



Computing, Artificial Intelligence and Information Technology

# Air traffic knowledge management policy

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## Abstract

A new air traffic knowledge management system is vitally important for the safety and efficiency of future air travel. It can be accomplished by developing a new-generation integrated operational decision support for pilots and controllers. At present the knowledge for decision making is only available when the latter parties share it and negotiate it in real-time. A new policy is required with a new management system and an automated planning of conflict-free air space–time allocation accomplished by an agent-based architecture of a global network of integrated operational decision support systems for airports, airlines and air traffic control. This aims at acquiring and monitoring a flow of air space–time knowledge-and-data structures of conflict-free and optimised flights given the available resources, and ensuring their long-term efficiency by an agent-based planning of flight-plan alterations off-line before signs of air space–time conflicts can develop in real-time. The Agents managing parallel knowledge acquisition and reasoning processes allocate air space–time resources according to the technical capabilities of aircraft in response to flight-plan clearance requests. They ensure decision support for efficient flights and use of air space–time, and conflict-free planning for air traffic management.

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## 1. Calls for changes

The current system of air traffic management is experiencing problems with coping with the estimated and inevitable increase of air traffic. Airports report with an irritating frequency flights which have been delayed.

As an air travel passenger I have experienced delays of flights caused by the deficiencies of the air traffic management. The most shocking experience was when I was travelling in the spring of 1998. A number of flights were cancelled and more were delayed. As a result a great number of passengers were waiting several hours without having any assurance when or whether there would be sufficient number of flights to take them to their planned destinations within a reasonable time-scale. I waited patiently for several hours assuming that the airlines and airports officers knew their responsibilities towards their passengers and would

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take care of us all. The latter belief created during the golden era of glamorous air travel happens to be out of date. I had a connection to catch at New York and I had to convince the airline officer before being allowed to board a plane that would take me there in time.

Another organisational deficiency has been made apparent to me as a passenger at a very busy international airport in the summer of 2000. Airport and airline officers do not always know the correct numbers of the gates from which flights leave and are unable to help the anxious and often hurried travelers who ask them. This irritating anomaly makes one wonder if the scheduling of gates and planes is still done manually. The airport officers were all carrying written notes which suggest that this was the case. Apparently they had different notes of the gate-number for a certain flight. To add to the story, all of them were sure that they had the correct information despite the fact that everything was most chaotic. The monitors were giving information that the flight was scheduled to leave from a certain gate but this turned out not to have been the correct one. It is most important that this situation be rectified. If the airport system cannot update its schedules electronically how can we expect the airport officers to inform the passengers correctly about the gates to which they should report and the flights to avoid delays?

The above practice is extremely inefficient. Incidents and delays of this nature are upsetting to passengers and not good for the reputation of the airports and airlines. They can be and should be avoided. In a complex system such as air traffic management we should not blame the air traffic control for all the delays of flights. Delays of flights can be caused not only by the current air traffic control operations but also by bad scheduling of airports' and airlines' operations.

It seems that the air travel is losing not only its glamour but also its reliability. 'The truth about the Air Traffic Control' revealed us by Perry [17] is that the ATC systems all over the world and particularly in the US domestic airspace rapidly lose their reliability for three main reasons: ageing equipment, old software, and maintenance prob-

lems. The airline operators lose billions of dollars annually because of delays of flights.

New strategies for increasing the capacity of the airspace are considered by the industry. They are reduction of the separation requirements between flight-plans, introducing of a flexible, more efficient, airspace track structure over the North Atlantic and air traffic routes in domestic airspace, and pilots being able to plan the most efficient route referred to as "free-flights". The North Atlantic Simulation Model [13,14,19] is designed to explore the strategies for increasing the airspace capacity. Steps have already been taken to modernise the existing air traffic management system. New Optimisation Approaches to Air Traffic Flow Management [15] have been considered by the European Organisation for the Safety of Air Navigation EUROCONTROL. The US National Airspace Board plans to move towards "free flights" (<http://www.faa.gov/freeflight>) by various phases. Phase 1 is expected to end in December 2002 to be followed by Phase 2 introducing incrementally new capabilities from 2003 to 2005.

As yet the industry does not consider introducing a new strategy for improving the management of the air traffic by setting up a new system of managing knowledge and airspace. In order to recover its former efficiency the industry has to introduce fundamental innovations and inter-organisational improvements.

### *1.1. Airspace and knowledge management*

This paper draws attention to the limitations of the current system of manual air space design and of the management of air traffic and knowledge. These are the factors which make a new air traffic knowledge management policy necessary. This aims at developing the air traffic management system and overcoming its deficiencies. To do this requires a new way of coordination and adequate sharing of air traffic knowledge which is managed at present by the three parties involved in the air traffic industry namely, the airports, the airlines and the air traffic control centres. This paper introduces the policy's innovations which will reshape and develop the present system. It discusses the design and technical effects of integrated op-

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