Airlines are becoming increasingly aware of the need to make reductions in fuel burn by all possible methods. Several software and system packages have become available to help airlines analyse all aspects of their operations and use data to help find ways of reducing consumption.

Systems & software to reduce fuel consumption

Airlines have started to realise that they have information available to them that will allow more efficient aircraft operations. Seemingly small improvements in planning and execution of operations can lead to large annual cost savings. Several software vendors have emerged offering solutions that combine information technology capabilities with industry and, in particular, operational knowledge.

One of the leading experts in the field of fuel management is Captain Marcel Martineau, president and chief executive officer of TFM (Total Fuel Management) Aviation. "People are swamped with data and they need to be able to analyse it. Also, pilots, engineers and dispatchers need easy-to-use software," says Martineau.

He says these personnel need to see how much can be saved by saving weight in a particular way. "You need to value each initiative and track it. Taking the use of reduced flap landings, for example, you need to convince the pilots to do this 70% of the time rather than 40%; a 30% improvement. You save 50-100kg of fuel per cycle, at a price of 75 cents per kg," he says. "Tracking aircraft in real-time is important for many fuel-saving initiatives. Such activities can now make the difference between being profitable and losing money."

Martineau has worked with the International Air Transport Association (IATA) and visited more than 50 airlines over the past five years. He was also an Air Canada A330/340 pilot and responsible for developing the airline's fuel management system. "I developed a picture of the general mentality. In some places pilots are left on their own, with no advice.

"The amount of extra fuel carried should be decided by the airline based on the big picture," continues Martineau. "This includes fleet status, time of day, weather and taxi times. I used to fly to about 40 airports in the US, and most of the time extra fuel was not needed."

Cost index

Martineau explains that the common way to measure the value of time non-dimensionally is the cost index. This is the cost of time divided by the cost of fuel; or the ratio between the two. The cost of time is produced by the time-dependent components of aircraft operating costs, such as pilots and crew, and some maintenance cost. If crew costs are $10 a minute and maintenance costs are $10 a minute, then the total is $20 a minute. If the fuel cost is $750 a tonne, which is 75 cents a kg, the fuel index is then 20/0.75: equal to a ratio of $26-27.

More important is the fuel consumption per minute. Time-dependent operating costs can be saved by flying faster, but more fuel will be burnt in the process. The cost per minute for fuel therefore needs to be calculated.

The issue is more complicated, however. "Some airlines use a dynamic cost index. For example, if they are part of an alliance they will have a lot of connections, so there are misconnect costs which could be up to $12,000-13,000, say, because of reimbursements to passengers and other costs. In this case, every minute that the aircraft is late could cost $600, so it does not matter how much more fuel is burnt. It is important is for the aircraft to go as fast as possible," explains Martineau.

Martineau believes that only 5% of airlines are analysing these issues, and that there may only be one flight planning system that can manage it. "However if this is managed with real-time data you can look at the whole series of flights in the network, and know which flights need to speed up and which can slow down," explains Martineau.

He adds that airlines can learn a lot from the work that IATA has done to give guidance on saving fuel. "One airline did everything IATA recommended and saved $150 million in a year," he points out.

Liberator.aero

Dublin-based Liberator.aero recently signed a five-year reseller agreement with SITA which will see its Liberator Fuel Index (LFI) product offered to SITA's 600 or so members.

The company, which was set up by former Aer Lingus managers Kevin Pryor and Tony McDermott, has so far placed its system with SAS, Bangkok Airways and Finland's Blue One. It claims that historically 66% of flights have been dispatched with a forward trim, resulting in significantly higher fuel burn per block hour than necessary. It also points out that although modern aircraft can transfer fuel dynamically between tanks in flight to optimise balance and reduce drag, the full benefits can only be achieved if the initial centre of gravity (CG) is optimised pre-departure.

Mary Grady, Liberator chief operating officer, says that Liberator was originally set up to monitor weight and balance, and loadsheet data. It was not always current, despite people depending on it, for example, at departure control at an airport." The data are compiled from load sheets. Liberator therefore set up a data distribution application with a specified list of recipients.

"A spin-off from this," says Grady, "was a system for auditing Departure Control System (DCS) information. Under European Union (EU) OPS rules airlines must put in place a system to check that DCS data is correct. "Arising from that we started looking at load efficiency, since it affects fuel efficiency, and created the Liberator Fuel Index (LFI) system," adds Grady. This had a web interface as standard from the beginning. The company partnered with Merrion IT, and uses a development team based in India.

"By integrating with legacy IT

There are several ways airlines can reduce fuel consumption. The majority of flights carry too much contingency fuel, and this is just one area where savings can be realised.

systems within an airline, this becomes an archive of business intelligence," says Grady. "The ethos is 'Measure to Manage'. Lots of airlines are trying to do this and are not doing it very well. The Liberator system can automate it, taking data from SITA, Amadeus and other sources to be processed and output as tables and graphs, or whatever is required.

"LFI can apply a dollar cost to inefficiencies in each flight. Then it is a tactical tool which flight planners and dispatchers can use to improve efficiency based on historic data," continues Grady. He gives the example of Blue One, which had specific routes on which it wanted to monitor weights to try to keep landing fees down. They saved $30 per flight, or $48,000 per year per MD-90.

Total savings of about 2% can be made on an airline's fuel bill, says Grady. "You cannot really underestimate the value of this saving when oil costs are $84 a barrel, and it is predicted that it will go to $90 per barrel. This is equal to $2.50-2.70 per US Gallon (USG), which is hugely expensive for the industry."

"Traditionally airlines have depended on pilots. In reality every department in an airline makes a contribution to minimising fuel burn," says Grady. LFI serves as a decision-making tool, while raising awareness generally, because aircraft will not take care of it themselves. Although the trim envelope is wide, getting the trim more accurate on its own can save 0.5%, adds Grady.

LFI does not require any training to use because it is 'intuitive', according to Grady. "The airline has one administrator, who manages access to the system. We offer technical support, but clients rarely need it," says Grady.

LFI was originally set up for long-haul carriers, with SAS being the launch customer. Grady says that the airline found that it could save 2,000kg of fuel per flight to the Asia Pacific, just by managing Zero Fuel Weight (ZFW). The LFI system, which takes about six weeks to implement at an airline, has now evolved to take the whole route network into account, although it does not take aspects such as differing route charges on alternative routes into account.

Liberator also did a six-month project for Etihad, which had already ordered a system but wanted an interim solution. "This worked very well," says Grady.

Bangkok Airways started by monitoring CG, and then went on to focus on ZFW management. These are two of the four main LFI elements. The other two are discretionary weight and planning gaps (which covers late changes in loading, for example). Grady gives an example of the Aer Lingus Dublin-Manchester flight which often used to carry mail. If the mail did not turn up the loading would be very different.

LFI's reporting capabilities can highlight by route aspects. These can then be improved. It can even be used to show whether certain pilots are burning more fuel, although some airlines decide against using this feature.

"The world recession has hit the aviation industry very hard and although fuel conservation projects have been done by airlines before, they have only looked at the big things. It is now time to micromanage," says Grady.

In conclusion, Grady says that the company has several on-going projects and trials where airlines are measuring performance. One major advantage is that airlines do not have to replace any IT systems. LFI simply draws data from the existing systems. "Data feeding can be as dynamic as an airline wants," says Grady. "It can be real-time, but some airlines do not want the cost. Bangkok Airways, for example, has all the data archived daily anyway, so it sends it to Liberator every night. They can then make decisions based on the output."

Evoke Systems

Evoke Systems was established by pilot Mark Linney with his business partner, who has a PhD in data mining. The company's Electronic Journey Log allows a highly structured database to be established from airline data, although Linney stresses the need to clean up and verify the data. "After knowledge discovery at an airline," he says, "Evoke recommends changes to flight planning procedures and other aspects, such as the way aircraft are loaded."

Evoke has worked with one client which it helped to establish a structured fuel-saving programme. This included having a 'fuel tsar' to work closely with staff, including pilots. One of the central tools is Evoke's EFOS software suite.

"Most airlines are doing what they can to reduce the amount of fuel they burn, although there are lots of factors such as air traffic control (ATC) that are they cannot influence," says Linney. "However, where those airlines probably fall down is how they collect the data. The industry is just finding its feet in terms of what can be done, but you are never going to save more than 2-3%, whereas ATC improvements that would allow optimum speed and height and direct routes could save up to 10% fuel."

In the areas where airlines can improve, the savings are still substantial in monetary terms, even if not revolutionary. "Airlines can ensure that they have the safety margins, but without the fat," says Linney. This means only using the legal minimum amount of fuel, which includes ample reserves anyway.

Linney stresses the need to tap domain knowledge, and is scathing of those trying to improve flight operations efficiency when they have little practical experience of flying. Applying domain knowledge is half the battle. Pilots know why and when they burn more or less fuel than the flight plan." He agrees that there needs to be an operational loop, along with a team working on it. "It

Many airline departments need to be involved in a fuel-saving initiative, rather than just pilots. The only way to achieve savings is to make all relevant personnel conscious of the possible savings.

should not just be down to one person, and an independent consultant can help by being unafraid to point a critical finger at different departments," he says.

Linney says that after going into an airline, it takes six to eight weeks to complete an initial study and to pick off any low-hanging fruit. Airlines can be efficient or inefficient.

Evoke's structured approach starts with scoping the project. The aims would usually be to improve the accuracy of, and trust in, the CFP (Computerised Flight Plan); to develop SOPs (Standard Operating Procedures); to maintain safety levels; and, last but not least, education and training. It advises the creation of a fuel committee consisting of a pilot from each fleet, operations and ground services personnel, engineers, plus commercial and training specialists.

Linney puts investing in people and software high up his list. There needs to be a data analyst, a project manager, an expert consultant (domain specialist) and specialist software.

"Other IT measures which assist include Electronic Flight Bags (EFBs)," says Linney. "These allow data collection to be timely, efficient, accurate and reliable, unlike paper-based systems."

Validation and error handling is then important. For example, fuel gross error checks, accounting for early departures, time gross error checks, excluded and duplicate sectors and missing GCD (Great Circle Distance) values. "Intelligent analysis looks at the entire domain to highlight trends and identify the problems. Then you can interpret the results for specific fleets, bases and city-pairs; pilot training and experience; SOPs and Continuous Descent Approaches (CDA)/Required Navigation Performance (RNP), and by asking whether the route, speed and altitude were flown as planned.

"The planning system should be refined so that realistic fuel allowances are given for holding, taxi, contingency and diversions, based on historic data. Meanwhile, a tendency to only round up should be avoided. The bottom line is that the pilots are being assisted in making the right choice," says Linney.

Finally, knowledge gained should be utilised so that SOPs can be improved. Linney warns airlines (partly in the interest of safety) not to incentivise individuals, or penalise them for loading extra fuel, to be careful how they use league tables, and to accept that occasional diversions will occur.

Linney concludes by saying that a fuel- saving programme reduces fuel consumption and carbon emissions, but it needs good data, domain knowledge, and employee buy-in in order to be successful.

O-Sys

O-Sys (formerly DS&S) is a wholly-owned subsidiary of Rolls-Royce. The company has been closely involved with the Thomas Cook Group (initially in advising MyTravel) and it is instructive to observe the development of its capabilities since 2003:

2003-4
Auto alternate selection and reduced contingency fuel. Flight planning as a fuel efficiency measure. Fuel tinkering and cost index flight planning introduced.

2005
4-D flight planning to take account of aircraft DOC charges including: overflight charges, hourly maintenance charges & crew costs.

2006
Consolidation as crew confidence in flight plan fuel increases year-on-year.

2007
Introduction of auto-generated short-haul programme.

2008
Merger of two dispatch teams of MyTravel and Thomas Cook, bringing 'best of both' procedures together, and merging specialist teams into an enlarged flight support department.

2009
Close working with UK NATS and Eurocontrol to database ATC standards, such as UK Standing Level Agreement, better capture of CDRs and major input via Eurocontrol & RNDSG.

2010
Introduction of Jeppesen new generation system for capture of RAD/CRAM/CDR and new digital aircraft performance databases; to allow progress towards 3% contingency fuel planning.

OSys also introduced EFBs to the Thomas Cook fleet in 2007, and has developed fuel analysis and ETS (EU Emissions Trading System) modules.

Nick Ward, OSyS product manager, outlines observations on industry adoption. He notes that early adopters gain a competitive advantage, while late adopters have to catch up to defend their position.

Phase 1
Simple: Airlines operate basic Class 1 with OEM performance tools and document libraries.

Phase 2
Enterprise: Fleet-wide automatic management of content increases control and eliminates logistical nightmare.

Phase 3
Integrated: Early 2010s - Read/write EFBs created two-way process integration with ground applications.

Phase 4
'Type C': Mid 2010s - advanced

While many airlines have yet to implement fully operational fuel-saving initiatives, some airlines have already followed all recommendations and achieved an annual saving of $150 million per year.

navigation applications integrated with aircraft functions.

BMB Fuel (GE Aviation)

In January 2010 Ottawa, Canada-based BMB Fuel Consulting Services was acquired by GE Aviation. GE says that it acquired BMB Fuel as part of its OnPoint service for customers, to give data-driven consultation, and that BMB's expertise in fuel management software would broaden GE's existing fuel and carbon offerings. BMB Fuel offers its Aviation Fuel Decision Support software to airlines. These now face fuel costs at 30% of total operating costs, compared with only 10% a few short years ago.

Peter Lay, BMB director of operational efficiency says that airlines have a lot of data from ACARS, FMS, and engine trend monitoring. "The quantity is increasing as the aircraft gets more capable," he says. "We specialise in taking all those data sources and integrating them. This is within 90 days for an initial solution, but there is no hard and fast rule. It depends on the sources and the data quality.

"My experience over the past 4-5 years is that airlines have become much more savvy in saving fuel; doing the intuitive things," says Lay. "But the difficulty now is how to know if they are actually saving fuel. We have reached a point in the evolution of fuel conservation where to improve further you need to measure and sustain over a period of time.

"Lots of things could advance now we have the GE tie-up," continues Lay. "This includes integrating ATC and other data. GE bought Naverus in late 2009 as part of the same initiative. The industry needs a snapshot of how the whole system is operating. There could be more acquisitions in the pipeline in this area for GE." Donna Gerber, GE services marketing manager, however, says that there is nothing else at the moment, and that the approach of GE will be 'evolutionary' rather than revolutionary.

CASSES Flight Briefer

Flight Briefer is a modular product that is produced by Amsterdam Schiphol Airport-based Casses BV, and is used by Air Canada (including Air Canada Jazz), Martinair, Finnair, KLM and Emirates.

In particular Casses worked closely with Airbus when Emirates was preparing to take delivery of A380s. It added a new module to the EFB on the aircraft, known as Electronic Flight Folder (EFF). This allows the flight plan to be displayed on the EFB, providing a briefing pack including weather information, charts, and Notams. EFF can be saved on a USB device or uplinked.

Casses can be offered online over the web, as a 'System as a Service' (SaaS). In this way the airline needs to acquire no hardware or software, just a client PC and a web browser.

Dirk Baas, president of Casses, says that although the company has done little marketing since being founded in 2003, it has the only really integrated system where data used in one module can be used in other modules. Its system now has 16 modules; while many other competing systems only have one module.

Prior to Casses, Baas was employed in the flight dispatch department of Martinair. He says that he used to get his briefing package as a big roll of paper from SITA, which was all garbled. He realised that there was a need to improve the efficiency of flight planning, since dispatchers were wasting so much time, for example trying to send faxes.

"We wanted to get rid of the tedious tasks," says Baas. "So a flight briefing system was established and access was extended to all departments. Then an aircraft movement control module was added, just by putting an overview on the web of where the aircraft were. The Flight Briefer has also been extended by adding a Notam management system. This is a function where there may be 12-14 people in an airline doing Notam management, whereas the Casses system only requires one or two people to manage the same work.

At its main customer, Air Canada, Casses also added an automated fuel distribution module to the system. "Air Canada can place its fuel order very shortly before a flight, so it has the best Zero Fuel Weight and does not over-order fuel," says Baas. "Air Canada's whole return of investment for Flight Briefer was based on more efficient fuelling. Many airlines do not realise that they can save so much.

"The most important thing in fuel efficiency is safety and awareness. This is not only monitoring fuel, but also creating the awareness of how much you are using, if you are using extra, and why this is" continues Baas.

He concludes by pointing out that if an airline can cut fuel usage by 3%, it will save a large sum of money. Casses has therefore taken its system a step further and has started to offer a dedicated fuel efficiency module, which it has offered to two airlines.

Conclusion

There is little doubt that the fuel crisis has acted as the catalyst for the sudden growth of the fuel management field, with several small companies vying to position themselves in the marketplace. Some have already partnered with, or been acquired by, the leading names in aviation; such as SITA and GE. This is likely to continue as there is a convergence and 'linking up' of various data feeds that surround airlines. AC