INTERVIEW(S):

1) Sherwin Lam, NS Air Force Technician, and SIA Intern

- 1. How long have you been working in the airline industry? Describe briefly the day-to-day activities and any experiences with airline delays.
    - I was an air force technician with the F15 during my NS days, and I also interned with Singapore Airlines Cargo Hub Operations Department for 3 months. Unfortunately, I can't go into much detail about the RSAF operations but with regard to the SIA job, I was involved in the tracking of container movements and also got to observe day-to-day cargo flight operations. I also helped track Service Level Agreement standards between SATS and SIA, part of which involved organizing delay reasons, and also helped come up with delay code mappings for a new collaboration between SIA and DHL.
    - Elaboration:
        - Service level agreements (SLA) are kind of like a contract between the companies, so SATS handles the cargo movement for most of SIA cargo, and they have certain standards/kpis to hit in the SLA, and if they fail to hit they will be paid less or if they exceed expectations they get a bonus for e.g. can't go into details but its essentially smth like that ah, so what i did was I helped to track cases of mishandling of cargo, some of which included cases where the cargo was delivered late or prepared late for a flight resulting in a delay
        - Delay codes are used by airlines as a way to report and track delays, so when a delay occurs, the operator will assign and have to decide on a reason for the delay, and assign a particular code to it to log it in their systems
        - The thing is different airlines/operators (so in this case SIA/DHL) and also IATA which is like the international aviation authority have different codes so as part of the collaboration I had to help kinda coordinate our diff codes and make sure there was a corresponding one for each code across the parties that was agreed on prior to the partnership
- 2. During your time working in the airline industry, what are a few of the most common factors that cause arrival or departure delays? How do these factors impact delays and if possible, how do the factors mentioned rank in terms of how much they affect delays?
    - Common factors are maintenance-related issues, airport congestion, and also late arrival of cargo. I would say maintenance affects delays the most (by hours) because most of the time fixing the issues can take very long whereas the other 2 factors typically cause fewer delays (by minutes).
- 3. Have you ever encountered any event(s) during your work in the airline industry where it is difficult to make a landing or departing decision? Why?
    - Unfortunately, this was out of my job scope so I can't really answer!

- 4. How severe or costly can every minute of an airline delay be? What were some of the consequences(e.g. Loss of resources, money, negative sentiments among passengers, etc)?
    - It's hard to put a numerical cost, but a common severe consequence is passengers missing connecting flights due to delays, and such issues can snowball into many extra costs/compensations.
- 5. Are there any kind of visualizations that you may find useful in understanding the impact of different factors of delays and why?
    - Probably visualization 2 (heatmap)? Can help to see which are the peak delay periods and airports/airlines can work to see if their long-term scheduling can be better to avoid this while still achieving efficient returns.
- 6. Which are the visualization(s) that you think may not be as useful in understanding airline delays and why?
    - Visualization 1 (Map with flight paths for visualizing cascading delays) will probably be way too dense to visualize data properly due to the large number of flights every day.
- 7. Is it alright for us to contact you again if we have follow-up questions?
    - Yup please feel free!

2) Liau Zhiying, role:

- 1. How long have you been working in the airline industry? Describe briefly the day-to-day activities and any experiences with airline delays.
    - 2 years as an ATC. An ATC provides inflight control for flying operations and ensures safe and expeditious launch and recovery of aircraft. We are also responsible for the aerodrome standards and ensure that the aerodrome conforms to international standards. Some other responsibilities also include the management of wildlife and birds within the aerodrome.
- 2. During your time working in the airline industry, what are a few of the most common factors that cause arrival or departure delays? How do these factors impact delays and if possible, how do the factors mentioned rank in terms of how much they affect delays?
    - There are various factors, the more common ones I believe are due to adverse weather, routings (did not obtain the necessary diplomatic clearances), and aircraft issues. The factors are ranked according to the sequence stated. 1) Adverse Weather – one of the main issues as it involves the conditions of an airport as well, if the weather isn't deemed satisfactory for landing/taking off, the wait could be unknown at times depending on when the weather clears up else there would be a risk of turn back/diverting to alternate aerodrome/airport after aircraft departed which isn't ideal. Bad weather also means poor visibility which affects the safety of aircrew. 2) Clearances are required to enter a specific point in air matters too and must be obtained prior to flight taking off. It's equivalent to a "passport" context. The no. of aircraft in the air in the same area could affect too as ATC would need to deconflict the routings of aircraft. 3) Aircraft issues – aircraft would require certain maintenance

and would be unable to take off immediately. Either there will be a change in aircraft, or you'll have to delay the flight.

- 3. Have you ever encountered any event(s) during your work in the airline industry where it is difficult to make a landing or departing decision? Why?
    - Not for myself so far. It is not difficult to make a decision because protocol, procedures, and criteria are there for us to follow if we are aware and stick to fundamentals, we will be able to decide the safest approach to take. One of the skills required of an ATC is the ability to make efficient decisions on the spot.
- 4. How severe or costly can every minute of an airline delay be? What were some of the consequences(e.g. Loss of resources, money, negative sentiments among passengers, etc)?
    - I'm not in the best position to answer this as I'm not on the civil side of ATC so unable to provide the best inputs for airline-related matters haha. But personally, I feel that it would be monetary and psychological (customers would lose faith somehow or another because of a delay and there are compensations to relieve such customer's unhappiness would come in) aspects.
- 5. Are there any kind of visualizations that you may find useful in understanding the impact of different factors of delays and why?
    - Visualizations 1 and 5 look good. Although I feel that Visualisaon 1 would not come off as intuitive at first look.
- 6. Which are the visualization(s) that you think may not be as useful in understanding airline delays and why?
    - Missing
- 7. Is it alright for us to contact you again if we have follow-up questions?
    - Yes sure.

ADDITIONAL RESEARCH:

1) Day in the life of air traffic control in Brisbane airport:

Details:

- Air traffic control is in charge of the safety and the orderly flow of aircraft.
- Types of ATCs:
    - En-route controller:
        - Look after aircraft that are cruising.
        - Assign descent to aircraft from 40,000 ft to 19,000 ft before handing them to the approach controller.
    - Approach controller:
        - Look after arriving and departing aircraft within 30 miles radius of the airport.
        - Hands over to tower controller.
    - Tower controller:
        - Look after aircraft concerning the runways

2) How air traffic control works, at Heathrow, Britain's busiest airport:

TLDR;:

- The flight of every single aircraft can be very complex and have many external factors that could affect the flight duration and hence delays.
- External factors such as strikes, shortage of ATCs can have very significant impact on delays of airlines.
    - Could potentially use to look into anomalous peak delays on non holiday periods where little delay is usually expected instead.

Details:

- Using a 90 minutes flight from London, Heathrow to Frankfurt as an example.
    - Hours before departure, British airways first send the flight plan to Eurocontrol's Network Manager Operations Centre in Brussels for them to ensure that the flight plan follows pre-defined airways/directions/routes and the rules of the roads. (Eurocontrol: An international organization working to achieve safe and seamless air traffic management across Europe.) If a flight plan is not up to standard, it will have to be fixed, and the new flight plan will be distributed to all air traffic control centers that each aircraft is expected to fly over.

    - If everything goes well, the plane is fueled, loaded, and ready to go. The pilot gets approval from British Airways' flight dispatcher and Heathrow's ground control to push back.

    - Ground control: Responsible for navigating all aircraft until the runway before handing over to tower control.

    - Tower control: Responsible to clear aircraft for take-off and after reaching altitude, hands it over to London Terminal Control Centre (LTCC) who navigates aircraft through the complex London-area airspace until it reaches about 24,500 ft/ flight level 245 and hands it over to London Area Control Centre (LACC).

    - LACC: navigate aircraft across the channel.

    - After about halfway, the aircraft leaves UK's airspace, enters Belgium's airspace, and is handed over to Maastricht Upper Area Control, also managed by Eurocontrol. Maastricht Upper Area Control handles 5000-5700 aircraft movements per day for aircraft at flight levels between 245- 660.

    - Large airspace is split into sector groups which can be further split into sectors, with a set of controllers in each sector to look after flights flying over their sector.

    - As the plane starts to descend, it is handed over to controllers for lower airspace, approach, and tower control to guide the landing in Frankfurt.

- ATCs handle a limited number of flights and there are a limited number of ATCs.
    - When there's a shortage of ATCs and an increase in flights, supply-demand issues. E.g. In 2018, 60% of en-route delays were due to a lack of ATC capacity. Often, in order to reduce overall delays, flights are delayed.

- Thursday, May 9th, 2019, French ATC strike -> Lack of ATC capacity over French airspace -> Many flights affected are delayed or need to change routes, etc. Communications needed to make with many other surrounding countries to try to increase ATC capacity before the strike news was confirmed. Additionally, on the same day, drones were spotted above Frankfurt airport which caused all arrivals and departures to be stopped. Contacting surrounding airports was needed to understand live traffic and where to land the many affected aircraft. Total 300,000 minutes delay (theoretically 1mil, but thanks to Eurocontrol).

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3) Do you know what causes flight delays?:

Some factors of flight delays:

- Weather (external):
    - Technological advancement allows aircraft to operate in increasingly bad weather but there is a limit on the severity of weather in which aircraft can operate in safely.

- Defects (internal/ external?):
    - A defect that could compromise safety needs to be fixed or worse, replacement aircraft is required.
- Baggage handling delays (internal/ external?):
    - Pilots may help to reduce the delay by flying higher to utilize higher wind speeds in higher altitudes, change routes, etc when possible

4) Flight delays: the causes and solutions, by Eurocontrol (2017):

About air traffic flow management delays

Some details:

- In the previous year, on average every flight had 1.5 mins of delay but about 8 percent of flights would have significant delays of more than 10 minutes.
    - Problem: If the same aircraft have successive 10 mins delay from city to city, delays would build up, very bad for passengers and airlines.
- 8-9 years ago very bad delays
- The economic downturn in 2009/2010 -> fewer flights

Causes:

- Bad weather on the ground/air/etc: Can reduce the capacity of the airport …
- Over demand during peak holiday periods
- The capacity of ATCs exceeded by demand
    - Delays are needed to manage the capacity

Solutions:

- Air traffic control centers/organizations improving equipment, recruiting ATCs.
- At Eurocontrol, have an excellent view of the whole intricate and complex European network of airlines -> see constraints and opportunities -> help individual flights lead their schedules.