THE REINVENTION OF AVIATION

Team Revelation

Meet Team Revelation

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What was your last air travel experience like?

TAKEAWAY

To recover from the disruption of Covid-19, the aviation industry must be reinvented.

NASA must focus on: **passenger satisfaction**, **sustainability**, and **collaboration**.

Overview

1. **Setting the Stage**
   The stability of the aviation industry before the pandemic
2. **Models**
   Current and future trends of the disruption in demand
3. **Literature Review**
   Develop an outlook for aviation sectors
4. **Recommendations**
   NASA's role in recovery & the path to reinvention
5. **Website Demo**
   Display of our website & additional resources for our work

Setting the Stage

Industry Pre Covid

- Prior to 2020, the industry was experiencing stable growth
- Although the industry went through devastating crises, it has always managed to recover

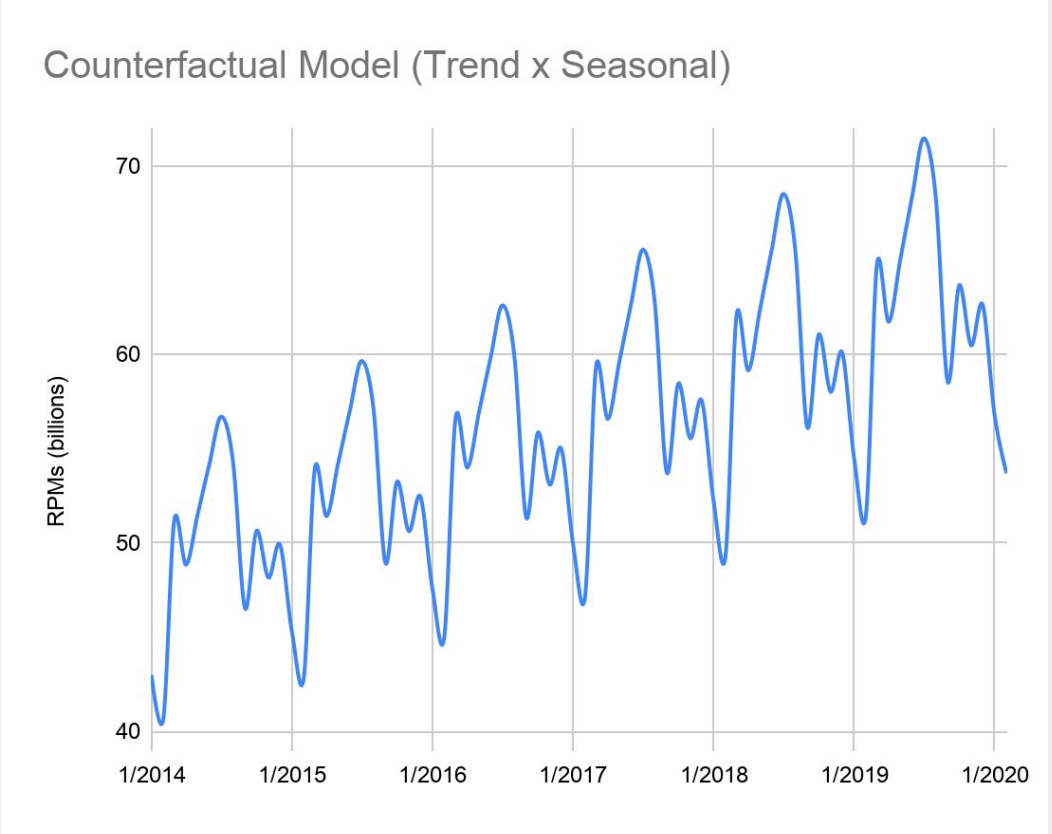
Models

Purpose

- To what extent did Covid-19 impact domestic air travel demand?
- What is the outlook for air travel in the coming months?
- To answer these questions, we developed a counterfactual statistical model and a predictive neural network model

Counterfactual Model

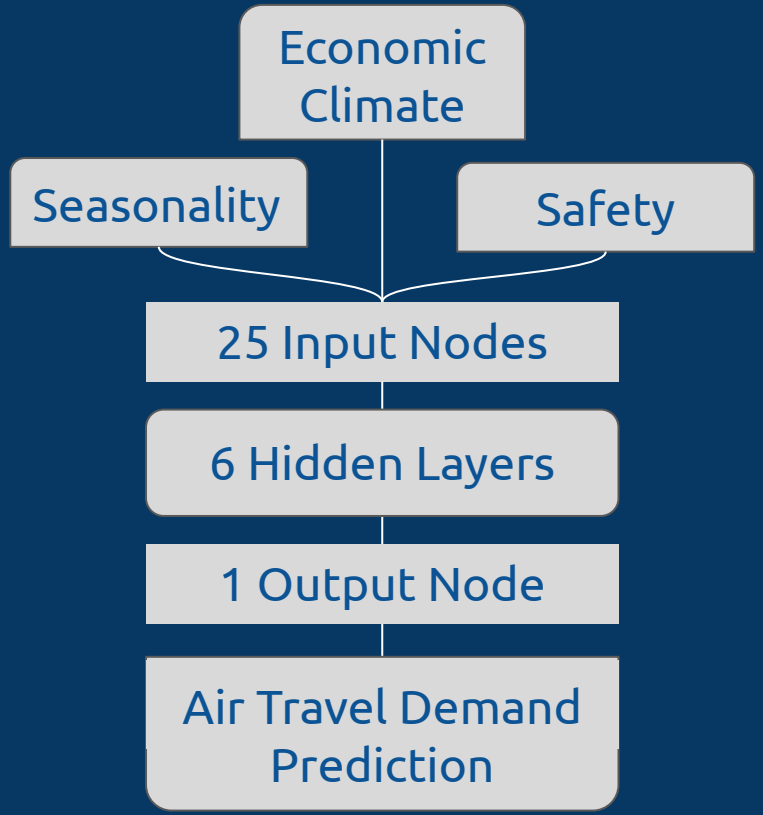
- ✈️ Multiplicative decomposition
- ✈️ Trend and seasonal components used to make predictions
- ✈️ Used as a reference



Predictive Model

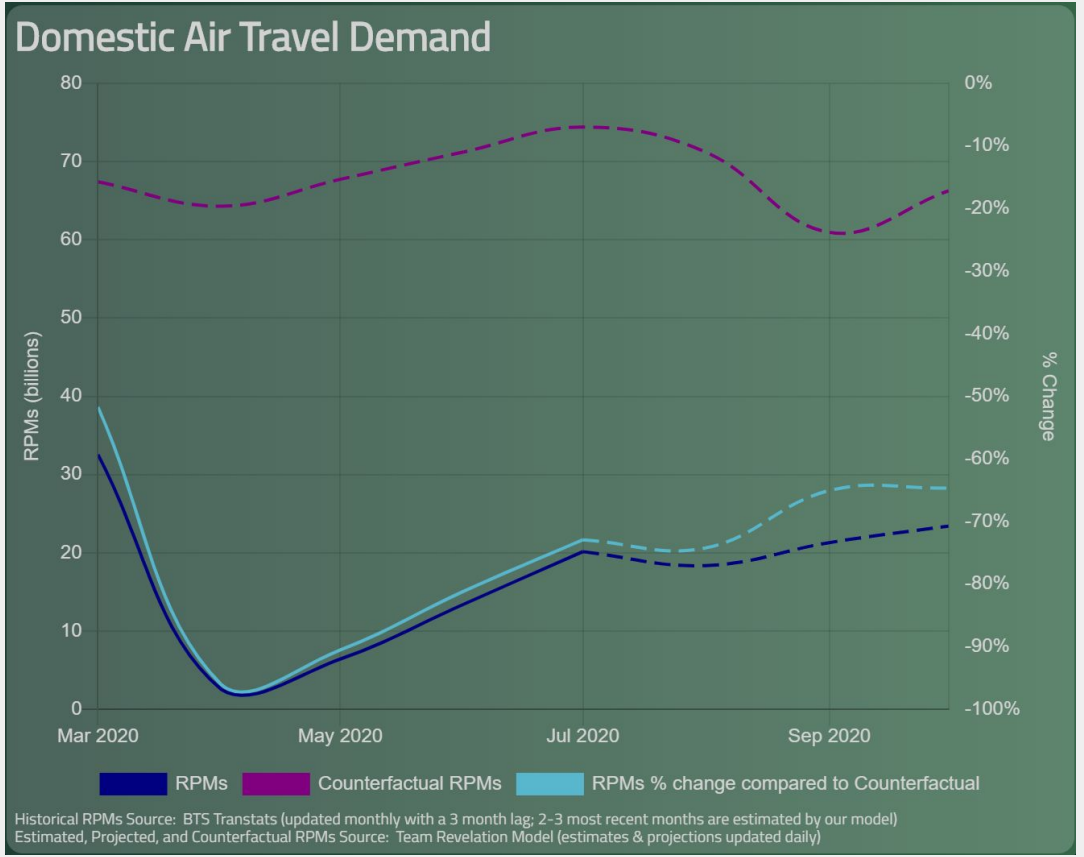
- Air travel demand can be predicted with 3 main factors
- Complex relationship can be learned with the neural network

Neural Network Overview



Results

- In April, air travel demand bottomed out at 4.0%
- Demand recovery disrupted by summer spike
- 35.2% recovery by October



Screenshot of Team Revelation Website

Sectors

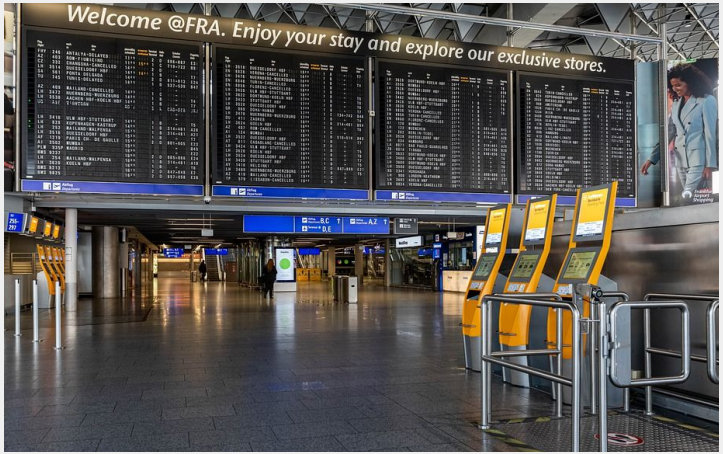
Passenger Travel

- Up until 2019, passenger travel demand flourished while the passenger experience suffered
  - Inefficient system
    - → Flight cancellations
    - → Excessive crowding
    - → Cramped flight seating
      - High load factor
    - → Overbooking

Source: Nanashinodensyaku

Passenger Travel

- Covid-19 has caused sweeping impacts on airlines
  - *Air travel is no longer seen as safe and trusted*
  - Plunge in demand
  - Huge losses of money

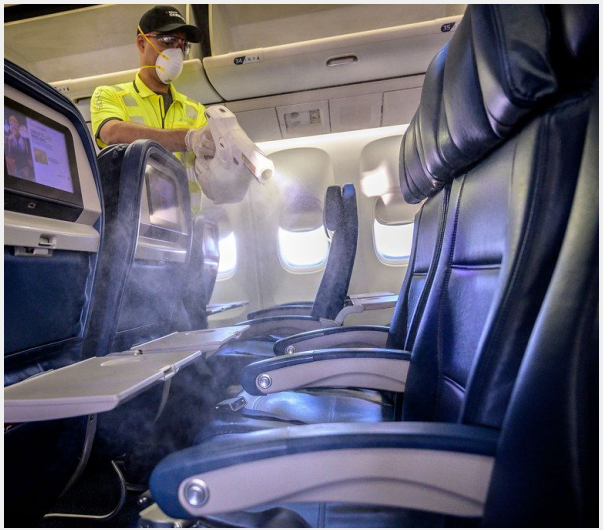


Source: Gerald Friedrich

Passenger Travel

- Systems have currently made small changes…
  - Social distancing on flights
  - Electromagnetic spraying
- *Need for new developments*

These changes must be expanded. Technological advances are needed to revive demand.



Source: Chris Rank

Air Freight

- E-commerce has surged
  - Shift towards online shopping and need for emergency deliveries

    → Rise in *“panic buying”*
  - Reconfiguration of passenger aircraft for freight
  - Opened a window for **UAM** to play a significant role

Source: Patrick Campanale

Urban Air Mobility (UAM)

- UAM was a new yet thriving industry with lots of predicted growth
- Autonomous Aerial Vehicles (AAVs) & delivery drone usage has increased during the pandemic
  - Growth in ecommerce
  - Drones could *replace* existing last-mile delivery services

Urban Air Mobility (UAM)

- ✈️ Public acceptance of UAM has grown
  - Past concerns: safety and autonomy
- ✈️ Work is still needed to be done
  - UAM needs to be safe, comfortable, & affordable

Source: NASA

Commercial Aircraft Manufacturing

- Aviation manufacturing was in state of decline prior to 2020
  - Boeing 737 MAX grounding
    - → Careless innovation
    - → What needs to change?
  - Manufacturing levels expected to grow in 2020

Source: Bruce Englehardt

Commercial Aircraft Manufacturing

- Pandemic has intensified problems from before
  - Production rates further reduced and paused
- Wide-body aircraft are being retired
- Market for commercial aircraft will look different
  - **Industry needs to reinvent itself**

    → Innovation process needs to change for safer flights

National Airspace System Infrastructure

- COVID-19 effects on the NAS (National Airspace System)
  - Airports have lost more than 50% of passenger traffic, over 97 billion dollars
  - 41.3% flight cancellation rate in April
  - 750, 000 people are employed by the industry

Source: Dominic Hart

National Airspace System Infrastructure

- CARES act will fund airports
  - Better safety
  - Infrastructure improvements
- NextGen
  - FAA's pursuit in modernizing the NAS
  - More efficient and safe
- NASA System-Wide Safety (SWS)
  - Research towards advanced aviation system, technology, automation and strategies that will assure safety in the industry

Environment

Aviation has an enormous environmental impact

- Contributes to climate change and harms human health
- Global aviation produced 915 million metric tons of CO2 in 2019 → equivalent to driving 200 million passenger vehicles
- Growing overall operations and little improvement in sustainability
- Various goals relating to: aircraft noise, air quality, energy use, and water quality

Environment

Severity of the problem:

- UN declared that the globe has 10 years before the effects of climate change are irreversible
- The industry is on track to triple its emissions by 2050
- Large anticipated increase in overall aviation operations due to UAM

The future of aviation is *sustainable* aviation.

OVERALL,

The effects of Covid-19 on aviation are widespread and persistent.

But they have created a unique opportunity for change.

Instead of returning to its former state, the industry must pave a path towards **reinvention** - the only way to ensure *lasting* recovery.

Recommendations

Recommendations

NASA must take significant action to support the reinvention of aviation, accelerating innovation in:

Sustainability and **Passenger Satisfaction**,

and increasing **Collaboration** to ensure the prompt *reinvention*.

Recommendations - Sustainability

NASA must “transition to zero carbon propulsion”.

Consideration of sustainability across all projects and programs

Develop both *evolutionary* and *revolutionary* aircraft, plus operational changes.

Source: NASA

Source: NASA

Recommendations - Passenger Satisfaction

Fast and convenient technologies geared towards **efficiency** will shorten flight lengths and improve system issues, benefiting **passenger experience**.

These technologies are useless without carefully planned systems of integration that allow them to function in the real world.

Sustainable supersonic aircraft are the future.

Recommendations - Passenger Satisfaction

Air travel is seen as a *threat* to safety. For this to change, a *shift* to non-contact, automated technologies is **crucial**.

In light of Covid-19, NASA has been working with hospitals to develop technologies that address the dangerous virus.

NASA must similarly **collaborate** to develop technologies for airlines that mitigate health risks, ensuring **safety**.

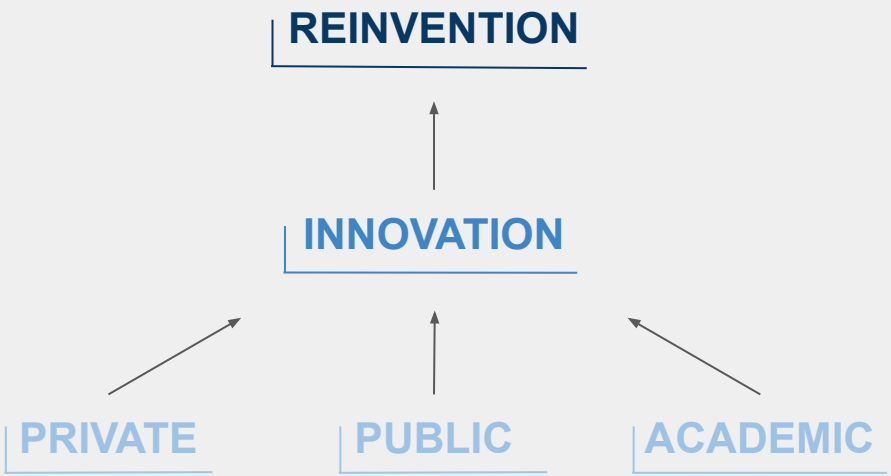
Recommendations - Collaboration

Industry reinvention is difficult. How do we get there?

"All hands on deck" mindset:

NASA must provide a **platform** for a variety of different partners (traditional and non-traditional) to **innovate.**

Recommendations - Collaboration



Recommendations - Collaboration

The innovation cycle of aviation is notoriously slow, and must be **accelerated**.

This is crucial in reinventing the industry. However, it must be done *responsibly*.

IN CONCLUSION,

Reinvention not regression.

NASA must pave the way for **innovation**, and focus on:

Passenger Satisfaction, Sustainability, and **Collaboration**

Website

Thank You!

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Questions?