The sophistication of air situation displays (ASDs) and flight monitors has improved to the point where airline operations staff can simultaneously monitor a large number of flights. Routeings can be changed or delays avoided, and save the user up to millions of dollars each year.

Using ASDs to reduce fuel burn & flight times

To monitor an aircraft's position throughout an entire flight, and how its flight path will develop, has been the wish of every airline operations department since mass transportation by air began.

As technology has evolved, so too has the accuracy of monitoring aircraft. From the 1990s, it became possible to access air traffic positioning data that used to be the sole property of organisations such as the National Aeronautics and Space Administration (NASA) and the Federal Aviation Administration (FAA). In the past an aircraft needed to pass radio position reports to the ground. Now it is possible to combine numerous data sources to have accurate positional information. Modern flight monitoring information technology (IT) systems have become indispensable and are known as Aircraft Situation Displays (ASD). Monitoring aircraft with ASDs can improve flight times, crew times and fuel burn, reduce delays, and give operations staff better visibility of their operations.

Why monitor flights?

An airline will monitor flights to pick up and prevent problems, or deal with them as they arise. An operations department will want to: continually assess the weather that each flight experiences; check the arrival airport's situation in case holding in a stack is required or the airport is temporarily closed; deal with potential issues on board, such as disruptive or sick passengers; and deal with air traffic control (ATC) changes, before and during a flight, that necessitate a re-working of the route and/or fuel consumption.

Dealing with even one of these problems can delay, extend or divert a flight, all of which can result in a financial loss for the operator.

If a flight is delayed, passengers can miss connecting flights. This can result in an oversubscribed flight later in the day, and incur hotel and refreshment costs for delayed passengers.

If a delayed flight is one of the first flights of the day for a short-haul crew, it can potentially put the whole crew, aircraft and operational schedule out of sync. If an aircraft is delayed coming into a particularly busy airport, it could miss its landing slot and have to go into a holding pattern rather than go into a straight approach. This can increase the flight time, and therefore the delay time, and raises the fuel burn. With only a finite amount of fuel on board, an aircraft will need to divert to an alternate if it is delayed, has to hold for too long, or passes through excessive poor weather. This will incur additional costs.

Diversions can also be caused by sick passengers, disruptive passengers that pose a security threat, and maintenance or safety issues. A diversion will put passengers, crew and aircraft out of sync with their planned schedules. Crews can run out of crew time earlier than planned, and additional crews have to be rostered, increasing costs.

The cost of diversions is exacerbated by the additional costs of transporting passengers to the correct airport, ferrying the aircraft, and extra passenger-handling charges. Delayed passengers, increased fuel use and diversions all cost money, so operations departments need to monitor flights more closely, and in real time, in order either to prevent these disruptions, or at least to minimise their impact. There is the potential to save millions of dollars.

Air situation displays

ASDs are the advanced tools that support flight monitoring. ASDs can be viewed on computer screens or large custom-made screens for a department's use.

The ASD display is arranged and used in layers of information. The main map, which covers a geographical area, can show single or multiple flights. Through additional layers, the track so far flown, the options of tracks to take, airways and navaids, and airports can all be shown. There are several other layers for weather and upper wind information, other carriers' aircraft and geographical terrain. The operator can click on any of the layers to bring up boxes of information and data. The information provided for an airport, for example, will be current weather, runways, notices to airmen (NOTAMs), and radio frequencies.

With this layered information, an operations department flight monitor can view the progress of all the airline's fleet in real time on a screen, and see if there are potential issues that could arise during the flight. They are then able to view each flight's position graphically, and monitor its progress in terms of actual time versus planned schedule. All the information provided by the ASD can be used to assess the situation and make informed decisions.

Without an ASD, changes to a flight would be handled by the pilots, who would not have all the data and information relating to weather, en-route and airport delays, and traffic volumes available to them. A pilot may be pleased to be offered a direct route into an airport by ATC, but then find that the strength and direction of the winds meant that the change was not cost-effective. If more communication of en-route information from ground operations was possible, such a direct routeing would be rejected. Moreover, the operations department would be able to assess the merits of a change in routeing prior to conferring with the flightcrew. While ATC can advise on new routeings, their only interest is in air traffic separation and safety. They are not concerned with airline economics.

By using any number of information layers in an ASD, an operations department can see clearly what is affecting its aircraft, resulting in: more accurate fuel figures and arrival times; fewer delays and diversions; minimised passenger disruption; and fewer personnel needed for an efficient operation. "We do not necessarily think of the ASD as a fuel consumption tool, but it provides our dispatchers with better visibility of the aircraft than flight plans or ATC," says Dave Fuller, director dispatch at jetBlue Airways.

The ASD allows operations departments to use a single screen that lets the user know when something out of the ordinary might occur. This is known as 'management by exception'.

Sources

A number of information sources will be required to build up a more accurate picture of an aircraft's situation, says Michael Brandes, senior consultant, Flight Explorer for Sabre. The ASD will need the original flight planning data, as well as an exchange of information from the relevant ATC centres. This provides all the necessary information that will allow a dispatcher or operations officer to see the potential routes and the actual route an aircraft has tracked, as well as any changes. If it is beneficial to the airline, then nothing needs to be done, but a good ASD will enable staff to assess what, if any, alternative routes might be better.

"ATC data is available from the FAA, EUROCONTROL, or partly from other regions like Australia, as well as from the aircraft itself," says Brandes. SITA and/or ARINC data, through an aircraft crew and reporting system (ACARS) data service, will transmit to the ASD. ACARS is a private communication system, whose use is dictated by an operator. For example, some operators use it for aircraft position reporting every 30 minutes as well as for flight monitoring.

"We use a surface movement tool and our integrated aircraft messaging system. We also have a number of weather tools attached. We would like to make even more of these available," says Fuller.

Before ASDs, an airline would only have a projected or estimated position for its aircraft once in the air. Now it is more precise, although if an aircraft passes through an area where there are limited information sources, the position will be projected - dependent on the previous, and the expected next, position. "For example, over Saudi Arabia today, position information is limited to an airline's own data sources," says Brandes. "In certain regions there is still a lack of ATC data sources."

Over the oceans airlines may also want to track their aircraft. Satcom-equipped aircraft here have an advantage. Brandes adds that accidents like the loss of the Air France A330 over the Atlantic in 2009 show the importance of flight tracking with exact aircraft positioning, regular data, communications and up-to-date weather.

Weather

It is not just the flight data that needs multiple information sources, but the weather. A satellite picture will show a number of weather factors, but ground weather is also needed at the arrival airport, as is wind data and information.

Many ASDs show areas of clear air turbulence, and specific factors such as volcanic activity and associated ash clouds. "The picture of the world can be overlaid with the location of active volcanoes, and details such as their elevation, how high the ash is going, the residual ash cloud areas and ash concentration at different levels," says Brandes. "In Flight Explorer, for example, an alarm is sounded as soon as

an aircraft flies into such an area."

In winter, the freezing levels and chance of ice will need to be looked at, as well as the winds and turbulence. These factors can seriously affect a routeing, although the precise point at which changes need to be made depends on the pilots, flight planners and the airline itself. With all the data available, they can see if it is better to continue on the current heading or to change the route to what may be a longer, but safer, option. If an aircraft has to fly against too strong a headwind, for example, the fuel burn may not be sustainable for the whole flight, meaning a diversion will be required. A suitable alternate then has to be found. Flying through a storm or turbulence can cause damage to passengers, crew and the aircraft, which again can potentially lead to a diversion.

"The optimal route is not necessarily the obvious one," says Brandes, "so we look at all the sources of information to make an informed decision."

Operations

It is generally accepted that an operator will use an ASD for all its routes and monitor all flights at all times. When an airline first looks at a system, however, it will trial it first on a few routes. "This is currently the case at British Airways (BA), where the trial is targeting a select few routes first," says Simon Scholey, chief pilot technical, BA.

More often than not a flight will pass uneventfully, but when something needs attention, an alert will be sent. It is now possible for each operations staff member to monitor more flights than before. In general, all an operator needs to do is download a system and run it. But, the more sources an operator has going into the ASD, then the better and more accurate it will be. Many are web-based, so theoretically any number of computers can be watching the fleet from any location, although this depends on the price paid for the ASD by the operator.

"Short flights with normal weather and traffic do not need to be monitored all the time, but since they are in the system, an airline's operations staff can be alerted if something changes, such as: weather developments, congestion, problems on-board or ATC changing routes," says Brandes. "If a flight is longer, more changes and developments can potentially occur, so flight monitoring and an ASD are even more useful."

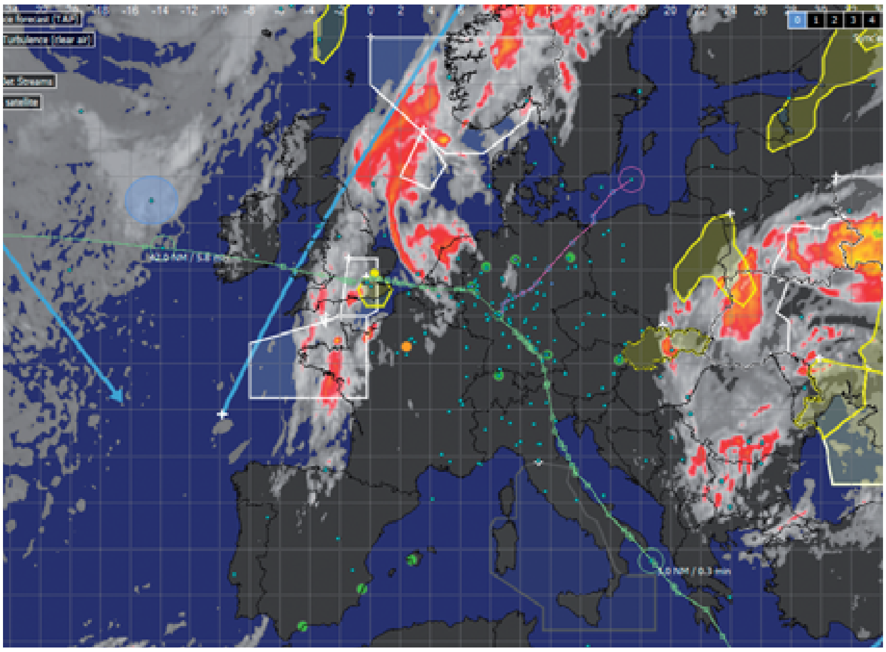
The ASD system used by most European airlines is Sabre's Flight Explorer, although Arinc's WebASD is also a major player. Other, similar, systems, are available, such as FlightView and FlyteComm.

Sabre AirCentre Flight Explorer

The Flight Explorer ASD system is a part of the larger Sabre AirCentre Enterprise Operations suite offered by Sabre Airline Solutions. The suite also includes a flight-planning tool that will be inter-connected to Flight Explorer by 2012. In its simplest form, the screen can show a fleet's location across the world. Shadows show the time zones, much as the moving map in the cabin of the aircraft will. The operator can add in layers of data or zoom into a particular area or flight. "We also have a 3D circle of world traffic, which shows the great circle route well, if needed," says Brandes. All active and planned flights are displayed at the side of the screen, in much the same way as flights are listed on an ATC screen.

The screen shows airport locations with colour-coded dots. An orange dot, for example, means that only instrument flight rules (IFR) landings are allowed at this time. The user can go into the full airport data with a summary of the airport's weather, wind speeds, sky conditions, NOTAMS and visibility. By focusing on a particular flight, the operations officer can bring up its details, position history (and which source sent the position) and current route.

All the different types of data can be



It is possible that by avoiding delays caused by poor weather, through the use of ASDs, airlines can save a large number of aircraft block hours. This translates into savings in aircraft, crew time, fuel and other aircraft operating costs.

viewed in smaller pop-up tables rather than in separate screens. The background will always show the main map, weather and flight plans or whichever overlays the operator chooses.

The system's Event Manager will alert the operator if attention is needed, for example, to weather developments, ATC route changes, ash clouds and airport closures. The method of alert can be chosen by an operator, depending on the situation. If the operator is very small, then it may choose to have an alert sent to the operations officer's phone by SMS message, when they are out of the office. Other alert configurations can be audible or visual or sent by email.

WebASD

WebASD is a system from Arinc Inc. Because it is web-based, there is no need to download any special software to a computer, and it can be used on any computer once access is approved.

"Flight dispatch is already very regulated," says Linda Hartwig, senior director, brand management and communications for Arinc. "So, while this system is an important aid, the aim is to keep the functionality similar to that already used by flight dispatchers to simplify its use."

Yuri Maslov, program manager for the Arinc WebASD product, adds that: "Each airline is different, so the product is tailored to customers' needs to ensure simplicity of use for each client.

"Although WebASD needs the same sources as any other ASD system, its advantage is that it does not need a third party to convert data, because Arinc itself is a source for ACARS," continues Maslov. "Ideally both internal and external data sources are needed, with an aircraft's ACARS feed being internal, and ATC being external."

WebASD is recommended as a tool to be used for every flight. A filtering system means that airlines can separate out flights on a number of screens, covering each dispatcher's responsibility. These can be monitored constantly or at regular intervals. Warning alerts also vary depending on the operator's needs. Run in conjunction with other Arinc products, the system becomes more complex, but robust, and develops additional methods of sending messages, including ACARS, to the operations department and flightdeck.

"The customer interface connects, via the web, to our server. A customer does not need to have an ASD feed at all at their base, so Arinc does it all for them. No other software is needed," says Maslov. "The cost is a very complex issue because an operator could choose various bundled Arinc solutions, not just WebASD. Also, with the system saving an operator money, the net cost is reduced. WebASD can itself make fuel savings, but works by integrating with other systems." In reality, WebASD's inter-connected systems reduce costs, so it leads to an accumulated time and money saving.

Diversions

Operators plan their schedules with an aircraft going from A to B. If an aircraft needs to divert for any reason, this starts to cost an operator a lot of money.

The actual cost of a diversion can vary greatly depending on a number of factors. The larger the aircraft, the more passengers will need to be transported to their final destination, which may not be so easy if they were also due to make connecting flights. During this time the airline is responsible for any refreshments and hotel accommodation. If the diversion airport is not a usual one for the airline, then passenger and aircraft handling charges may be higher, with no previously arranged contracts. An airline's schedule will be affected by the aircraft no longer being at its base and continuing on its planned operations. This can mean further delays and irregular operations (IROPs), again affecting connecting passengers and schedules. It also increases the number of aircraft in a fleet an airline needs to make its schedule commitments.

Taking into account passenger and crew re-location, handling charges, schedule knock-ons and potential hotel costs, an average diversion can cost an airline tens of thousands of dollars. In Europe this could be more, as the European Union (EU) has set down minimum standards of passenger payments to which operators flying in Europe must adhere. For cargo operations, perishable freight, that is food and flowers, could be delivered to the wrong destination with little time to correct.

An ASD can prevent diversions in a number of ways. An on-time aircraft may still be told it needs to go in to a holding pattern, and more fuel than planned will be used. If, for whatever reason, the amount of fuel held is low, and the slot-time predicted by ATC is too long, then operations staff can use the ASD to calculate the actual hold time by looking at the aircraft ahead. Pilots then know whether they need to divert to another airport for a straight-in approach.

A pilot will request an aircraft's fuel load that is sufficient for the flight, taking into account weight, expected weather, the route and alternative airport distances. By using an ASD, it is possible for the operations department to have all relevant information right up to the last minute before a flight, so that fuel loads can be adjusted accordingly. Even if a diversion is unnecessary, by assessing up-to-date data right up until departure, pilots and operations staff limit the stress to which they may be exposed during the flight.

There are also diversions due to sick or disruptive passengers. By using an ASD, it might be possible for the operations staff to find a more suitable airport. This could be cheaper, nearer to a hospital, or be on a less congested route than the theoretically nearest airport.

The sophistication of ASDs has grown to such a level that it is now possible for each flight operations staff member to simultaneously monitor a large number of flights.

With pilots liaising with the ground more effectively and using the data available on an ASD, an operations department can have everything in order by the time the aircraft actually lands. This saves time on the ground and could reduce diversion costs. "An alternative airport range is shown by a circle, dictated by the remaining fuel. With these data you can make a better decision on which airport to go to, for example, with medical treatment options," says Brandes. "The operator may know nothing about the alternative airports so it is possible to bring up a UVTripPlanner screen, which gives them details of hotels, transport, and handling agents quickly, and potentially saves them money."

A diversion can therefore easily be one of the most costly and disruptive situations an airline has to handle, especially given that this could happen hundreds of times a month for a large operator. Research in 2008 calculated that a large North American international airline could potentially prevent 150 diversions per month. The same research suggested that a diversion could cost an airline about $20,000. Even if half these diversions were prevented, the airline could still save $1.5million per month.

Flight time & fuel burn savings

By ensuring that most, if not all, flights are flown efficiently and on time, the airline's total fuel bill is minimised. ASDs can assist by allowing operations staff to easily monitor situations and prevent delays. "To save fuel is good, but some airlines are more keen on just getting to destinations on time, especially at hubs where connections need to be made," says Brandes. While the larger global airlines might be more interested in time, some low-cost carriers are more interested in costs and fuel, especially with the EU's Emissions Trading Scheme taking effect. ASDs can calculate whichever profile the operator needs, and show the best outcome.

An ASD will alert staff if there are ATC route changes, but staff can improve fuel burn by looking for potential route improvements. "ASDs can be used to avoid large weather systems and/or to take advantage of the most up-to-date wind data that may become available after the flight has departed. An example is where the flight plan for a long-haul route is based on the wind/temperature data available at the pre-flight stage. In this case, the aircraft may be airborne for up to 14 hours, and it may be possible to re-route the aircraft as newer data become available during the flight, which could reduce the flight's fuel burn," says Scholey.

It is possible, through route improvements and bad weather avoidance, for a large North American airline to reduce its operation by 4,500 block hours (BH) per month by making in-flight changes. The average aircraft operating cost per BH in 2008, for such an airline, was at least $7,000, so an ASD could potentially realise $31.5 million a month in second level savings.

Other benefits

There are also many indirect savings achieved through the use of ASDs. With fewer delays and diversions, customer opinion is likely to improve, improving goodwill and so improving load factors.

During a diversion, an aircraft is out of sync. The same can apply to crew, who may not be able to complete that day's duty, or even the following day's, if flight duty regulations are affected. Airlines factor these issues when planning staffing levels, and additional crew are employed and extra aircraft held in the fleet. With a definite reduction in delays and diversion, there is a reduced need for crew and aircraft.

This also applies to operations staff, with multiple flights monitored by fewer personnel. It is therefore possible that ASD systems could reduce staffing costs slightly. "The system allows dispatchers, Air Traffic Coordinators or Operations Controllers to oversee more flights than would be possible without the tool," comments Fuller.

"While an operator is trialling a system and learning its nuances, however, ground personnel will need to monitor the flight's progress and seek potential re-routes," says Scholey. "This will increase costs, which will need to be balanced against any identified fuel benefits."

Long-haul routes often fly over areas that charge overflight fees. An ASD can calculate the cheapest route, taking into account these charges, weather en route and congestion to get the best route at that particular time of day.

Overview

With so many savings expected, the ASD systems will more than pay for themselves, as well as improve an operation department's productivity. It is probable that the cost of installing and implementing the ASD will be less than 1% of the total potential savings.

Automated alert systems, multiple layering of information, data sources coming from numerous locations and ease of use have produced an IT system that will be irresistible to many operators. Not only do the systems reduce costs, but they also free up the time of operational staff to complete other duties. Then there are the potential aircraft maintenance savings and other less tangible costs.

"Operations tools in general," says Fuller, "need to move closer to a 'manage by exception' philosophy to provide better integration and display of information." AC