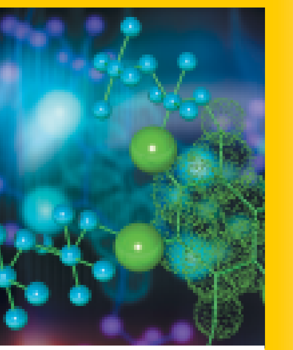
Image courtesy of KLM Royal Dutch Airlines

Major Heathrow project takes off



science

In the high-pressure world of aircraft scheduling, lost seconds cost money, damage customer relations and pollute the environment. Calculating the best take-off order at one of the world's most famous airports is a complex affair.

The Automated Scheduling, Optimisation and Planning group at The University of Nottingham is working closely with National Air Traffic Services Ltd to build intelligent decision support methodologies which will enable air traffic controllers to work with a computerised scheduling system and produce more efficient and effective schedules.

> ***"We're developing a scheduling system to aid the runway controller and improve throughput, without compromising safety"***
>
> *Professor Edmund Burke*

According to its website, Heathrow is the 'world's busiest international airport' and the 'hub of the aviation world'. More than 1,200 flights take off and land there every day, with some 63 million people jetting to 170 destinations around the world.

You'll know if you've flown from there what a swarming, chaotic environment it can appear to be. But behind the scenes in the control towers and offices, the whole vast operation has to run with military precision. There's little room for error as the day's flights come and go.

Down on the ground, an aircraft is ready to go. It taxies to a holding point near the end of the runway where it joins others awaiting take-off. It's the job of the runway controller to sequence the waiting planes to get the best order. Seconds are precious: aircraft should be delayed as little as possible and there are numerous complicated factors for the controller to consider: sizes, speeds, directions, allocated take-off time-slots. Safety is always paramount.

Incredibly, the runway controller isn't using state-of-the-art computers to work all this out. All the calculations are made in his or her head.

'A major constraint at Heathrow is the physical structure,' explains Jason Atkin, a PhD student at Nottingham who plays a key role in the project. 'With many airports, you have the space to reorder aircraft before they reach the runway. At Heathrow it's more practical to reorder in the queues at the runway, so the physical structure of the holding point affects what reordering can be performed.'

Aeroplanes queuing at Heathrow. (Courtesy of National Air Traffic Services Ltd.)

The order of take-off is important, for example 'big aircraft create more turbulence, so you don't want the next aircraft to be too small. Also you don't want a fast aircraft catching up with a slower one; and you don't want to send too many on the same route as this creates a headache for later air traffic controllers.'

Intelligent decision support

Jason is part of The University of Nottingham's Automated Scheduling, Optimisation and Planning group (ASAP).
This project is being funded by EPSRC (Engineering and Physical Sciences Research Council) and NATS (National Air Traffic Services Ltd.) through the Smith Institute for Industrial Mathematics & System Engineering.

The ASAP group, based at the School of Computer Science and IT, is one of the most reputable in its field. It was launched in 1996 and has current funding worth over £4 million from bodies such as EPSRC, BBSRC, the EU and industry.

The team, led by Professor Edmund Burke, specialises in providing intelligent decision support that can be applied across a wide variety of areas including bioinformatics, health care personnel scheduling, cutting and packing, production scheduling, timetabling and space allocation.

'What underpins all the problems we look at is computerised search,' explains Professor Burke. 'With aircraft scheduling you need instant answers, so we're developing a scheduling system to aid the runway controller and improve throughput, without compromising safety.'

Ongoing investment by National Air Traffic Services Ltd means that for the first time the necessary equipment will be in place to facilitate a computerised decision support system. ASAP's input to the development of this decision support technology is crucial to the success of this goal.

Another key goal is pollution control. Heathrow would like a third runway in the future, but before the government entertains the possibility, the airport has to meet strict environmental targets. Another runway can't add to the noise and fuel pollution of the current two. Reducing waiting times for aircraft awaiting take-off with their engines running will improve the situation.

Jason sits at his computer to determine how best he can reorder the aircraft at the holding point. He pulls up a schematic of the Heathrow site and points to a corner of the north runway showing the holding point. He's now looking at a replay of what really happened and using the same data as the runway controllers had, he can experiment using a simulation of the 600 or so daily take-offs.

'We want to be able to give the controllers a system that takes account of everything that's coming up. Whenever they look at the screen it must be up to date; if it's behind it's no good. The challenge here is to solve the problem instantaneously rather than in minutes or hours.'

Robust scheduling

In addition, the ASAP group is collaborating with KLM airlines to generate more robust fleet schedules.

Next to Jason sits Geert De Maere, a PhD student who is working on the KLM project. 'KLM is a carrier that has a lot of transfer flights,' he says. 'To maximise the number of connections between journeys, the airline creates peaks in the schedule when a lot of aircraft arrive and depart at the same time; maybe 50 coming in and then leaving within an hour.

'If there are any delays to the incoming flights, this may cause serious knock-on delays to whole sections of the fleet, which, of course, can be costly.'

Both the KLM and Heathrow projects are at an early stage, but a new generation of intelligent decision support systems will be of enormous benefit to airlines, controllers and ultimately passengers.

Further information
Jason Atkin T: 0115 951 4234 e-mail: jaa@cs.nott.ac.uk