluctuation of air travel in different countries, since the start of 2020.
[Source: <https://www.statista.com/statistics/1104036/novel-coronavirus-weekly-flights-change-airlines-region/>]



Figure 2: An image depicting the exhaust fumes given off by planes.
[Source: <https://www.iflscience.com/environment/its-time-to-wake-up-to-the-devastating-impact-flying-has-on-the-environment/all/>]

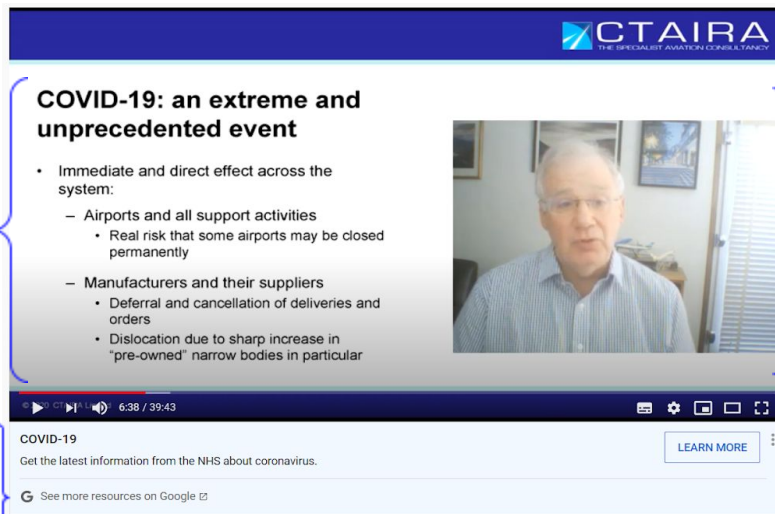
Methodology

As aforementioned, the research question is extremely broad, and has effects on a global level. This meant that, in order to gain the most representative and accurate research and data possible, I predominantly used secondary data sources. These included:

1. Webinars

The first method I used was synthesis of information from webinars, whereby I watched them in their entirety, and made notes on the key pieces of information relevant to my topics of interest.

There is usually a powerpoint to supplement the audio/video, generally providing a condensed transcript, which is useful for note taking.



Listening to the presenter and noting down the most relevant points they mention, or things they place particular emphasis on, is one way to collect useful data and information.

Webinars will often provide further sources which supply more details about their topic of discussion.

Figure 3: An image depicting the typical formatting of a webinar.
[Source: <https://www.youtube.com/watch?v=dq4PrV4ahvs&t=398s>]

2. Academic Papers

I supplemented the webinar research with information from academic papers. These are extremely thorough and detailed, so I used the abstract to first identify whether the paper would be useful and relevant to my study, then I looked at the table of contents to pinpoint which headings would provide me with the most useful information. If the paper didn't have a table of contents, I simply skimmed through, looking at the titles denoting each section, then used the same selection process as I did if the table of contents was present initially. Once I had identified the useful section(s), I noted down key quotes or ideas that were able to support the research question and sub-topics.

3. Articles

The final secondary source I used was articles. I ensured all the article sources I used were as politically impartial as possible, and that they were broadsheet if taken from newspapers. I found these to be the most valuable sources of information and data because they are continually published, which is extremely useful as the virus and its effects evolve every day. Furthermore, they are concise, but very informative, hence

providing numerous facts and statistics in an easily accessible and interpretable form. For this reason, unlike with the academic papers, I was able to read articles in their entirety, then write brief summaries of what I had learnt from that article, of which I could refer to in the findings section of my investigation.

Written by a reputable journalist and published recently, hence a reliable resource to use.

▲ The aviation industry had been shaken by the coronavirus pandemic. Composite: Guardian design team
 “The political moment is now” to address the climate risks posed by the aviation industry, analysts, insiders and campaigners sav. as governments

Title is directly relevant to one of our research subquestions.

Contains a term from our main research question, therefore can be linked to several points.

Figure 4: An image depicting the format of an article.
 [Source: <https://www.theguardian.com/world/2020/may/17/is-covid-19-crisis-the-catalyst-for-the-greening-of-worlds-airlines>]

However, when writing an academic paper, it is important to include a variety of qualitative and quantitative, primary and secondary sources. So, I did try to incorporate a primary source of data into my investigation to fulfill this aspect:

1. Questionnaire

The primary data aspect leant itself in the form of a questionnaire about usage of the aviation industry, which provided me with 5 responses to analyse and evaluate. I then linked the results back to the initial research question, as well as the secondary data sources.

Research and Results

In this section I will discuss my findings, relating to each of the research subquestions. I will outline all the information I have accumulated, ultimately allowing me to explain the positive and negative impacts Covid-19 has had on the aviation industry, and how this will affect the future of aviation and aerospace.

How has Covid-19 socio-economically impacted the aviation and aerospace sector?

Covid-19 has brought upon one of the worst economic crises we have experienced in modern society, and it is extremely apparent that the global economy will feel the impact for years, if not decades, into the future. Specifically within the aviation industry, the impacts have been expansive, and have affected all workers and companies within the sector in some way or the other.



Figure 5: An infographic depicting the potential economic impacts of Covid-19 on the aviation industry. It outlines two possible routes that could occur.

[Source: <https://www.icao.int/sustainability/Pages/Economic-Impacts-of-COVID-19.aspx>]

directly linked to a potential US\$100 billion reduction in airport revenue, but there is also a huge number of consequent economic losses that can occur. Some of the main consequences have been experienced by the tourism sector, a US\$10 trillion industry that has been halted for several months, and is only now starting to reopen itself.³ This has had rippling effects throughout travel agents, regional economies dependent on tourist attractions and many other aspects of the sector, eventually culminating to an approximate loss of \$US1000 billion in tourism receipts. This reinforces not only the severity of the situation, but also the difficulty in quantifying the impacts, hence why most forecasts and current numerical data is so volatile, and usually provided in a range. Another point of note is the global merchandise trade volume, of which could experience a decline of up to 32%. The transportation of goods is vital in

Figure 5 represents not only the extensive impacts we are currently facing, but also the ambiguity the future holds. The orange arrows illustrate an optimistic recovery, while the red arrows represent a prolonged recovery, with the potential of never returning to normality. Through analysis of this figure, one is able to perceive the true financial impact that Covid-19 has had, and will have (n.b. **Figure 5** covers the full year of 2020 and Q1 of 2021).²

Firstly, international air passenger traffic could experience a decrease by over 50%, which is hindering in a huge variety of ways. Not only can this be

maintaining a productive economy, as it allows countries and companies to trade resources, ensuring constant economic flux. Even though this percentage decrease seems small against the other decreases, any reduction in the transportation of goods can cause strains on supply in certain areas, and surpluses in other areas, completely altering regional prices and decreasing the economic stability. To compound this, trade is politically essential as it maintains good relations between many countries. Thus, if inhibited for a prolonged period of time, it may not only bring about economic detriment, but there is the additional risk of disputes emerging between countries and organisations.

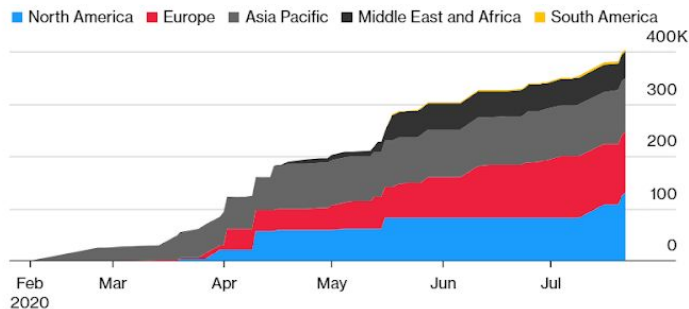


Figure 6: A graph depicting the number of employees that have been/will be furloughed or made redundant by airlines as a result of Covid-19. [Source: Bloomberg]

It is also important to consider impacts from a social perspective. Several airlines have been branded as remorseless for laying off huge numbers of staff, with no financial support; this is the harsh reality of working in aviation amid the Covid-19 virus. Such behaviour has been exhibited by big name companies such as British Airways, Deutsche Lufthansa AG, Emirates Airline and Qantas Airways Ltd.⁴ So, not only has the aviation industry

experienced extreme economic decline, but there have also been huge reductions in workforce numbers, and even wealthy TNCs have struggled to pay employees, or find that the lessened air traffic demands less employees. **Figure 6** demonstrates the sheer magnitude of staff being furloughed or laid off as a consequence of Covid-19, with the global number totalling around 400,000. Therefore, it is undeniable that such a huge loss of human capital within the aviation industry will have untold effects, i.e. it will not be able to function at its regular level if the reduced employee numbers are maintained.

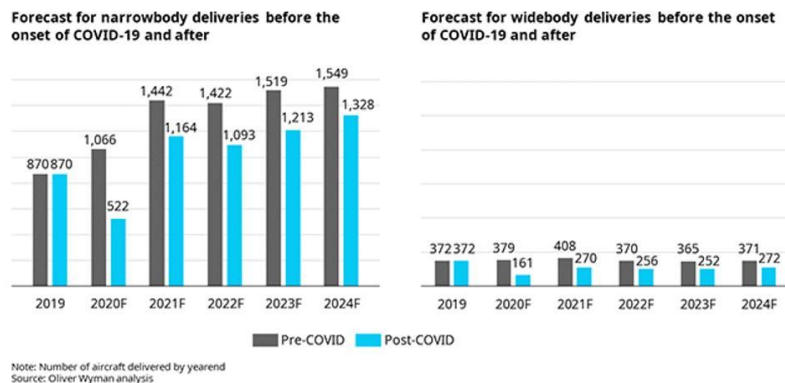


Figure 7: Two graphs depicting the number of narrow and wide body aircraft deliveries forecasted before the onset of Covid-19 vs after. [Source: Forbes]

In terms of aerospace, effects have been equally as significant. Initially, 2020 was set to be an extremely promising period of development and innovation for aerospace, and the main fears were having a lack of pilots and mechanics to cope with the ever-increasing demand. At the start of this year, 27,500 aircrafts were in service, and by the month of May, less than 7,500 were still in flight. To

make matters worse, the fleet isn't predicted to exceed 27,000 until the end of 2022, as an optimistic estimate.

The reason why the impacts have been so extreme is ultimately due to the prosperity presumed for 2020. As already mentioned, international air passenger traffic has been drastically lowered, but optimistic companies ordered aircrafts in bulk at the start of 2020, with the hopes of their frequent utilisation. Being that airlines are the biggest buyers in aerospace, and the reduced air traffic has decreased the demand for planes, aerospace companies have been left with overwhelming inventories due to order cancellations, that could take roughly five years to return to normal stock levels, i.e. the main sources of revenue in aerospace have become worthless for the foreseeable future. The expected number of planes that were supposed to be delivered throughout the course of 2020 (1066) has been roughly halved to 522, yielding a huge disparity between production and delivery of aircrafts, abating the replenishment of the aerospace economy. To make matters worse, as within aviation, there are also a number of consequent effects. The production-delivery disparity will leach into the maintenance, repair, and overhaul (MRO) and spare parts aftermarkets, since many of the unused aircrafts will eventually be taken apart for the useful materials and parts they contain. The MRO industry is heavily reliant on aerospace, and with the declines experienced, as well as those to come, the industry is likely to have lost approximately US\$48.5 billion by the end of 2020, a huge deficit to equilibrate.⁵ Such economic losses go hand in hand with social losses, as many mechanics, pilots etc. are no longer needed due to the lower demand. Overall, Covid-19 has brought about nothing but problems for this sector, as rapidly decreasing storage capacity, aircraft order cancellations and workforce reductions now plague aerospace. Hence, there are many imbalances in the industry, and returning to the success hypothesised for 2020 is extremely unlikely to occur for many years to come, illustrated by the significantly lowered aircraft delivery numbers, outlined in **Figure 7**, when the onset of Covid-19 is accounted for vs when it isn't.

UK Case Study: Heathrow Airport

Looking specifically within the context of the UK, the aerospace and aviation sector has experienced some of the worst effects of the virus in the world. Several major airports are located within the UK, thus, with the prohibition of most inbound and outbound flights, the consequences on people and the economy have been immense. This is reflected in the £1 billion loss by Heathrow Airport in the first half of the year. Not only this, but passenger numbers plummeted by a huge 96%, while cargo volumes dropped by 30%.⁶ Though the cargo volume number is not dissimilar from the global estimates, the decrease in passenger numbers is unfathomably high, and has put the airport in the most intense financial state it has ever experienced. Such rapid changes have meant that 25,000 workers have been put at risk of unemployment by the airport, with 7000 likely to have their salaries cut by up to one third, hence the social detriment also exists in this scenario.⁷ This acts as a microcosm for the rest of the UK, as elsewhere the consequences of Covid-19 have been equally as bad. In Scotland's Edinburgh Airport, one-third of the workforce is to be made redundant due to the £3.5 million monthly losses forcing them to take drastic action, as the furlough scheme is no longer a sufficient means of financial relief.⁸ Terminal 2 in Manchester Airport is being closed, after opening on the

15th July, due to low demand for air travel, as a direct consequence of the pandemic.⁹ Hence, the UK aviation industry has been impacted equally as much as the global aviation industry, and in some some cases, even more severely.

The ultimate impacts of Covid-19 on the aviation and aerospace sectors are the reductions in socio-economic productivity as many companies grapple with achieving the perfect balance of regular functioning and safety. Essentially, larger-scale economic consequences front smaller scale social impacts, as while the global aviation industry teeters on the edge of recession, hundreds of thousands of individuals have been forced into financial strain without any time for preparation or planning. Thus, the pandemic has been detrimental on both corporate and personal levels within both of these sectors.

How has Covid-19 environmentally impacted the aviation and aerospace sector?

Though the pandemic has incited a huge array of socioeconomic consequences, there is a lot of hope to be found from an environmental point of view. Before Covid-19, the global aviation industry produced around 2% of all human-induced carbon dioxide emissions, and 12% of transport related CO₂ emissions, hence a notable contributor to climate change and other associated issues.¹⁰ Utilisation of aviation and aerospace related transport is a vital part of globalisation, connectivity and economic productivity, as it warrants mobility between countries, as well as the transportation of goods across the globe. Aviation is also, as mentioned earlier, a necessity for much of the tourism industry, as it ultimately delivers people to the countries where visitors are relied on for regional revenue. So, this has meant that though the environmental issues created by aviation and aerospace are aplenty, they are vital in maintaining a huge number of global processes.

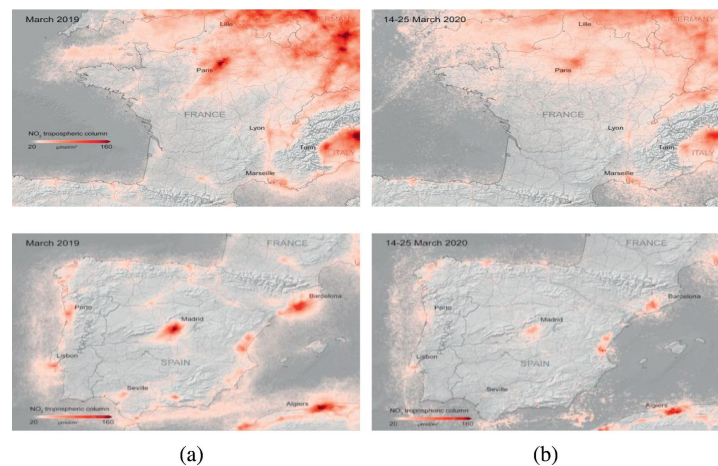


Figure 8: Four images depicting the difference in Nitrogen Dioxide Concentrations in Spain and France in March 2019 vs March 2020 [Source: <https://www.sciencedirect.com/science/article/pii/S0048969720323305>]

As Covid-19 became more prevalent in society, however, the environmental impacts as a result of aviation and aerospace completely changed, and it seems that the crisis may have created opportunities for environmental progression in the future. Most of these improvements have been attributed to the 'lockdowns' implemented in many countries, which prohibited non-essential travel between borders for several months. In fact, NASA and ESA released data which indicated that pollution within a variety of 'Covid-19 epicentres' (e.g. Wuhan, Italy, Spain, USA etc.) had fallen by up to 30%, a gargantuan reduction in just a few months. Other positive



Figure 9: Two images depicting the difference in air quality before (left) and after (right) lockdown was implemented in Milan.

[Source: <https://news.sky.com/story/coronavirus-before-and-after-how-lockdown-has-changed-smog-filled-skylines-11976473>]

changes include: decreased concentrations of Nitrogen Dioxide and PM 2.5, reduced noise pollution and cleaner beaches. Of course these positives are compounded with the socio-economic detriment, but the reason that they inspire a hope, within this otherwise tragic situation, is that they pave the way for a new future for aviation, aerospace and all other industries, whereby they can implement environmental consciousness into their recovery plans to ensure the continuation of these reductions.

Though even when discussing environmental impacts, unfortunately it still isn't a solely positive conversation. The amount of online shopping in recent months has spiked as people feel that this is the safest alternative to contact shopping, that still allows for them to maintain their regular lifestyle. The aviation industry has facilitated this spike through the transportation of these goods, and has thus increased the incidence of both inorganic and organic household waste, amidst the existing global shortages of locations for waste storage. Not only this, but the transportation of medical equipment has also increased, thus effecting increases in medical waste. These issues are worsened by the reduction in recycling, as many governments have shifted focus from recycling schemes to prioritize other, more immediate Covid-19 related issues.¹¹ So, though overall reduction in the active fleet number has yielded huge improvements in air quality, the pandemic has made the industry accountable for significant increases in waste, which may hinder the positive environmental future that recovery plans hope for.

There is also the question as to whether this environmental progress will essentially cancel itself out once everything returns back to normal, as people and companies may adopt their old ways of life. The hopes are that the realisation that one can still survive by a more conservative way of living will influence people's future behaviour, e.g. hosting business meetings via online video platforms, rather than flying employees to other countries. But, one must also consider the stockpiles summounting in aerospace warehouses, for example, and thus the need for immediate production and transportation. There is also the matter of those that will go on several long-haul flights once they are occurring more frequently, to compensate for the months of travel that they have missed. To complicate the environmental effects even further, the volatility of the virus comes into play again. The period of time in which the 'positive' effects are continually observed will depend on how long the virus restricts the degree to which aviation and aerospace industries can function. Essentially, the longer they remain closed, the longer the positive environmental impacts will last for. As it stands, there will be an approximate 0.3% drop in global emissions by the end of 2020, which is less pronounced than that of the 2008-09

crash, but still a notable step towards the decarbonised, sustainable future that many are hoping for.¹² Hence, when it comes to considering the environmental implications of Covid-19, there are a lot of factors in play.

How will the aviation and aerospace manufacturing industry be affected?

There is a multitudinous number of aviation and aerospace manufacturers globally, and each of these manufacturers would have experienced, and will continue to experience significant effects at the hands of Covid-19. These impacts are mainly due to the stock accumulation of materials and finished products, as clients cancel their orders due to the abrupt drop in demand, and the pressure on part suppliers to continue manufacturing in the midst of encountering economic stress. In observing the effects on aviation and aerospace manufacturing within the UK alone, we can begin to understand the complexity behind the industry, and how even just a small alteration within the supply chain can have huge effects on other companies involved in the manufacturing process. **Figure 10** outlines the components needed to make the Midlands Airbus A380. Over 20 companies within the Midlands Aerospace Alliance are involved in this manufacturing process, and this demonstrates the importance of cohesiveness and minimal interference when trying to construct the Midlands Airbus A380.



Figure 10: An infographic depicting the different suppliers involved in the manufacture of the Midlands Airbus A380. [Source: [https://www.midlandsaerospace.org.uk/documents/A380%20Supply%20Chain%20\(high%20resolution\)%20Emirates%20aircraft.pdf](https://www.midlandsaerospace.org.uk/documents/A380%20Supply%20Chain%20(high%20resolution)%20Emirates%20aircraft.pdf)]

Hence, with the presence of Covid-19, many suppliers would have been put under stress trying to provide parts on time, as they also coped with the economic and social impacts of the virus. This example only illustrates the effects within the Midlands aerospace cluster, and there are many other clusters within the UK which would have experienced similar effects. These include:

- ❑ **The West of England Aerospace Forum** - One of their members (Poeton Industries) have had to expand their production horizons beyond aerospace, as they have manufactured medical equipment, patient handling equipment and ventilators, alongside their usual products.¹³ In the long term, this could affect their efficiency, as they may find themselves strained and unable to keep up with increased demand when aviation and aerospace industries reopen. There is also the risk of reduced profitability as the costs of manufacturing the medical equipment may not exceed the inbound revenue from clients purchasing aviation and aerospace related products, as this would have decreased within the lockdown period.
- ❑ **Aerospace Wales** - Members have been working alongside Astute Wales, of whom have been providing support in terms of: driving productivity, modelling risks and opportunities and sustainable materials, all from university-based, industrially focused research specialists.¹⁴ Such a high quality assistance scheme must have some cost attached to it, which will heighten the economic damage within the company or organisation that has to fund the scheme. Also, the necessity for such a thorough scheme highlights the extent to which the companies of this aerospace cluster have been affected, reinforcing how significantly their industrial processes need to improve, in order to reach their previous manufacturing levels.
- ❑ **Aerospace, Defence, Security and Space Group** - The Chief Executive commented on the evident impact that Covid-19 has had on aviation and aerospace, and the uncertainty that it still creates. This is due to the 88% decrease in aircraft orders in the second quarter of 2020, compared to the same period last year, and the vast backlog of aircraft firm orders which totals to around 13,673 aircrafts (representing up to £210 billion) that will take years to overcome.¹⁵ Aerospace and aviation manufacturers will be put under extreme pressure to cope with this huge backlog, made especially difficult with the financial strain and loss of workforce.



Figure 11: An infographic demonstrating the abundance of companies within the Space & Satellite Applications UK Landscape.

[Source: <https://space.ktnlandscapes.com/>]

There are other clusters to consider (North West Aerospace Alliance and Farnborough Aerospace Consortium), which account for over 1000 organisations, on top of the entire UK Space Industry, all of which will be experiencing similar effects to the above companies. **Figure 11** quantifies the abundance of

categories affiliated with space manufacture within the UK alone, all of which have subcategories, which then branch out into individual companies, once again highlighting the sheer scale of the aerospace manufacturing industry. Since companies themselves will be experiencing stock imbalances, potential debt and short staffing, on a national scale, the aviation and aerospace manufacturing industry will recover slowly, and the process will be difficult, given the severity and unpredictability of the entire situation.

How will the wider aviation and aerospace operators be affected?

As mentioned throughout the paper, aviation and aerospace span a very large variety of companies, including airports themselves, airlines, maintenance and repair companies, and many more. To begin to illustrate which airlines have experienced the greatest effects, I carried out a questionnaire on five people, providing me with a starting point for further research. The results are as follows:

Table 1: Contextual Questions

| Person | What gender do you identify as? | How old are you? | Are you a full time or part time student? | (If applicable) What is your profession? |
|--------|---------------------------------|------------------|---|--|
| 1 | Female | 17 | Yes - Full Time | n/a |
| 2 | Female | 21 | Yes - Full Time | Retail Assistant |
| 3 | Male | 54 | No | Software Analyst |
| 4 | Non-Binary | 25 | Yes - Part Time | Accountant |
| 5 | Female | 42 | No | Solicitor |

Table 2: Research-Related Questions

| Person | How many holidays did you go on in 2019? | (If applicable) Which airline did you use most frequently? | How many holidays have you been on since Covid-19 was declared a global pandemic?* | (If applicable) Which airline have you used most frequently since Covid-19 was declared a global pandemic?* | On a scale of 1 - 5, how much has Covid-19 influenced your willingness to travel by plane?*** | Do you know anyone who works in the aviation industry who has been laid off as a result of Covid-19? (If so, from which company?) |
|--------|--|--|--|---|---|---|
| 1 | 5 | Wizz Air | 3 | Wizz Air | 2 | No |
| 2 | 4 | British | 1 | Alitalia | 3 | No |

| | | | | | | |
|---|---|-----------------|---|-----------------|---|-----------------------|
| | | Airways | | | | |
| 3 | 3 | British Airways | 2 | Virgin Atlantic | 2 | Yes - British Airways |
| 4 | 1 | Ryan Air | 0 | n/a | 5 | No |
| 5 | 4 | EasyJet | 1 | Virgin Atlantic | 3 | Yes - EasyJet |

*This declaration was made by the World Health Organisation on March 11th 2020.

**1 - Not At All; 5 - Significantly

There are several key points that I picked up from this data:

- Before Covid-19, British Airways was the most frequently used airline.
- Since Covid-19 was declared a global pandemic, Virgin Atlantic has become the most frequently used airline.
- Every participant's willingness to travel by plane has been reduced by some degree.
- Every participant's holiday frequency has decreased.
- Person 1's most frequently used airline (Wizz Air) didn't change.
- Only one participant hasn't had any holidays since Covid-19 was declared a global pandemic.
- % of the participants knew someone who had been laid off as a result of Covid-19, with the responsible organisations being British Airways and EasyJet.

Upon analysis of the results from the questionnaire, it became evident that 'British Airways' and 'EasyJet' would be the best airlines to use to begin research under this sub-question.

UK Case Studies: British Airways and EasyJet

Before the Covid-19 pandemic fractured the financial stability of British Airways, it boasted itself as the epitome of 'timeless British values and modern Britain's strengths', yet now it seems to have lost some of this confidence. In recent months, staff described the working environment as 'toxic', and to compound this, the relationship between the airline and the government has been tainted. The main reason for these two issues was the drastic staffing changes proposed by British Airways' parent company International Airlines Group, which would have involved 12,000 redundancies. On top of that, British Airways' uptake of the restructuring programme meant that the existing workers would face significant wage-cuts, some in excess of 50%. However, there were already plans for British Airways to reduce their workforce prior to the virus, and many believe Covid-19 was used as a vehicle to catalyse these changes.¹⁶ So evidently, Covid-19 has had a huge effect on this iconic brand, as it has provided the management with a reason to rapidly implement workforce reductions and alter wages. Though most other wider aviation operators didn't have the same plans before the virus, many did also experience issues

concerning the large volumes of redundancies and cuts to staff wages. For example, up to 4000 members of EasyJet's 15,000 person workforce faced being laid off due to the lower customer demand. On top of this, its fleet will be reduced to 302 planes, which is 51 less than had been planned. They also received criticism about their leadership's response to the virus, as a £4.5 billion order for over 100 new Airbus aircrafts wasn't scrapped, despite the demand reduction and the difficult financial predicament.¹⁷ Hence, similarly to the other companies encompassed within the aviation industry, wider aviation operators are facing economic and social challenges, and the difficulty in creating a perfect recovery model has meant that they have experienced much criticism and resentment from staff and other players.

Looking beyond Airlines UK, there are other wider aviation and aerospace stakeholders to consider, including the members of groups like BBGA (British Business and General Aviation Association), AOPA (Aircraft Owners and Pilots Association) and LAA (Light Aircraft Association). They will also experience some degree of economic setback, as a result of the combination of grounded fleets, with the continuation of maintenance costs and other background fees. However, the social impacts will vary very significantly because companies that are members of BBGA will have much larger workforces than those of LAA, for example, meaning the necessity of furlough schemes and staff cuts will be very different. All in all though, Covid-19 will once again inhibit progression, here specifically for the wider operators in aviation and aerospace, making 2020, and likely several years to come, very challenging.

How will aviation and aerospace industries recover from the impacts of Covid-19?

With the multitude of impacts on the aviation industry, it has been vital for companies to begin mapping out their recovery, with hopes of regaining their economic productivity as quickly and efficiently as possible. The variance of the pandemic across different regions in the world, paired with altered development levels, as well as the scale of aviation and aerospace companies within given regions, means that there is no single recovery plan which can be generalised for the entire global industry. This is then compounded with the unpredictability of the future spread of the virus which makes it even harder to put in place a definitive recovery plan, therefore, there are many strategies that will apply exclusively within a specific country or company. Initially, forecasters hypothesised a U-shaped or V-shaped recovery, but as time has progressed, evidence suggests that the realistic roadmap will be something between the two. On the one hand, as restrictions have been eased in many countries across the world, families and individuals have been booking holidays, and domestic flight numbers have surged, rejuvenating the aviation economy and suggesting an optimistic V-shaped future, whereby the aviation industry will easily bounce back from the damage. But, domestic flights are a single component within the complex network of factors influencing the aviation industry, thus the influx of flights in this sector cannot sufficiently repair the immense economic damage. In fact, though the flight numbers have surged within the past two months, looking from an overall perspective of 2020, there will still be some 1.5 billion fewer passengers than the previous year, yielding a US\$273 billion loss in revenue for the world's airlines, evidencing the fact that we can't rely on this

increase as the holy grail in the rebirth of aviation. In any case, this increase has generally been observed in short-haul flights, as opposed to long-haul ones which draw in the most revenue. This means that it is unlikely that the aviation industry will experience an unrealistically fast V-shaped recovery, or an extremely slow U-shaped recovery, since flight numbers should steadily increase as more borders open and airlines commission more flights. This gives rise to a middle ground, and what the Royal Aeronautical Society Corporate Partners have branded a 'recumbent L-shaped recovery'.¹⁸

But, for the aviation industry to achieve this L-shaped recovery, a huge variety of measures and steps must be implemented, especially after months of drastic cost-cutting measures, requests for government assistance and the grounding of many fleets. We have experienced events previously that have had a fair impact on the aviation industry, such as 9/11 in 2001, the SARS outbreak in 2003 and the global recession in 2009, so nations have been able to utilise previous techniques to initiate their recovery plans. For example, towards the beginning of the Covid-19 outbreak, Hong Kong officials knew that recovery could only begin if testing and social

distancing was implemented, something they had learnt from the SARS outbreak, as illustrated in **Figure 12**. But, as much as re-using recovery techniques from previous crises is useful, it is important to note that the aviation and aerospace sectors have been hit much harder by Covid-19 than the other events listed above. This ultimately means that the recovery plans previously used must be fortified with innovative and sustainable solutions to insight the rapid improvements that both governments and players in aviation want. Some examples of recovery methods already in place, and set to be used are:

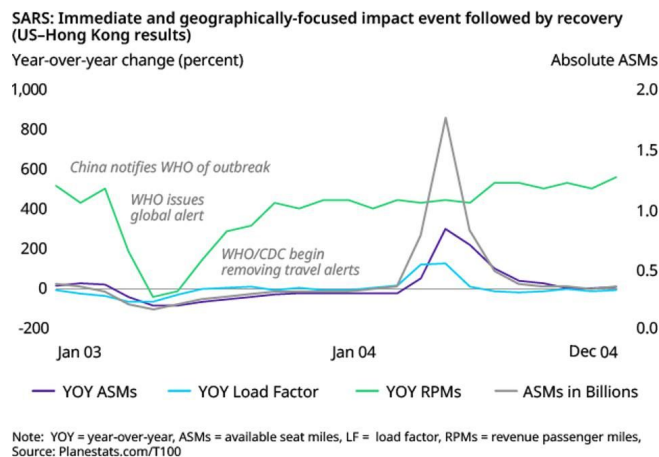


Figure 12: A graph depicting the recovery from the 2003 SARS outbreak in Hong Kong. [Source: Forbes]

- ❑ Maintaining agility in terms of network and capacity decisions, to enable mobility during the ever-evolving course of the virus, and avoid secondary economic crises.¹⁹
- ❑ Monitoring supply chains more situationally to ensure that geographically differing responses to Covid-19 won't affect the airline. If there is an immediate change, it is important to have an existing archive of alternative suppliers so that recovery isn't hindered further.
- ❑ Utilising government assistance offered, to supplement the existing recovery methods in place.²⁰
- ❑ Automating as many processes as possible to reduce the demand for contact, thus maintaining productivity of the industry, while lowering the risk of the virus spreading.

-
- ❑ Ensuring all automated platforms are continually updated to provide consumers and employees with the most accurate information as possible.²¹
 - ❑ Augmenting flight numbers by transporting PPE and other Covid-19 related resources to increase air traffic, while helping mitigate the global spread of the virus. There has already been evidence of this in the mobilisation of some Aerospace, Defence and Space companies, such as Meggit, GKN, Airbus & Thale, all of which have been delivering vital medical supplies and equipment.²²
 - ❑ Manipulating the unorthodox situation as a means to improve the airline in terms of digital modernisation, increased environmental conscience, heightened transparency and better cohesiveness. This is one of the most essential parts of the recovery roadmap, as it is seminal in accelerating the recovery time, and potentially allowing the airline to emerge even more productive than before.

These are just a few examples of how industries within the aerospace and aviation sectors can adapt to this situation, and ensure that they are able to emerge from the undesirable economic state Covid-19 has unexpectedly thrust them into. However, these strategies are from a more general perspective, in reality there are thousands of individual employees whose day-to-day working life has been greatly affected, and this warrants for other, specialised roadmaps. On the surface, aviation and aerospace seems to only span pilots, flight attendants, mechanics and engineers, but there are a huge number of roles that this industry encompasses. These include roles within defence, security, resilience, space and telecommunications, travel technology and innovation, MRO and many more. Thus, such a diverse variety of sub-industries will demand much more specific recovery methods. Many have been implemented already, and others will slowly be integrated across the sectors; the methods may include:

- ❑ Establishing high standards of sanitation amongst employees, and ensuring that all are educated upon the necessary practices needed to keep everyone safe.
- ❑ Endeavoring to monitor the geographical movements of employees, affirming that all are correctly following self-quarantine rules etc.
- ❑ Outsourcing functions which can de-concentrate the number of employees working at a given site, while reducing operation costs.²³

UK Case Study: RVL Aviation

To contextualise both general and specific recovery methods, we can observe RVL Aviation, an airline based at East Midlands Airport. They underwent 374 flights in July, which was the greatest number by far observed since the pandemic began hindering aviation, and August was equally as successful. The success was attributed to the rapid response of staff in adapting to the unfamiliar circumstances, which ultimately allowed for masterly operational planning, logistics and maintenance, ensuring flights could return both safely, and in fairly large numbers.²⁴ Hence, though the RVL Group are only at the beginning of their recovery roadmap, this triumph in the reopening of their company shows that so long as the methods are

implemented to a high standard, there is a possibility that the aviation industry will return to its normal operations eventually. Similar approaches to recovery have been adopted across the UK, as self-quarantine rules for returning passengers from countries showing increases in case numbers, and a huge variety of other methods have been implemented, proving that it is ready to bounce back from the recession and follow the L-shaped recovery path, alongside many other countries.

Conclusion

To conclude, it is evident that Covid-19 has had, and will continue to have an immense impact on the aviation industry. As discussed, companies within the aviation and aerospace sector have suffered the socio-economic consequences of such an unexpected, hugely impactful event whereby fleet numbers plummeted, air traffic reached record lows and manufacturers experienced backlogs and, in some cases, the additional pressure of manufacturing medical equipment. Thus, companies were forced to change and adapt abruptly to the unorthodox circumstances, trying to regain financial stability as quickly as possible, while ensuring the protection of their staff, in terms of both salary and sanitation. Ultimately, the first half of 2020 was difficult for players in the aviation industry, but recently, as flight numbers have slowly begun to rise, the recovery of the industry is gradually coming into fruition. There is also hope in the fact that air quality has improved over the global lockdown periods, and as the industry reopens itself and companies begin implementing their recovery methods, they may be able to incorporate more environmentally conscious processes into their plans, paving the way for an even more sustainable future in aviation.

Bibliography and Further Reading

1. Gardiner, B. (June 2020), '*Why Covid-19 will end up harming the environment*'. Available at: <https://www.nationalgeographic.com/science/2020/06/why-covid-19-will-end-up-harming-the-environment/> (Accessed: 2nd September 2020)
2. Lau, H., Khosrawipour, V., Kocbach, P., Mikolajczyk, A., Ichii, H., Zacharski, M., Bania, J. and Khosrawipour, T. (June 2020), '*The association between international and domestic air traffic and the coronavirus (COVID-19) outbreak*'. Available at: <https://www.sciencedirect.com/science/article/pii/S1684118220300864> (Accessed: 2nd September 2020)
3. Serrano, F., Kazda, A. (October 2020), '*The future of airport post COVID-19*'. Available at: <https://www.sciencedirect.com/science/article/pii/S0969699720304841> (Accessed 3rd September 2020)

References

1. Royal Aeronautical Society (April 2020), '*COVID-19: Impact on Airlines and the Future of Aviation - Corporate Partner Briefing by Chris Tarry*'. Available at: <https://www.youtube.com/watch?v=dq4PrV4ahvs> (Accessed: 15th August 2020)
2. ICAO (2020), '*Economic Impacts of COVID-19 on Civil Aviation*'. Available at: <https://www.icao.int/sustainability/Pages/Economic-Impacts-of-COVID-19.aspx> (Accessed: 19th August 2020)
3. Royal Aeronautical Society (May 2020)
4. Kotoky, A., Modi, M. and Turner, M. (July 2020), '*Jobs Are Being Wiped Out at Airlines, And There's Worse to Come*'. Available at: <https://www.bloomberg.com/news/articles/2020-07-23/400-000-jobs-lost-at-airlines-during-coronavirus-pandemic> (Accessed: 20th August 2020)
5. Wyman, O. (May 2020), '*Why Aerospace's Recovery From COVID-19 May Take Five Years*'. Available at: <https://www.forbes.com/sites/oliverwyman/2020/05/20/why-aerospace-recovery-from-covid-19-may-take-five-years/#6bd3222e3d94> (Accessed: 21st August 2020)
6. Sweney, M. (July 2020), '*Coronavirus: Heathrow boss says UK risks 'playing a game of quarantine roulette'*'. Available at: <https://www.theguardian.com/uk-news/2020/jul/29/heathrow-airport-boss-calls-for-passenger-coronavirus-tests> (Accessed: 21st August 2020)
7. Tovey, A. (August 2020), '*Heathrow 'to slash staff pay by up to a third' after collapse in air travel*'. Available at: <https://www.telegraph.co.uk/business/2020/08/12/heathrow-acting-greed-not-need-claim-s-union/> (Accessed: 22nd August 2020)
8. International Airport Review (August 2020), '*A third of Edinburgh Airport's workforce to be made redundant*'. Available at: <https://www.internationalairportreview.com/news/122391/edinburgh-airport-workforce-redundancies/> (Accessed: 23rd August 2020)
9. BBC News (August 2020), '*Coronavirus: Manchester Airport closes Terminal Two*'. Available at: <https://www.bbc.co.uk/news/uk-england-manchester-53866567> (Accessed: 23rd August 2020)
10. Air Transport Action Group (January 2020), '*Facts and Figures*'. Available at: <https://www.atag.org/facts-figures.html> (Accessed: 25th August 2020)
11. Zambrano-Monserrate, MA., Alejandra Ruano, M. and Sanchez-Alcalde, L. (April 2020), '*Indirect effects of COVID-19 on the environment*'. Available at:

<https://www.sciencedirect.com/science/article/pii/S0048969720323305> (Accessed: 25th August 2020)

12. Henriques, M. (March 2020), '*Will Covid-19 have a lasting impact on the environment?*'. Available at: <https://www.bbc.com/future/article/20200326-covid-19-the-impact-of-coronavirus-on-the-environment> (Accessed: 26th August 2020)
13. West of England Aerospace Forum (April 2020), '*WEAF Members Poeton Ltd Ramp Up Support For Medical Ventilators*'. Available at: <http://www.weaf.co.uk/news/weaf-members-poeton-ltd-ramp-up-support-for-medical-ventilators/> (Accessed: 30th August 2020)
14. Stewart, D. (July 2020), '*Supporting Welsh Manufacturing Through Lockdown to Recovery*'. Available at: <https://www.dropbox.com/s/3397tllmvxh8cmx/ASTUTE%202020%20-%20Supporting%20Welsh%20Manufacturing%20Through%20Lockdown%20to%20Recovery.pdf?dl=0> (Accessed: 30th August 2020)
15. Gilchrist, H. (July 2020), '*COVID-19 Crisis Causes Worst Quarter for Aircraft Deliveries on Record*'. Available at: <https://www.adsgroup.org.uk/news/newsroom/covid-19-crisis-causes-worst-quarter-for-aircraft-deliveries-on-record/> (Accessed: 30th August 2020)
16. Leggett, T. (June 2020), '*British Airways: A breakdown in trust?*'. Available at: <https://www.bbc.co.uk/news/business-53023563> (Accessed: 1st September 2020)
17. Partridge, J. (May 2020), '*EasyJet plans to cut up to 30% of staff as Covid-19 hits demand*'. Available at: <https://www.theguardian.com/business/2020/may/28/easyjet-plans-to-cut-up-to-30-per-cent-of-staff-because-of-covid-19-crisis> (Accessed: 1st September 2020)
18. Robinson, T. (May 2020), '*A V or U-shaped recovery?*'. Available at: <https://www.aerosociety.com/news/a-v-or-u-shaped-recovery/> (Accessed: 24th August 2020)
19. Wyman, O. (April 2020), '*How COVID-19 Is Transforming Global Aviation's Outlook*'. Available at: <https://www.forbes.com/sites/oliverwyman/2020/04/06/how-covid-19-is-transforming-global-aviations-outlook/#72356d661b9c> (Accessed: 24th August 2020)
20. PricewaterhouseCoopers (2020), '*COVID-19: What it means for the aerospace and defense industry*'. Available at: <https://www.pwc.com/us/en/library/covid-19/coronavirus-impacts-aerospace-and-defense.html> (Accessed: 24th August 2020)
21. IBS Software (2020), '*Aviation - A Roadmap to Recovery Infographic*'. Available at: <https://r2r.ibsplc.com/covid-19-recovery/aviation> (Accessed: 25th August 2020)

-
22. Royal Aeronautical Society (May 2020)
 23. PricewaterhouseCoopers (2020), '*COVID-19: What it means for the aerospace and defense industry*'. Available at: <https://www.pwc.com/us/en/library/covid-19/coronavirus-impacts-aerospace-and-defense.html> (Accessed: 24th August 2020)
 24. Robinson, J. (August 2020), '*Record Month For Aviation Company*'. Available at: <https://www.insidermedia.com/news/midlands/record-month-for-aviation-company> (Accessed: 25th August 2020)

Acknowledgements

I would like to thank my supervisor Amy Chau for her support, encouragement and advice throughout the undertaking of this research project, as well as The Nuffield Foundation for providing me with the opportunity to conduct my research.