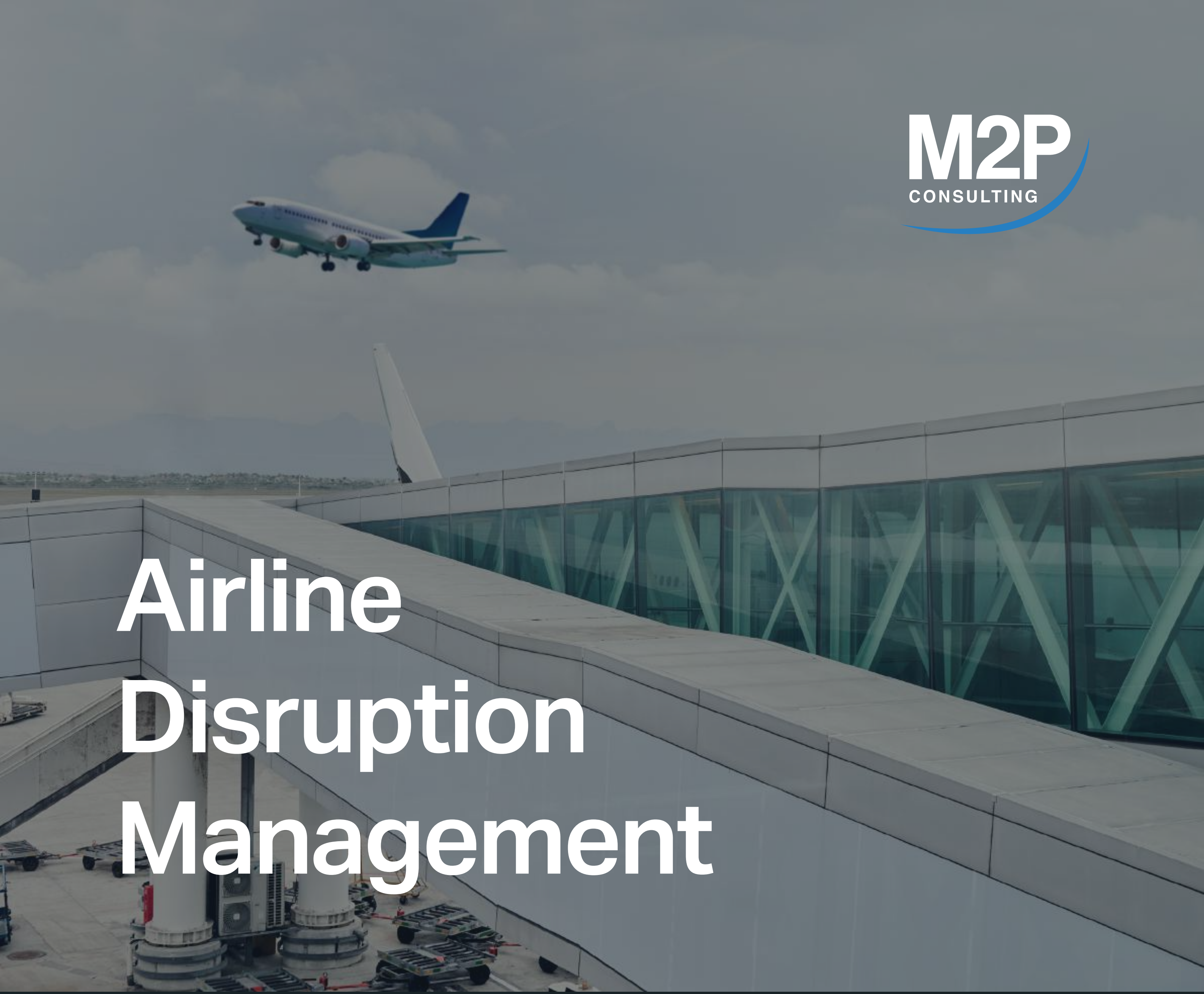

Airline Disruption Management

Whitepaper 2024

Proactive Solutions for Airline Disruption Management: Leveraging Technology to Transform Disruption Handling and Optimize Customer Experience

M2P Consulting

www.m2p.net

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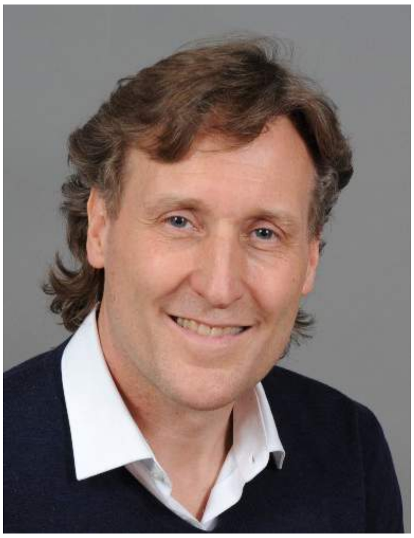
Welcome to the future of aviation optimization.

In today's fast-paced world, disruptions in air travel are inevitable and can have significant impacts on airlines. From unexpected technical issues to unforeseen weather events – the list of potential disruptions is endless.

However, amidst these challenges lies an opportunity: our innovative disruption management system, Orbit.

By integrating cutting-edge technology and mathematical optimization, Orbit offers a tailored solution to proactively manage disruptions in the short and long term.

Dive into our whitepaper and discover how Orbit is revolutionizing the future of air travel.



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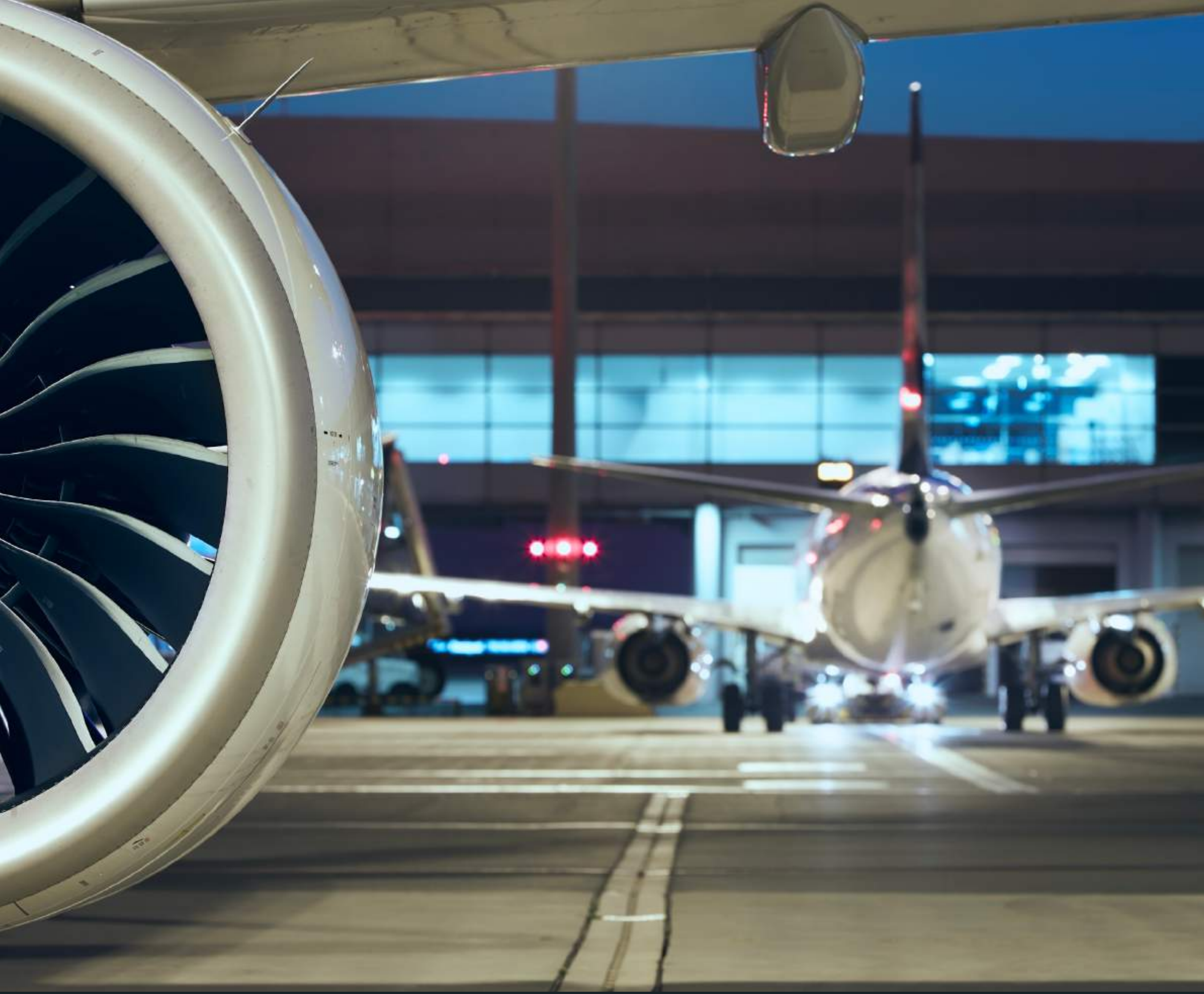


Introduction to Disruption Management

Our Understanding of Disruptions for Airlines

Disruption in airline operations refers to any irregularity or deviation from the published flight schedule, influencing the planned course of operations. These disruptions may be due to factors both within and outside the airline's control. Internally driven disruptions may stem from commercial decisions or operational issues such as unexpected technical problems resulting in unplanned, time-consuming maintenance activities or prolonged Aircraft on Ground (AOG) events. External factors may include adverse weather conditions, air traffic congestion, airport operational issues leading to the unavailability of infrastructure or ground support, industrial action or unexpected strikes, and even entire airspace closures.

Airlines respond to disruptions by implementing measures to mitigate operational impact, such as developing contingency plans, maintaining communication with customers and relevant authorities, and adapting to dynamic circumstances to ensure minimal schedule disruption. The complexity of these measures depends on the severity of the disruption, making effective disruption management a dynamic and multifaceted challenge.

Role and Challenges of an Airline OCC

The Operations Control Center (OCC) of an airline is the central hub where the intricate and dynamic network of airline operations is monitored and managed. The OCC is responsible for overseeing the entire flight schedule, ensuring that every aspect of the operation runs smoothly. Key tasks performed by the OCC include flight planning, tracking aircraft movements, managing crew schedules, and coordinating with various departments such as maintenance, customer service, and ground operations. The OCC brings together different stakeholders and departments, acting as the focal point for communication and decision-making. This coordination is crucial for maintaining operational integrity and efficiency, as the OCC ensures that all parties are informed and aligned, especially during disruptions.

During disruptions, the OCC takes on an even more crucial role by swiftly implementing recovery plans to minimize the impact on passengers and the airline's schedule. This includes rerouting flights, reassigning crews, and communicating with affected passengers. The OCC's ability to manage these challenges relies heavily on its capacity to integrate information from various sources and stakeholders, enabling a cohesive response that maintains service continuity.

The OCC faces various challenges and constraints when it comes to effectively managing disruptions:

Customer Impact: Ensuring minimal disruption to customers is at the heart of effective disruption management and underpins the airline's commitment to delivering a seamless customer journey - even if disruptions may occur along the way. Tasks such as finding alternative transportation for affected passengers (or cargo, depending on the airline's business model and customers) and providing timely and accurate information are integral steps in sustaining customer satisfaction.

Swift resolution, proactive customer engagement and effective communication are critical, not only to mitigate negative publicity or future loss of revenue, but also to secure the airline's overarching commitment to prioritize the seamless customer experience throughout the end-to-end process. Today, the responsibility of the OCC extends beyond securing and stabilizing operations; they have become an increasingly central element that directly influences customers' perceptions of the airline's responsiveness and reliability during challenging situations.

Time sensitivity and complex interdependencies: Besides having a reliable fleet, one critical aspect of airline operations revolves around the availability and scheduling of crew members. Disruptions may be caused by the unavailability of crew due to illness or no-shows, scheduling conflicts, regulatory limitations, or unexpected strikes. To tackle these challenges, one requires efficient planning and coordination to ensure that the airline's workforce remains adequately staffed and adheres to regulatory standards.

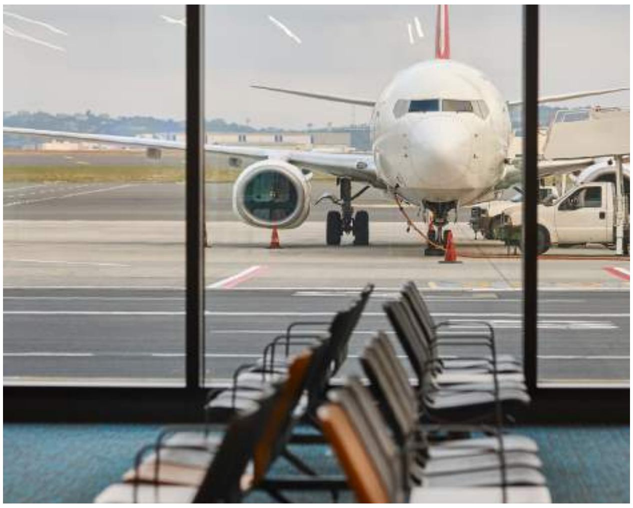
Regulatory compliance: Navigating strict regulatory and safety requirements is an essential component for airlines dealing with disruptions. Balancing the need for rapid response while keeping regulatory guidelines in mind adds an additional layer of difficulty. For example, airlines must comply with regulations governing customer rights, which may include provisions for compensation in the event of delays. Flight and cabin crew are directly affected as changes in flight schedules and assignments can impact duty time regulations, rest periods, and overall shift patterns.

Disruption management needs to ensure crew legality and minimize fatigue-related risks while maintaining operational continuity. Airlines must comply with operational regulations established by aviation authorities, such as air traffic control directives and airspace restrictions; this may involve implementing enhanced security measures during disruptions with increased security risks. Airlines must also consider environmental regulations related to emissions, noise, and other environmental impacts, particularly in cases where alternative flight paths are necessary.

Cost considerations: Operational inefficiencies during disruptions can lead to significant financial implications for airlines. The cost considerations encompass not only direct financial losses, such as increased costs from e.g., rebooking, compensation and refunds for customers who experience significant inconvenience, excess fuel consumption, overtime pay for crews if delays extent beyond a certain duty threshold, unplanned aircraft maintenance or repairs –also, poorly managed disruptions along the customer journey can have lasting effects on the airline's reputation, potentially leading to future revenue losses. Striking a balance between swift resolution and cost-effectiveness is another key challenge in disruption management.

Growing workforce shortage: Although it may not be the most obvious of all challenges, today's aviation industry, like many other industries, grapples with a growing shortage of skilled professionals, particularly in operations. For many airlines, retaining knowledge and expertise becomes increasingly difficult during a period where OCCs transform into less experience-driven, but more customer-centric and data-driven entities.

Airlines must leverage knowledge management strategies to capture and transfer critical insights from seasoned professionals to newer staff, ensuring continuity in operations while embracing advanced data analytics to enhance decision-making processes within the OCC. This shift not only addresses workforce shortages but also empowers the OCC to adapt to evolving operational challenges in the dynamic aviation landscape.



The E2E Disruption Management Process

In navigating the complexities of airline disruptions, a well-structured process is essential for effective resolution. The disruption management process comprises five key steps, each playing a crucial role in maintaining the flow of airline operations.

Identification of Disruptions: The first phase is about recognizing and recording potential interruptions in due time, ranging from adverse weather and technical problems to crew unavailability and air traffic congestion. Swift identification serves as the foundation for proactive management, enabling airlines to respond promptly to changing situations.

Assessment and Prioritization: Once disruptions are identified, the focus shifts to assessing their potential impact. Prioritization becomes key, considering factors such as safety, regulatory compliance, customer impact and financial considerations. This step ensures that resources are allocated efficiently, addressing the most critical disruptions first and aligning with the airline's overarching objectives and priorities.

Resource Allocation and Recovery Planning: With a clear understanding of the disruptions' impact, the next step involves resource allocation and recovery planning. Airlines must strategically reallocate resources, including aircraft, crew, and ground support, to minimize disruption impact. Developing recovery plans and identifying alternative options are crucial elements in ensuring the continuity of operations.

Executing and Monitoring: The next step revolves around the execution and continuous monitoring of the recovery plan. This dynamic process may require airlines to implement necessary actions promptly or prepare for their implementation, depending on the immediacy of the disruption. Ongoing monitoring ensures that disruptions are effectively managed, allowing for adjustments as required to maintain operational stability – whether the disruption demands immediate attention or permits planning and preparation for implementation at a later time.

Reporting & Analysis: Following the execution of recovery plans, the process extends to analysis and reporting. This step involves evaluating the effectiveness of the implemented measures, examining the outcomes, and identifying areas for improvement. The insights gained during this analysis serve as valuable lessons for future scenarios. The reporting component ensures that data and knowledge gained are documented, fostering a continuous learning cycle within the airline's disruption management framework.

Overview of the Disruption Management Process

Identification of Disruption	Assessment & Prioritization	Resource Allocation & Recovery Planning	Execution & Monitoring	Reporting & Analysis
Timely identification and recognition of potential disruptions	Assessing severity of disruption and impact on airline operations	Reallocation of resources to minimize disruption impact	Rapid implementation of measures and continuous monitoring	Analyze effectiveness of recovery plan for future learnings

How Technology Supports Effective Disruption Recovery

Like in any other field within the aviation industry, the role of technology becomes increasingly evident, addressing the challenges posed by outdated legacy systems and the absence of automated solutions and decision support tools. Many airlines find themselves grappling with the limitations of manual decision-making heavily reliant on human intuition rather than data-driven insights. Recent developments in advanced analytics and data processing present airlines with a compelling opportunity to revamp their IT infrastructures, particularly within OCCs, and streamline processes to mitigate the impact of disruptions on operational stability, customers, and costs.

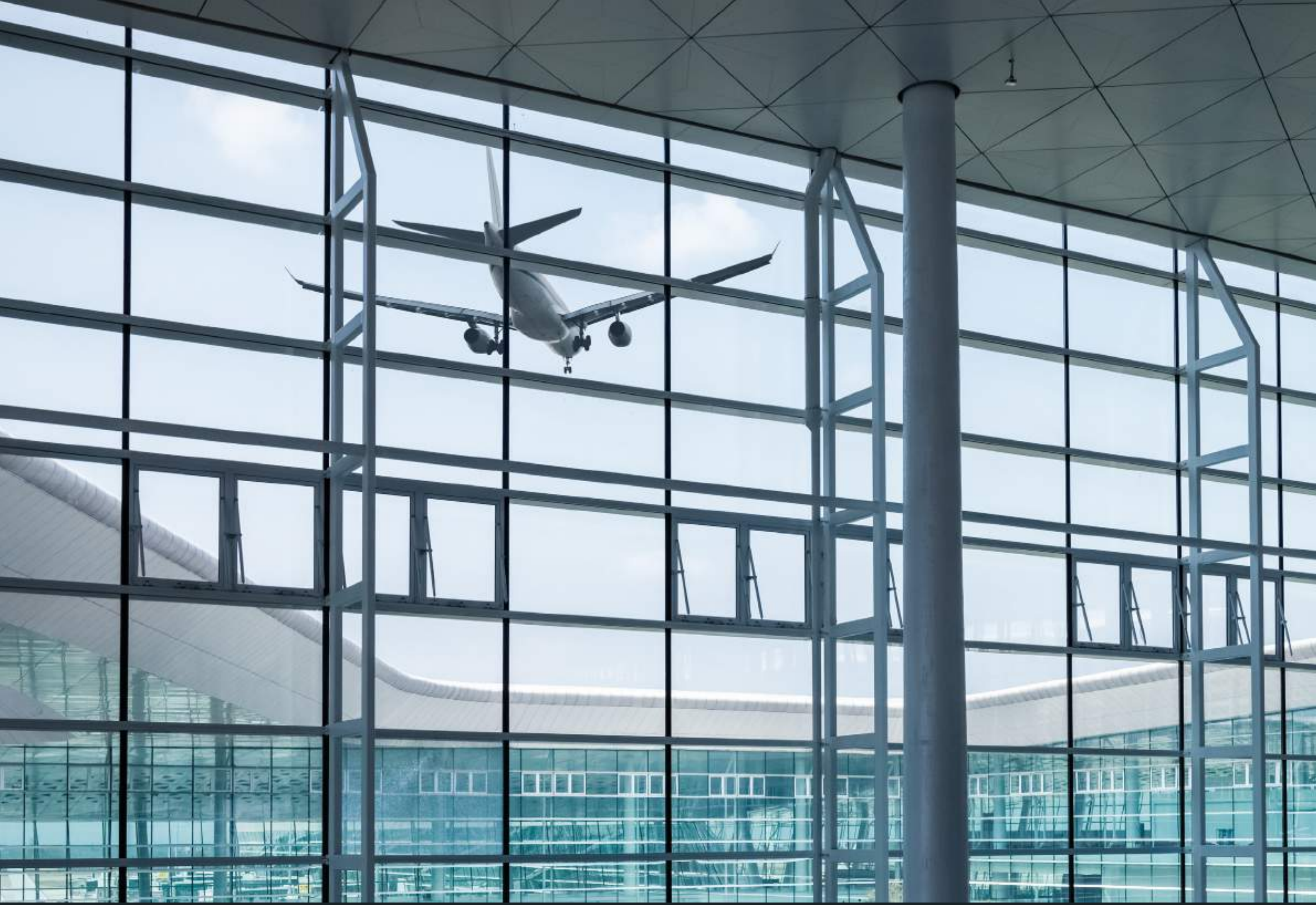
Resilient Data Ecosystem Strategy: A fundamental aspect of this technological transformation involves having a structured framework in place to manage and leverage data effectively within the OCC's ecosystem. This strategy involves establishing processes, technologies, and partnerships to gather, integrate, analyze, and utilize data from various sources across the airline to stabilize the operation during disruptions whilst securing safety and customer satisfaction at the same time.

By leveraging data from various sources such as aircraft systems, crew scheduling, airport operations, weather forecasts, maintenance, commercial and other relevant sources, the OCC can make informed decisions promptly, allocate resources efficiently, and implement contingency plans effectively.

Further, a data-driven approach allows for predictive analytics, enabling the OCC to anticipate potential disruptions and proactively take measures to minimize their impact on customers and operations. Overall, a well-executed data ecosystem and infrastructure strategy within the OCC enhances operational resilience, ensures customer satisfaction, and maintains the airline's reputation even during challenging situations.

Artificial Intelligence (AI): The integration of Artificial Intelligence technologies will play a transformative role in disruption management and has the potential to significantly simplify daily recurring tasks within the OCC by automating routine processes and providing intelligent decision support. Through AI-driven automation, OCCs can streamline tasks such as flight scheduling, crew management, and resource allocation. For example, AI algorithms can analyze historical data and current conditions to optimize flight schedules, minimizing delays and maximizing efficiency. Similarly, AI can assist in crew scheduling by considering factors like qualifications, availability, and regulatory requirements to generate optimal crew rosters. Furthermore, AI-powered predictive analytics can anticipate maintenance needs and identify potential operational disruptions, enabling proactive planning and mitigation strategies. By automating these tasks and providing actionable insights, AI empowers OCCs to operate more efficiently, reduce manual workload, and focus on strategic decision-making, ultimately enhancing overall operational performance and reliability. AI will empower airlines to predict future consequences even before a disruption occurs, enabling them to take preemptive action to minimize delays and prevent cancellations.

The key challenge in leveraging AI technology within OCCs lies in effectively integrating it with the human, hands-on element of operations. While AI offers powerful capabilities for automating tasks, analyzing data, and making predictions, it must be seamlessly integrated with human expertise, intuition, judgment, and decision-making processes within the OCC. This requires striking the right balance between AI-driven automation and human oversight, ensuring that AI augments human capabilities rather than replacing them.



Introducing the Orbit Decision Support Platform

Our Virtual Operations Control Assistant

Vision and Capabilities

Imagine if you could design your own operations control assistant, it would work like M2P's Orbit Decision Support Platform – in short: Orbit. Orbit embodies the ideal decision-support tool for airline operations: Whether it is quick responding to unforeseen minor disruptions, navigating through significant global airspace challenges, or pre-emptively identifying emerging issues before they escalate – Orbit acts as a virtual co-pilot, providing OCC personnel with actionable insights, predictive analytics, and scenario-based recommendations to enhance decision-making.

It allows airlines to dynamically adapt to changing conditions, allocating resources efficiently during small disruptions as well as large-scale operational issues and, simultaneously, optimizing flight schedules. Moreover, it streamlines mundane and time-consuming daily tasks, freeing up valuable time and resources for more strategic planning and proactive optimization.

And be honest to yourself: Who has not used ChatGPT for at least one issue, be it on the operational end of things, to deepen your understanding of a topic or to just perform a task which can be done more quickly by AI. For Orbit, we envision a similar approach: Introducing a Large Language Model for getting insight about the rules that Orbit uses, what the focus of a specific use-case is in terms of problem dimensions or just to give knowledge management of the deeply complicated operations problem a whole 'new' meaning – there is a plethora of possibilities when combining LLMs and our decision support platform.

Orbit has the capability to seamlessly integrate all dimensions essential for disruption recovery in a single operation: The tool's holistic modeling approach integrates critical factors like managing rotations, optimizing aircraft utilization, enhancing the customer journey, promoting fuel efficiency, and not only ensuring compliance with crew legality but meticulously organizing crew pairings to guarantee operational readiness for the airline's flight operations.

It automatically adjusts flight schedules to align with the airline's unique set of business rules. Upon input of relevant information, such as use-cases and schedule details, Orbit can analyze vast amounts of data within seconds and develop immediate action plans in response to complex scenarios. In addition, it generates a set of comprehensive reports, instantly providing detailed insights into the projected outcome of each optimization scenario or recovery plan in terms of customer impact, cost, and many more key performance indicators.

Further, Orbit can be fully customized and fine-tuned to reflect your airline's specific business needs and integrate within the existing infrastructure of your operations control systems. Through collaborative parameter calibration with our clients, Orbit can leverage available data for precise real-world modeling. This collaborative process ensures alignment with user preferences, empowering the Operations Control Center to navigate complex operational challenges with agility and precision and make informed decisions, blending their expertise with Orbit's mathematical accuracy for optimal schedule optimization and recovery.

Mathematical Optimization Models and System Integration

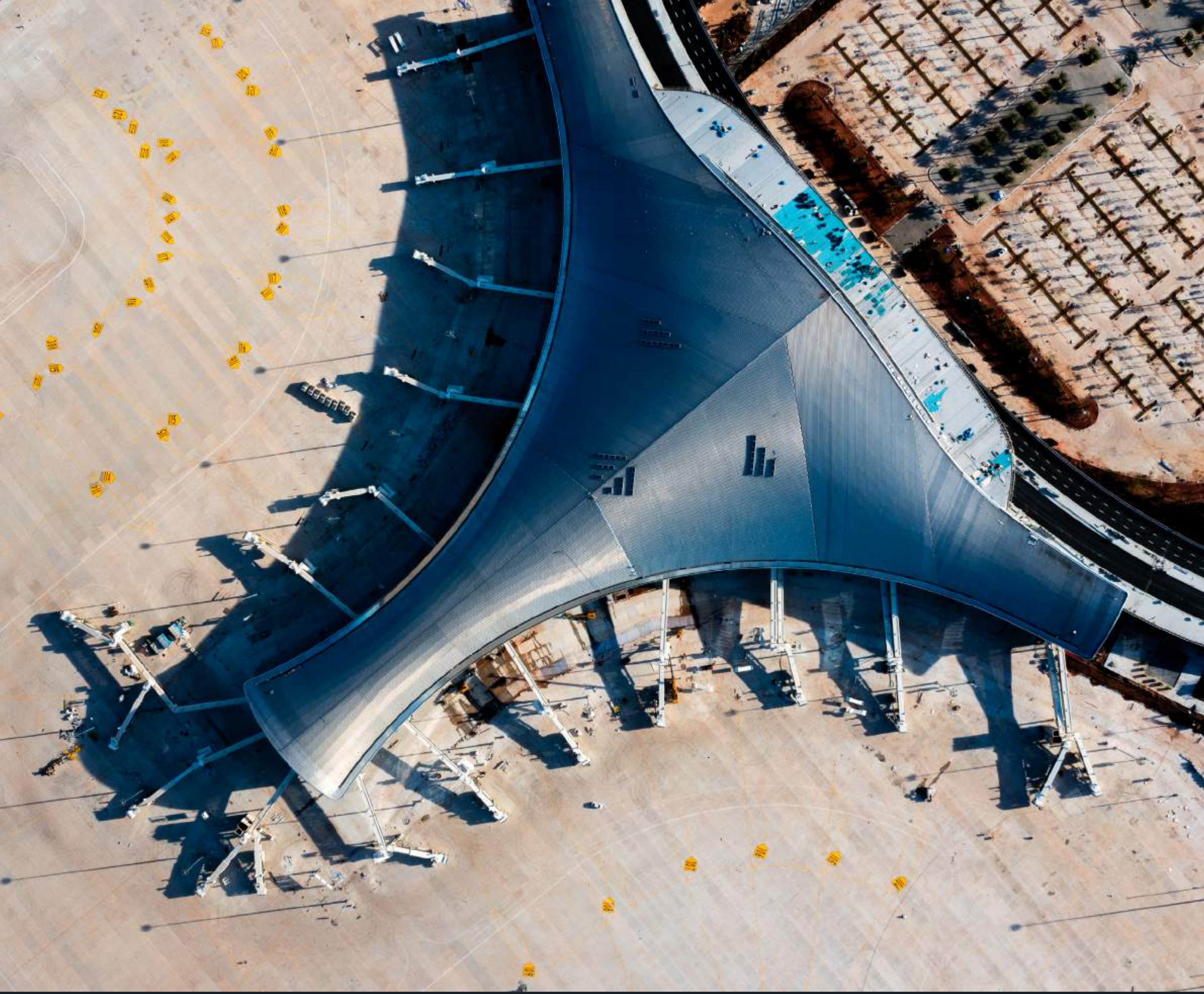
The core of Orbit lies in the modeling of schedule recovery as a mathematical optimization problem. In particular, the mathematical model can be described as an integer linear program, which is difficult to solve in practice. Although the number of variables and constraints can easily exceed 100,000 each, our customers' models can be solved within minutes using a powerful solver.

A particular strength of Orbit is the difference between our "rule-engine" and the "model". We are always in close contact with our customers to calibrate Orbit correctly so that all the rules of the specific airlines are considered, with a separate set of rules and parameters calibrated for each customer. The mathematical model is created using these customer-specific rules aside from the general rules required for our mathematical model. Should a customer requirement change, or a new requirement be tested, this "rule-engine" approach allows for easy integration into the model.

Orbit is a cloud-based solution that is controlled via a simple REST API. Thus, it emphasizes seamless technical integration with other third-party operations control tools. Recognizing that successful tool adoption hinges on minimal interaction complexity and uninterrupted application flow, we always vote for a tight UI integration with an airline's operations control system.

For this, we assist manufacturers of operations control systems by sharing interface details and UI/UX best practices from our integration projects. This enables direct configuration within the operations control system using Gantt charts for optimization windows and constraints, ensuring no need for additional applications.

Our approach ensures a streamlined, efficient operational process, reflecting our commitment to high-quality, user-centric technological solutions.



Use Cases for the Orbit Decision Support Platform

Orbit

Examples Illustrating Orbit's Effectiveness in Addressing Disruptions

Orbit supports various Use Cases from planning to maintenance for a major European multi-hub-airline.

Time →

Use Cases for Planning	Use Cases for Operations	Use Cases for Maintenance

Use Case/Applicant	Elaboration
Initial Tail Assignment	• Assignment of aircraft to the rotations. • Used for short-haul flights.
Fix Aircraft Assignment	• Ability to incorporate disruptions at tail assignment stage and repair broken rotations. • Used for short-haul flights.
Optimize Aircraft Assignment	• Optimize the original aircraft-assignment when short-term new changes in market conditions are known (e.g. Demand spike due to Champions League soccer matches, concerts etc.). • Used for short-haul flights.
Nightly OPS Preparation Used at the start of the day (1am) to optimize the next 24 hours up to 48 hours	• Should implement the plan robustly with a balanced weighting of different KPIs. • Focus on reducing aircraft changes of the pairings. • Respect minimum ground times (minGT). Minimum ground time refers to the time that an aircraft must stay on the ground between two flight legs. It is also called turnaround time. • Efficient and sensible assignment of reserve events. Example: If you have a necessary check of an aircraft at 6pm at FRA, and place a reserve event from 3 to 5 pm, this reserve event cannot be used for legs not landing in FRA. • Fuel-efficient aircraft assignment including subfleets. • Used for short-haul-flights.

Day of OPS disruption Used for disruptions that need to be solved immediately	• Is used with e.g. one hour buffer/delay (you cannot use Orbit at 10:59am to optimize something starting at 11am). • Orbit reflects the impact of disruptions on aircraft infrastructure and capacity by imposing an airport capacity reduction, e.g. 50%. • During severe disruptions, Orbit focuses on minimizing passenger impact. Thereby, it is more tolerant towards flight delays. • Only used for short-haul-flights.
Next Day(s) Disruption Used for disruptions that are known for following days	• By introducing an airport capacity reduction, Orbit reacts to the disruption of the next day (e.g., bad weather is already known). • During severe disruptions, Orbit focuses on minimizing passenger impact. Thereby, it is more tolerant towards flight delays. • Used for short-haul and long-haul-flights (Usually one does either short-haul or long-haul), two different use-cases.
Fuel-Optimization Strong focus on fuel optimization, specifically for long-haul-flights	• Ability to optimize for fuel consumption on long-haul-fights, respecting key constraints such as turnaround times and passenger parameters.
Fix/Optimize AC Assignment	• Effective planning of subfleets. • The technology is sensibly integrated into the flight plan. • No fuel optimization. • Equipment changes typically only within subfleets. • Integration of requested Maintenance events. • Resolve station breaks. • Used for short-haul flights.

KPIs Currently Used

Flight Leg Related KPIs	
KPI	**Description**
Number of unassigned flight legs	Counts the flight legs that are unassigned in the optimized schedule.
Number of legs that were unassigned but are assigned to an aircraft in the optimized schedule	Counts the flight legs that were not assigned to any aircraft **before** optimization but are assigned to an aircraft in the optimized schedule; is distinguished by aircraft-change and equipment-change.
Number of introduced ferry flights	Counts the ferry flights that need to be introduced in the optimized schedule, such that there are no station breaks within the optimized schedule.
Block time of introduced ferry flights	Returns the required time for all newly introduced ferry flights to be performed.
MinGT-Shortfall	The sum of all flight leg's MinGT-shortfalls.
Number of flight legs with a MinGT-Shortfall	Counts the number of legs that have a minGT-shortfall, i.e., would need to start later to match the MinGT. Can be distinguished in various intervals (e.g. delays up until 15 minutes, delays higher than 30 minutes…).
Base changes (flight leg)	Counts the number of base changes. A base change happens when a leg that is flown with an aircraft of a base is flown with an aircraft of another base in the optimized schedule. Usually, a base refers to a hub.
Number of Aircraft/ EQT-changes	Counts the number of legs that, compared to the original schedule, are affected by an aircraft-change or equipment-change.

Ground Event Related KPIs

KPI	Description
Number of unassigned ground events	Counts the ground events that are not in the optimized schedule.
Number of ground events that were unassigned but are assigned to an aircraft in the optimized schedule	Counts the ground events that were not assigned to any aircraft but are assigned to an aircraft in the optimized schedule; is distinguished by aircraft-change and equipment-change.
Total ground event delay	The sum of all flight leg delays in comparison to the original schedule (delay referring to the original departure time).
Number of ground events with a delay	Counts the number of ground events that have a delay in the optimized schedule (delay referring to the original departure time). Can be distinguished in various intervals (e.g. delays up until 15 minutes, delays higher than 30 minutes…).
Number of ground events that are shortened in the beginning	Counts the number of ground events that are shortened at the beginning; note that this does not mean that the ground events end later.
Total shortening time of all ground events	Returns the total time ground events are shortened.
Number of ground events carried out another airport	Counts the ground events that are carried out at another airport in the optimized schedule.
Number of reserve events not to take place directly after and directly before a flight leg	Counts the number of reserve events that are not surrounded by flight legs.

Time between reserve events and the events directly after and before them	The total time of the events surrounding reserve events.
Number of reserve events not covered by a standby crew	A reserve event should have the standby crew assigned to it on the leg directly before the reserve event.

Connection* Related KPIs

KPI	Description
Number of 'connection* with property X' violations	Counts the connections with property X of the input schedule but are not in the optimized schedule. (e.g. for over-night reasons, two legs should be subsequent)

Passenger Related KPIs

KPI	Description
Number of passengers on unassigned flights	Counts the passengers of unassigned flights. Can be distinguished in the passengers that could be rebooked to another flight/ground transportation and passengers that could not be rebooked. Can be even further distinguished by the delay of the passengers compared to their original flight.
Number of downgraded passengers	Counts the passengers that are downgraded during the rebooking process.
Number of overbooked passengers	Counts the passengers that could not take their planned flight because the flight is overbooked.

Ratio of passengers who did not catch a flight because of a cancellation	Among all passengers of unassigned flights, this KPI returns the ratio of passengers that missed another flight because of the un-assignment.

Aircraft Related KPIs

KPI	Description
Number of violated requirements	Counts the number of violated requirements of aircraft in the optimized schedule. For example, some aircraft are not allowed to fly to certain destinations, or some aircraft should fulfill certain technical properties.
Number of aircrafts not in use	Counts the aircrafts that do not have any event assigned to it in the optimized schedule.

Crew Related KPIs

KPI	Description
Number of pairings that need to change aircraft	Counts the pairings that need to change the aircraft. Can be distinguished by before optimization and after optimization.
Number of pairings that could not finish their duty as planned	Counts the pairings that are stranded somewhere in their pairing and could not end their duty as planned. Can be distinguished by non-base and base, where base refers to the airline-specific crew base.
Number of crew complement violations per position	Counts the pairings where crew members are missing in the optimized schedule. Usually used for minimum crew complement (without this complement, the leg cannot start) at the moment, but can be extended to any other crew complement easily.

Number of flight legs with missing crews	Counts the number of flight legs where the whole crew is missing after recovery.
Number of crew reassignments	Counts the pairings that were reassigned to legs they were not originally planned for.

Fuel Related KPIs

KPI	Description
Fuel savings (kg/EUR)	Returns the saved fuel from a weight and a monetary perspective.
CO_2 savings (tons)	Returns the saved CO_2.

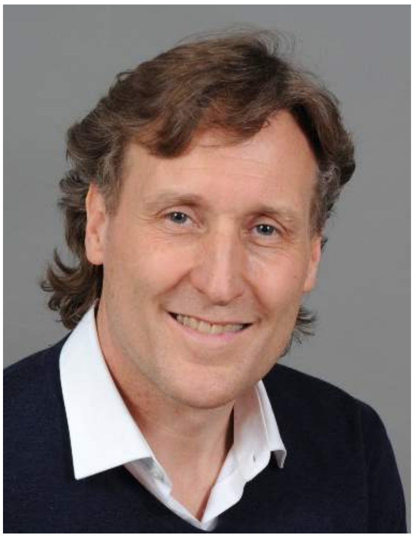
Solver Related KPIs

KPI	Description
Running time of a solver	The time the solver requires for recovering the schedule and returning the solution.

*Connection = Two events that are subsequently carried out by the same aircraft.
**Sector = A sector refers to “a flight from one place to another”, without specifying departure or arrival times. For example, flying from Frankfurt to Hamburg is called a sector. If there are three legs, one starting at 9 am, one at 10 am and one at 11 am, then they are all part of that sector.
***Reserve events = A reserve event is planned to ensure that, should an aircraft not be able to operate a flight, the aircraft with the reserve event can take its place and operate the flight.

Get in touch

Speak with our expert team to learn how Orbit can help you.



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