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# Airline disruption management: yesterday, today and tomorrow

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**Abstract**

Adverse weather conditions, strikes, political reasons and other different causes can impact the long-term success of an airline. An effective Disruption Management System can predict the occurrence of these events and assist by reducing the impact on the operations. The paper offers an overview on what is considered a disruption for airlines and analyses the state-of-the-practice of airline operation control centers. Traditionally, Operations Control Centers (OCCs) are mainly composed by aircraft dispatchers, maintenance operators, and other operational personnel. Currently, there is a tendency to integrate into this control centers other departments critical for the decision making, such as commercial department, social media, ground operations, etc. However, we propose an analysis of what other data is required to provide fact-based decisions during Irregular Operations (IROPS). The need for implementing these decisions, requires a promptly access to real time data by frontline and operational staff. The paper also offers an understanding of this required data. Furthermore, one of the indicator to measure the long-term success of an airline is the number of passenger flown by year and their engagement to continue flying with the airline in the future. This aspect is not always considered during disruption, therefore decisions are taken based on previous operational experience without considering real long-term impact on value of passengers. The paper explores some of the solutions to personalize passenger preferences in case of disruptions. Specifically, we look into self-serve options to provide the passenger with the sense of control of the situation. Lastly, the complexity of Disruption Management in airlines is motivated by the lack of resources (aircraft, crew, etc.) and limited transportation options. An assessment is conducted on the Meta-CDM project which incorporates rails and buses as an alternate mode of transportation.


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*Keywords:* Disruption Management, Irregular Operations, passenger-centric, Meta-CDM, Operational Control Centers.

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## 1. Understanding disruptions

'Flight disruption' is defined[2] as 'situations where a scheduled flight is cancelled, or delayed for two hours or more, within 48 hours of the original scheduled departure time'. Disruptions in aviation cost airlines and their customers up to $60 billion per year, or about 8% of worldwide airline revenue according to Amadeus (2016). As of today, these disruptions are far away to be solved due to quasipredicatbility of the incidents (airport constrains, weather, etc.). Therefore, decisions need to be taken to close the gap between the uncertainty of these incidents and the scheduled plan.

The small window for error in the flight schedules can cause disruptions to have multiple delays propagated further down in the flight schedule. Understanding these events (predictability, duration and impact) is the key step in the disruption management process. Table 1 shows a list of incidents according to its predictability, the main elements disrupted and its propagation along the network.

*Table 1: List of incidents and associated variables that might impact the aviation sector.*

| | Predictability (**N**one, **H**ours, **D**ays, **M**onths, **Y**ears) | | | | | Element/s disrupted (**Gr**ound **Tr**ansport, **Air**space, **Rw**ay/**Tx**i**w**ay, **Thr**oughput, absence **sta**ff, I**T** systems, ) | | | | | | Propagation (Single/multiple airports) and estimated recovery time | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | H | D | M | Y | Gr Tr | Air | Rwy/ Twy | Thr | Sta | IT | Sing. | Mult. |
| **Accidents/incidents** | | | | | | | | | | | | | |
| Crashes | x | | | | | | | x | | | | h-d | |
| Ac technical | x | x | | | | | x | | | | | h | |
| Aircraft manoeuvring incidents | x | | | | | | | x | | | | h | |
| Gr. Tr. Disruption | x | | | | | x | | | | x | | h | |
| Safety related groundings | x | | | | | | | | | | | | d-m |
| **Capacity constraints** | x | x | x | | | | x | x | x | | | | |
| **Disease** (Pandemics) | | x | x | | | | | | x | | | | d-m |
| **Financial** Airline/ tour operator collapse) | x | x | x | | | | | | | | | | d-m |
| **Geology** | | | | | | | | | | | | | |
| Volcano Ash | | x | x | | | | x | | | | | | d-w |
| Earthquake | x | | | | | x | | x | | | | h-w | |
| Tsunami | x | x | | | | x | | x | | | | h-w | h-w |
| **IT systems** | x | | | | | | | | | | x | h-d | |
| **Infrastructure upgrades** | | | | x | x | | | x | x | | | h-m | |
| **Major events** (Christmas, Olympics, etc.) | | | | | x | | | | x | | | | d-m |
| **Security** | | | | | | | | | | | | | |
| Security alerts | x | | | | | | | | x | | | h-m | |
| Terrorist attacks | x | | | | | | | | | | | h-m | |
| Cyber attack | x | | | | | | | | | | x | h-d | |

[2] Airport Council International (ACI) (March 2013), Passenger protection under cases of flight disruption. Worldwide Air Transport Conference (ATCONF). Montreal, Canada.

| | Predictability (**N**one, **H**ours, **D**ays, **M**onths, **Y**ears) | | | | | Element/s disrupted (**Gr**ound **Tr**ansport, **Airs**pace, **Ru**n**way**/**Tax**i**way**, **Thr**oughput, absence **sta**ff, **IT** systems, ) | | | | | | Propagation (Single/multiple airports) and estimated recovery time | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | N | H | D | M | Y | Gr Tr | Air | Rwy/ Twy | Thr | Sta | IT | Sing. | Mult. |
| War/unrest | x | x | x | x | | x | x | | | | | d-y | |
| **Strikes** | | | | | | | | | | | | | |
| Airport staff | x | x | x | x | | | | | x | x | | h-m | |
| ATC | x | x | x | x | | | | | x | x | | | h-d |
| Airline staff | x | x | x | x | | | | | x | x | | | h-d |
| **Weather** | | | | | | | | | | | | | |
| Snow & icing | | x | x | | | x | | x | | | | | H-D |
| Fog | | x | x | | | | | | x | | | | H |
| Convective | | x | x | | | | x | | | | | | h |
| Strong winds | | | x | | | x | x | | | | | | h-d |
| Thunderstorm | | x | | | | x | x | | | | | h | |
| Flooding | | x | x | | | x | | x | | | | h-d | |
| Sandstorms | | x | x | | | x | | x | | | | | h-d |

Source: authors

## 2. How airlines manage disruptions

### *2.1. Disruption management process and phases*

A disruption can be divided into three phases: 1. the emergency/response phase is the moment when an event impacts the planned schedule (e.g. an aircraft skid off a single runway airport causing to close the entire airport operations). This phase focuses in the humanitarian response and passengers who are not directly involved in the incident or accident are not, at this stage, impacted. As the event continues, delays and cancellations disrupt other passengers. At this moment, the continuity phase commences, when, at least, the minimum level of service and/or products that is acceptable to the organization to achieve its business objective is delivered (also known as the Minimum Business Continuity Objectives (MBCO)). During this time, the two main objectives are to provide the duty of care to passengers and to remove the element that caused the disruption initially. Specifically, airlines operators rebook passengers during this phase, aiming to reduce their delays on their trips plans. Last phase is the recovery phase that starts at the end of the continuity phase and lasts until normal service is restored.

When one of these events occurs, the airline's personnel in the Operations Control Centre (OCC) reacts immediately aiming to resolve the situation in a promptly and cost-efficient manner. The disruption management process is carried out by operators at the OCC that firstly formulate the problem qualifying it in terms of resolution time, passengers impacted, delay propagation through the network and others. Secondly, different options to resolve the situation are listed and ranked. And lastly, the most suitable solution is implemented.

### *2.2. Control centers roles during disruptions*

The OCC team's objective is to monitor the operations, and continually manage unplanned situations by implementing control measures. The prominence of the Operations Control Centre (OCC) in airlines structure has

increased during the last years. As the number of passengers carried continues growing by 6-7 % per year[3] and the regulations to protect passengers rights are also strengthen, airlines operators are forced to evolve. Some authors suggested amendments to the training syllabus of the ICAO´s Flight Operations Officers/Flight Dispatchers Training Manual, Part D-3 of document 7192 aiming to cope with the required 'operational excellency'. As suggested by Pazourek (2013) it is necessary to enhance the Human Factor chapter by adding three new parts: 1. - Advanced time management skills, 2. – Advanced stress management skills and 3. – Advanced decision making principles. As well, he also considered that a complete new chapter of economics should be added and an amendment to the chapter of security with the addition of "Security associated risks".

With the purpose to enhance the decision-making process, multiple airlines (e.g. China Eastern 2015, Air France 2007) created a two tiers command and control structure, the Network Operations Center (NCC) or OCC and the Hub Control Center (HCC). In this structure, the HCC is responsible of the Hub's operations, and subsequently they manage only situations at the Hub. HCC acts as an "attention-to-detail" Control Center managing aircraft turn-around activities, passenger connections and terminal operations among others. Once a disruption occurs at hub level, HCC has an agreed window that they can use to resolve the disruption and return to the planned schedule. If the controllers foresee that the disruption will exceed the agreed time, HCC informs OCC of the possible impact to the network operations. OCC at this time, takes the lead, and decides what the actions to be taken will be considering the network perspective.

Due to the criticality of the decisions taken by either OCC or HCC, a well-defined decision-making framework and data integration systems are required. Usually, OCC does not have access to the detailed information of the processes occurring at the airport that HCC has, yet they continuously interact with one another.

During past years multiple airlines (American Airlines 2015, Qatar Airways 2015, etc.) started to build a so called Integrated Operations Center (IOC). IOC is seen as the transition from department-focused decision-making to company-focused decision-making. This is the result of incorporating to the OCCs, life information and decision makers from catering, ground handlers, maintenance, social media, data analysis, revenue management, etc. With this, real-time decisions are based on suggestions from the most important departments. The output is that IOC and its participants have real authority to make and implement operational decisions, expediting the implementation of solutions.

## 3. Passenger centric Disruption Management and Multimodality Recovery: Understanding passengers needs during IROPS

Today, disruptions are managed from an airline and airport point of view. Airlines, logically, look for the "lesser of two evils" solution during Irregular Operations (IROPS): from a network's point of view, the operators at OCC will choose the solutions that less impacts the network's level, even highly impacting certain flights at a local level.

For a customer, a disruption corresponds to any change to the itinerary planned or the vacation package purchased. In a time when personalization is paramount, airlines are considering only the big picture in terms of disruptions but the aviation business, in general, continue categorizing passenger under two main groups: business and leisure. With this simplification, the purpose of personalizing the recovery processes ends, as the objective of the passenger travelling is unknown. So, going to the obvious, a passenger traveling to visit his/her family member who is at the hospital will be considered under which category? For example, after a flight cancellation; is he/she going to be rebooked before or after a passenger who pays double for his/her ticket? As of now, the answer is not always the same as there are airlines that value passengers according to his/her ticket price but there are some who consider other variables such as the Customer Lifetime Value (CLV).

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[3] International Civil Aviation Organization (ICAO) (2016). Air Transport Yearly Monitor [Online] Available: https://www.icao.int/sustainability/Documents/Yearly%20Monitor/YearlyMonitor_2016.pdf

As explained by Asinovski (2016), the value of a passenger should not be based on his/her current ticket but on his/her future willingness to fly with the airline. In parallel with the statement of Cook et al. (2009) after a delay, the propensity (Pi) of a passenger to switch from a given airline to other choice can be expressed with the familiar "S" curve as shown in Figure 1.

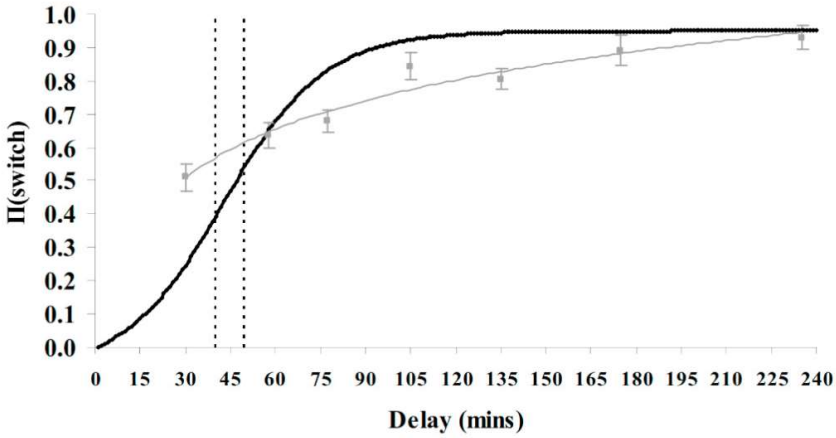


*Figure 1: Switching propensity by delay duration. Source: Adapted from 'The hidden cost of airline unpunctuality' by Cook et al. (2009.*

Airlines have to meet penalties and compensations as a result of delays, cancelation or tarmac delays. All this unplanned penalties cause airlines to increase their ticket fares to cope with this readjustment. As demonstrated by Britto et al. (2012) flight delays lead airlines to increase their fares to cover the costs of the disruption. At the end, as explained by Zou, B., & Hansen, M., (2012) after experiencing delays with an airline, the passengers' willingness to pay for air travel with an increase of air fares, decreases.

### *3.1. Airlines shall go personal: identifying passenger objectives*

It was recently highlighted by Boutin et al. (2016) that: "Airlines need to get personal with their customers". Personalization is a powerful tool that helps to build strong customer loyalty rooted in a customized experience. In a customer-centric approach, airlines understand each customers' needs from the airline, which is translated into a complete customer profiling by sharing data across the main travel partners: hotels, rental cars, ground transportation, etc.

This customization is only possible, from the authors' perspective, if airlines incorporate new data to assist passengers during disruption by:

1. Firstly, identifying the **Passenger Main Trip Event (PMTE)**: the main reason for which the passenger is flying.
2. Secondly, define a new time to be incorporated in the passenger persona data: **Passenger Event Time (PET)**: the time when the PMTE starts.
3. **Understand passenger needs** during **IROPS,** according to passenger types**.**
4. Define and offer to **passengers** the **recovery options** (rebooking, hotel accommodations, etc.) for their approval

5. **Implement** the **solution**

*3.2. Passenger necessities during disruptions*

During the continuity phase of the disruptions is highly important to understand what passengers need, and how to provide it. At this stage, we are in the position to categorize passengers according to their requirements during disruptions. According to Marzuoli et at., (2013) there are 2 passenger's categories: Empowered and guided travellers. From our experience, these 2 types become 4 : **dependant** (1. - Requiring or, 2. not to manage their trip plans) and **self-served** (3.- requiring or, 4.- not to manage their trip plans).

The **dependant passengers** need face-to-face contact to resolve a situation. For these passengers, employees continue playing a key role in the customer service. On the other side, **self-served passengers** can take actions on their own, only requiring the right data at the right time on their mobile-phones. This category of passengers look for less human interaction, as they consider that they can go faster through the different airport and airlines processes by themselves, than assisted by a person. Additionally, the self-served option provides them with the sense of control of their actions that they do not have when they are "managed" by a staff member. A great example is self-served passport controls. For clarity to differentiate the two categories, during a flight cancelation, the dependant passenger will require to approach the check-in desk or call the airline, while the self-served passengers will be able by him/herself to rebook his/her own flight.

The variable that makes the two big categories: dependant or self-served to become four is their necessity from the passengers to manage or not their trip plans. Airlines need to think beyond their own segment of the travel industry, if a flight is delayed, for example: Can the airline communicate with the customer's hotel and ride service (such as Uber or Lyft) ?, In that way, appropriate arrangements can be made ahead of time. They have multiple opportunities to work with other companies to personalize service across the customer's travel experience.

It is important to remark that as a passenger you are not always under the same class. As an example, a passenger can be very familiar with delays, but does not know how to react when his/her plane is diverted. As a result, airlines and airports cannot presuppose that self-served passenger will never require staff assistance

*3.3. Intermodal transportation as a suggested recovery solution during airline disruptions*

Intermodal transportation is seem as one of the desired recovery solutions for airline disruption management. It takes special relevance in events that constrains the airspace partially or totally. As we might remember, during April and May 2010, more than 8.5 million passengers were stranded due to the eruption of the Icelandic volcano Eyjafjallajökull. As expressed by Alexander (2013) the situation was stressed due to the lack of integration between airports and others modes of transportation that could have assisted to rebook passengers, and accordingly reduce the overall delays.

Today, a faster and seamless transport is linked with a high standard of living. The European Union is constantly looking at ways to improve mobility, and one way to do this is by integrating different transport modes. In its vision for Europe in 2050, the European Commission sets the following goal: "90% of travellers within Europe are able to complete their journey, door-to-door within 4 hours. Passengers and freight are able to transfer seamlessly between transport modes to reach the final destination smoothly, predictably and on-time."[4].

[4] European Commission (2011) Flightpath 2050 Europe's Vision for Aviation. Report of the High Level Group on Aviation Research. [Online] pp. 11. Available: https://ec.europa.eu/transport/sites/transport/files/modes/air/doc/flightpath2050.pdf

It is widely admitted that flights lasting less than one hour could be advantageously replaced by ground transportation, such as rail. Multimodality is slowly becoming a reality, at least within the European transportation system. Some European airlines[5] already offer origin-destination fares that are using rail transportation for some of the passenger journey.

Real-time intermodality includes the substitution of flights by surface vehicle trips and, when the hub is part of a regional airport system, the use of inter-airport ground transport to enable diversion of flights to alternate hubs. As described by Y. Zhang and M. Hansen (2008) it is possible to reduce impact to passengers by enhancing intermodal transportation.

One of the case studies developed by Marzouli et al. (2015), focuses on the impact of the Asiana crash and highlighted how the multimodal reaccommodation of diverted passengers via bus services could have decreased the delays of the affected passengers as shown in Figure 2.

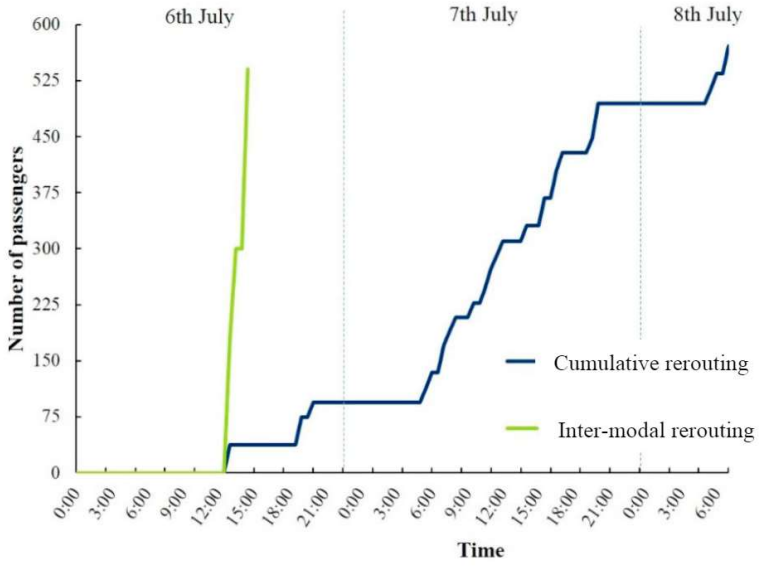


*Figure 2: Comparison of multimodal reaccommodation with reaccommodation of passengers on later flights, regardless of the airline. Source: Adapted from 'Air Transportation and Multimodal, Collaborative Decision Making during adverse events' by Marzuoli et al. (2015)*

An interesting approach is the use of virtual hubs. As suggested by Karow, M. (2003), by shifting part of the operations from a hub airport suffering irregular operations to an under-utilized airport, her results indicated that "significant passenger delays are reduced 94% and flight cancellations are reduced by 15% when a virtual hub is implemented".

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[5] http://www.lufthansa.com/de/de/Lufthansa-Express-Rail-Fly;
http://ww.airfrance.fi/FI/en/common/resainfovol/avion_train/reservation_avion_train_strasbourg_airfrance.htm

## 4. Conclusion and further research

Incidents impacting the flight schedule will never have the required grade of predictability to allow OCCs controller proactively implement control measures that completely remove delays and cancellations. Thus, operation controllers will continuously be required to take and implement decisions during IROPS.

At this stage, the problem presented in this paper is based on literature review and it provides a guideline for future research. Our work will aim towards proposing a passenger-centric disruption management framework. For this, a research will be conducted supported by interviews to passengers and OCCs controllers. Additionally, it is the wish of these authors to develop the Concept of Operations (CONOPS) of a platform and an Integrated Multimodal and Multiairline Operations Center (IMMOC) that assist airlines to manage disruptions in an integrated and multimodal way.

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