Meeting Agenda

Date	Time	Presentation Title
Monday	May 22, 2000	
	08.30 – 09.15	Airline Updates I
	09.15 – 09.45	Plenary Speaker I
		Understanding and Managing the Interactions between Air Traffic Control and Airline Operations Prof. John-Paul Clarke – *MIT*
	09.45 – 10.15	Decision support for integrated management of disruptions in Descartes project Sergey Tiourine – *British Airways/Carmen Systems*
	10.15 – 10.45	The Development of the Airline Operations Control Center Michael Clarke – *Sabre Inc. Research Group*
	10.45 – 11.00	*Coffee Break*
	11.00 – 12.00	Breaking Down the barriers between strategic planning and operations *Panel Discussion I*
	12.00 – 13.00	*Lunch*
	13.00 – 13.20	Beyond OCC: A new extended role for Operations Control Thomas Büermann – *Lufthansa Systems*
	13.20 – 13.40	Integrated Operations Control Solutions Ayyaswamy Sampath – *Sabre Inc.*
	13.40 – 14.00	An Operations Control System as the key to high quality decision making Paul Rainford – *SITA*
	14.00 – 14.20	ICL Limited
	14.20 – 15.30	Vendor Demonstrations

Meeting Agenda

Tuesday	May 23, 2000	
	08.30 – 09.00	Airline Updates 2
	09.00 – 09.45	Plenary Speaker II The Decision Support System for the Optimization of Aircraft Rotation and Routing in the Integrated Resources Management Process at Alitalia Cappelletti Susanna – *Alitalia* Fiorucci Claudia – *Alitalia*
	09.45 – 10.15	*SIMAir* – An Integrated Simulation Environment for Studying Airline Operations Prof. Ellis Johnson – *Georgia Institute of Technology*
	10.15 – 10.45	Efficient Algorithms for Overhaul Task Scheduling Tim Niznik – *American Airlines*
	10.45 – 11.00	*Coffee Break*
	11.00 – 12.00	Proactive Journey Management – Passenger re-accommodation *Panel Discussion II*
	12.00 – 13.00	*Lunch*
	13.00 – 13.30	Carmen Crew Tracking Ulf Hellman – *Carmen Systems*
	13.20 – 13.40	An Integrated Tool for Schedule Planning, Real-Time Recovery Henrik Imhof – *Atraxis AG*
	13.40 – 14.00	Advanced Integrated Real-Time Decision Support Systems David Walker – *Caleb Technologies*
	14.00 – 14.20	Resource Management Operations Control System Jonas Tarkiainen – *Resource Management*
	14.20 – 15.30	Vendor Demonstrations

Meeting Agenda

Wednesday May 24, 2000

08.30 – 09.00	Airline Updates 3
09.00 – 09.30	Gate and Fuel Management Jean-Francois Page – *Air Canada*
09.30 – 10.00	Simulation of Demand for Ground Resources Bart van Asten – *KLM Dutch Airlines*
10.00 – 10.30	Managing Airline Alliances - Competitive Environment and Network Efficiency Torsten Busacker – Berlin University of Technology Prof. John-Paul Clarke – *MIT*
10.30 – 10.45	*INFORM AC*
10.45 – 11.00	*Coffee Break*
11.00 – 11.30	Aspects of Efficient Implementation of Algorithms Ekkehart Vetter – *INFORM GmbH*
11.30 – 12.00	Total Airspace and Airport Modeller (TAAM) Dr. Alexander Klein – *The Preston Group*
12.00 – 14.00	*Closing Session*

Panel Discussions

Breaking Down the barriers between strategic planning and operations

An airline's ability to maintain its flight schedule during daily operations could be significantly improved if the overall airline schedule planning process incorporated a higher level of robustness. The schedule planning process has been traditionally subdivided into several discrete decision phases based on the pre-existing functional divisions within the airline. These include schedule generation, capacity planning, aircraft maintenance routing, crew planning, airport resource management, revenue management, and operations control and schedule recovery. This sequential approach to schedule planning has resulted in each airline group trying to achieve resource-specific objectives that often affects the outcome of downstream decisions. Additional, there is very little feedback to upstream process that could help improve the integrity of the final flight schedule. We will explore the potential benefits of improving the interaction between operations control and schedule planning.

Panelists
Michael Clarke – Sabre Inc.
Michael Irrgang – Lan Chile
TBD

Proactive Journey Management – Passenger re-accommodation

The topic of passenger re-accommodation during irregularities has been identified as an important issue for an individual airline, as well as in the context of global airline alliances. An alliance's system network will consist of multiple hub airports, which would allow individual airlines to offer passengers alternative itineraries on their partner carriers. However, most airlines in alliances do not have the necessary mechanisms and passenger IT systems in place to assist with passenger re-accommodation, which requires real-time cooperation between all airlines. Recent advances in telecommunications and computing power enable individual airlines to store, analyze and process large data-sets and information in a real-time environment. Many technical and procedural issues still exist that will limit the extent to which airlines using different CRS systems can easily exchange passenger information, seat availability and revised flight schedules needed to make decisions. It is anticipated that airlines will find it essential to address the topic of passenger re-accommodation, through developing a comprehensive IT decision support system to handle the issue of Journey Management.

Panelists
TBD

Presentations Abstracts

Runway Operations Planning and Control: Sequencing and Scheduling
Ioannis Anagnostakis, Prof. John-Paul Clarke – *MIT International Center for Air Transportation*
Dr. Dietmar Boehme, Dr Uwe Voelckers – ***DLR***

It is a common observation that delays occur during departure operations at major European and US airports. The resulting environmental impact and economic inefficiencies generate a growing need for the reduction of such delays. There are ongoing research projects at the German Aerospace Research Establishment (DLR) and the Massachusetts Institute of Technology (MIT) towards the development of automated decision-aiding systems to assist air traffic controllers in handling departure traffic and mitigating the adverse effects of ground congestion and delays. After considering the operational context for such systems, a conceptual architecture with planning and control layers is described. During this development effort, system inherent uncertainty is always taken into account in studying the dynamics of the planning process. Also, a framework for future research investigations is provided.

Incorporating Robustness in Airline Fleet Assignment and Aircraft Routing
Yana Ageeva, Prof. John-Paul Clarke – *MIT International Center for Air Transportation*

The "optimal" schedules used today by commercial airlines are far from optimal in practice as airline performance degrades significantly when faced with operational delays which develop from severe weather conditions, air traffic control constraints and unexpected aircraft and personnel failures. Presently airlines are using scheduling systems which create optimal schedules that do not take into consideration possible weather/air traffic control (ATC) delays. One way to resolve this dilemma is to develop real-time algorithms to re-optimize the schedule after irregularities occur. Another approach is to build robustness into the schedule when it is being developed so that schedule adaptations are easier. This paper presents three methods for adding robustness to the schedules of commercial airlines by incorporating the following features into the fleet assignment and aircraft routing model during the strategic phase of planning: Sub-Route Switching, Passenger Flow Redundancy and Optimized Connection Timing.

Decision support for integrated management of disruptions in Descartes project
Sergey Tiourine – *Carmen Systems*

Efficient management of disruptions is a major challenge in today's airline operations. British Airways, Carmen Systems and Technical University of Denmark have joined forces in the EC sponsored Descartes project to develop a comprehensive operations control system. The system will allow an airline to consolidate

all resources on the day of operations in order to provide high level customer service while maintaining an efficient operations plan. We will present a design of an open network of decision support systems, in which technologies from artificial intelligence and mathematical programming are used to coordinate a recovery process from situations ranging from minor disruptions to major breakdowns.

The Development of the Airline Operations Control Center

Michael Clarke, Ladislav Lettovsky, Barry Smith – *Sabre Research Group*

We present an overview of the state-of-the-practice in airline operations control centers, highlighting some of the recent trends and initiatives in development and deployment of decision support. Sabre is currently developing the Airline Integrated Recovery (AIR) framework that suggests operationally viable recovery solutions that minimize the impact of schedule changes on passenger trips while simultaneously taking into consideration aircraft, and crew availability. We will compare the underlying solution methodology of AIR to the current practices in airline operations control centers, and highlight the potential benefits of using the system.. In addition, we will discuss issues related to operations control such the impact of global airline alliances on operations, the need for robust airline planning, and journey management – coordinated customer service in the aftermath of irregular operations.

The Decision Support System for the Optimization of Aircraft Rotation and Routing in the Integrated Resources Management Process at Alitalia

Cappelletti Susanna, Fiorucci Claudia – *Alitalia*

In the first part of the talk, we'd like to present the models, developed by Alitalia's Operational Research Department, for the optimization of the integrated resources management process. Two distinct models compose the Decision Support System for the integrated resources management process:

- ARM (Aircraft Rotation Model) builds the weekly aircraft rotations of the Alitalia's fleet that adhere to the rules of resource employment. ARM supports all the Alitalia's Departments that build and manage the aircraft rotations from a month and a half (Planning Phase) until the day before the flight activities are to be executed (Preoperative Phase).

- AAM (Aircraft Assignment Model), every day for the day following, assigns all the flight and maintenance activities to a particular aircraft, taking into account the technical and functional needs and the maintenance expirations of each single aircraft.

The DSS for the integrated resources management process can be an adequate tool for supporting the whole process of building the daily plan of operations because it's able to preserve the rules of resource employment

in the Operational Management through the integration between the two models ARM and AAM. In the second part we'd like to present the results and the influence the System's use has brought to the Flight Scheduling, Planning and Operations Control Process.

SIMAir – An Integrated Simulation Environment for Studying Airline Operations
Prof. Ellis Johnson – *Georgia Institute of Technology*

SimAir is a modular code developed at Georgia Tech that simulates the daily operation of an airline. Its primary purpose is to evaluate plans, such as crew schedules, and recovery procedures in a dynamic, random environment. The notion of robust policies can be thought of as integrating planning over time. Planning should be thought of as an ongoing, or sequential, activity. Robust planning means making plans at each stage of the planning process so that later stages of planning have available better options. We summarize the research work in Industrial and Systems Engineering in these areas.

Efficient Algorithms for Overhaul Task Scheduling
Tim Niznik – *American Airlines*

The most intensive form of routine aircraft maintenance, known as a "D-Check", occurs every 6-8 years or approximately every 20,000 flight hours, involves thousands of tasks, and costs between $1-$2 million. Scheduling the tasks during such an event is typically performed by hangar supervisors and crew chiefs who use experience and judgement to make decisions about what tasks to do, when to do them, and with which resources. This presentation discusses a modeling approach and solution algorithm for overhaul task scheduling, with the objective of minimizing aircraft downtime and reducing overtime labor costs.

Gate and Fuel Management
Jean-Francois Page – *Air Canada*

Gate Management – Along with marketing and maintenance implications, hub optimization is an important part of the flight schedule development process. The Air Canada flight schedule at its Toronto hub is based on two-hour non-directional connection banks. The purpose of this research is to analyze an alternative to this rule consisting of directional connection banks and, more specifically to assess how this would impact gate assignment performance.
Fuel Management – We will present the definition of a new project which has the objective of minimizing corporate cost in the operation of our flights. The idea is to incorporate miss-connected passenger cost, etc. into the corporate cost.

Simulation of Demand for Ground Resources
Wouter Couzy and Bart van Asten – *KLM Dutch Airlines*

Several times a year, the KLM Ground Services Department has to evaluate a new schedule with respect to ground resources. Examples of ground resources are baggage handling systems, check-in desks, lounges, tanking equipment, service centers, etc. In order to facilitate this process, a dynamic model has been developed that translates a schedule into demand for resources. Currently, the model is not only used to evaluate mid-term schedule issues (3-6 months ahead), but also to support decisions on long-term investments.

Managing Airline Alliances - Competitive Environment and Network Efficiency
Torsten Busacker – *Berlin University of Technology*
Prof. John-Paul B. Clarke – *MIT*

Airline alliances have been the airline industry's particular response to the trend of globalization. This study focuses on the competitive environment, in particular the behavior of players in the marketplace, and gives an overview of what strategic alliances have achieved in other industries. It then focuses on establishing a metric for the efficiency of two airlines' joint networks. Accessibility has been established as such a metric. It is calibrated using data for the Star Alliance's traffic out of three US airports from 1994 to 1999. Results show that a combination of efficient hub-to-hub links and point-to-point services maximizes market share potential.

Aspects of Efficient Implementation of Algorithms
Ekkehart Vetter – *INFORM GmbH*

Various algorithms rely on integer matrix and polynomial computations. They spend a substantial amount of their running time in performing multiplications and exact divisions, integer by integer, or polynomial by polynomial with the remainder known to be zero. Here the main achievements are faster algorithms for exact division, and their exemplary application to determinant evaluation leading to better running times in practice as well as to better asymptotic performance by using fast multiplication techniques.

Vendor Abstracts

Beyond OCC: A new extended role for Operations Control

Thomas Büermann – *Lufthansa Systems Berlin*

After a short definition and review of state-of-the-art OCCs, an outline of an extended definition of future OCCs is given. The pros and cons of such extended responsibilities and functions are discussed. Consequences on organisation, human resources and IT infrastructure are presented.

Integrated Operations Control Solutions

Ayyaswamy Sampath – *Sabre Inc.*

The effective operations of an airline depends on several supporting departments working together to achieve a common goal. In addition to synchronized business processes supporting this goal, the systems used by these departments should be tightly integrated as well so informed decisions are made. Sabre's flight operations product portfolio supports the Integrated Operations Control with seamless data integration while offering decision support capabilities for irregular operations.

An Operations Control System as the key to high quality decision making

Paul Rainford – *SITA*

Operations are expected to make decisions about the disposition of an airlines most expensive asset. Decisions need to be made quickly and communicated to relevant staff to implement them. The impact of these decisions directly affects the paying customer. And yet Operations is often a neglected area for computerisation

To make good quality decisions, having access to relevant facts about the flights is a start. Having a Decision Support application to propose solutions to the problem in a consistent way, quickly and effectively, moves the process a stage further. That is where the SITA Operations system – FleetWatch – can assist.

ICL Limited

Carmen Crew Tracking

Ulf Hellman – *Carmen Systems*

Carmen Crew Tracking handles disruptions in the crew plan after rosters have been published. The system notifies the user about changes and illegalities and gives extensive decision support, making the plan flyable, minizing change and cost and maximizing crew satisfaction. Carmen Crew Tracking allows many users to work on the same problem and create scenarios that can be committed to the plan. The system is integrated with all other Carmen crew and vehicle planning products regarding e.g. user interfaces and rule language.

An Integrated Tool for Schedule Planning and Real-Time Recovery

Henrik Imhof – *Atraxis AG*

For mid size and large airlines, schedule recovery in daily operation is a task of high combinatorial complexity. A similar problem arises in schedule administration, where changing market requirements suggest deviations from a schedule optimised at an earlier stage. SAREX is an expert system originally designed to drastically speed up the response time to schedule disruptions in Operations Control. Later on, several other modules were added, dealing with Schedule Administration and Maintenance Planning. This combination allows airlines and engineering departments to work together on an optimised fleet utilisation, thereby adjusting their production dynamically to the market. In the optimisation model, engineering constraints, as work load or hangar space, can be switched off thus taking account of the fact that many airlines have outsourced the maintenance of their fleet. As a result, if engineering forms its own profit center, SAREX allows differentiating more easily between scheduling and engineering requirements, such as third party work.

In the presentation, we focus on the role of SAREX in Operations control, touching briefly on Schedule Planning and Maintenance Scheduling.

Advanced Integrated Real-Time Decision Support Systems

David Walker – *Caleb Technologies*

CALEB™ Technologies Corp., the emerging leader in Advanced Integrated Real-Time Decision Support Systems (AIRDSS™), provides fully integrated management systems for the airlines industry. CALEB Technologies 'AIRDSS real-time operations products include OpsSolver™ for real-time aircraft schedule management, CrewSolver™ for real-time crew management, and MaintenanceSolver™ for real-time maintenance schedule management. Additionally, CALEB™ Technologies Corp. offers ManpowerSolver™ for management of pilot and flight attendants. For more information, visit our web site at www.calebtech.com

Resource Management Operations Control System
Jonas Tarkiainen – Resource Management

Integrated IT Solutions as a Competitive Advantage in a Globalized Ground Handling Service Market
Samantha Wynn – *INFORMS AC*

Airline alliances, deregulation and digitization are setting new rules in ground operations. Facing this dynamically changing general conditions, ground handling service companies should use state-of-the-art IT solutions to gather maximum efficiency. Measuring, visualizing and managing their performance by this means, they could leave their competitors behind.

In the era of modern information technology the solution can only be an integrated technological platform, allowing the ground handling partners to integrate their planning, dispatching and controlling applications and processes. There are three dimensions to describe the integration function of such IT systems:

- the horizontal dimension integrating the different service units
- the vertical dimension due to the management structure and
- the temporal dimension, covering the complete dispatching cycle from planning to controlling .

Additionally, the system would need to have interfaces to airlines, airport authorities, the SITA system and to other sites on other airports, was the ground handling operator to be a multi-local one.

A case study will focus on the success factors –and benefits of integrated resource management systems.

Total Airspace and Airport Modeller (TAAM)
Dr. Alexander Klein – *The Preston Group*

The Preston Group, a wholly owned subsidiary of The Boeing Company, has developed the Total Airspace and Airport Modeller (TAAM). TAAM is used by airlines and civil aviation authorities, and aviation organizations worldwide. TAAM is a gate-to-gate, fast-time simulation tool, which assists our customers in modeling their current operations and then performing multiple, fast-time, "what-if" analysis. Customers achieve analysis results, which can substantially reduce ground and airborne delays, increase capacity and revenue, and improve utilization of ATC systems. TAAM is the only total, gate-to-gate system capable of modeling the entire airside and airspace environment in detail (pushback, terminals, en-route, and oceanic airspace) in one seamless application. TAAM's main objectives: Airway congestion mitigation, Apron, taxiway, and runway delay analysis and management, redesign of terminal area and en-route procedures and National airspace redesign. When weather and airport/airspace usage data are added, TAAM can provide fast and accurate situation prediction.