Air-to-Air Triathlon

ATRiCS

Barco Orthogon

INFORM

Joint What-If
Air-to-Air Triathlon

- **Triathlon:**
  Swimming, bicycling and marathon,
  three different areas of fitness – *one competition*.

- **TAMS Joint What-If:**
  ATC, Airport and Airline driven by safety and efficiency,
  three different stakeholders – *one Air-to-Air process*

- **Three solution providers, one integration**
Information instead of resources

Lindberg’s Spirit of St. Louis (1927)
- Fuel reserve to compensate lack of information

Fossett’s Global Flyer (2005)
- Satellite communication and navigation to compensate lack of fuel
What If …

What if I click “cancel”? That’s what killed Carl.

www.dilbert.com
Air-to-Air Triathlon

ATRiCS

Barco Orthogon

INFORM

Joint What-If
Company Introduction

ATRiCS provides: intelligent ATM solutions

Founded in 2002
Based at Freiburg Airport in Germany
20 highly educated employees
Software solutions and consulting services
Exclusive focus on Air Traffic Management
ISO 9001:2008 certified

ATRiCS provides:

- Tower Surface Management System
  - Jane's ATC Award for Innovation 2012
  - Runway Incursion Prevention and Detection
  - Pilot Conformance & ATC Clearance Monitoring
  - Routing, Guidance and Control
  - 4D Trajectory-Based Planning

- Airport Collaborative Decision Making
  - Traffic Event Detection
  - Advanced Taxi Time Calculation
  - Pre-Departure Sequencing
  - Sequence Analysis

- Simulations
  - Operational Concept Validation and ATCO Training
  - Benefit Assessment and System Verification Tests

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Introduction

Major contribution to TAMS:

**Surface Manager – the connector of air and ground**

- Advanced taxi time calculation
- Pre-departure-, off-block and taxi-sequencing
- Automated guidance – “following the green”
- Situational Awareness
- Joint What If
Predict – Plan – Control

- **Prediction** – *gather Information*
  - Advanced taxi time calculation

- **Planning** – *take a decision*
  - Long Term:
    - Strategy: taxiway routing patterns
  - Short Term
    - PreDeparture, Off-Block and Taxi Sequencing

- **Controlling** - *carry the decision into execution*
  - Active routing and guidance – *following the green*
Advanced taxi time calculation

- **Static Tables**
  - Changes on…
    - Infrastructure
    - Traffic Situation
    - Input Datas
  - … has no impact

- **Advanced**
  - Real-time calculation
  - Differentiate between Unimpeded and Impeded times
  - Increase prediction quality while the process
    - Updates by sequencing results
    - Taking ground surveillance into account

Decision Opportunities

**real Time**
- SMAN automated planning and routing
- Collaborative planning of DMAN and SMAN
- SMAN parameters as part of different airport strategies

**medium term**
- individual guidance
- taxi sequencing
- pre departure sequencing
- taxiway routing patterns
- Stand coordination

**very long term**
- Impact of new

Relevant decision in an APOC

Piekert and Strasser: „Potential Impact of Data Variance on the Prediction of Key Performance Indicators (KPI) as a Decision Variable for Airport Pretactical Decision Making within a Total Airport Management (TAM) Airport Operations Center (APOC)“ Tokyo, Japan. EIWAC 2010
Taxiway routing patterns

**Operative**
Standard routing pattern

Predicted take off order: ATR1; ATR2; ATR0

**What-If probing**
Alternative routing pattern

Predicted take off order: ATR1; ATR0; ATR2
Taxi-Sequencing

- A startUp sequence is **not** a takeOff sequence

- Taxi Sequencing
  - Optimised take off order
  - Reduce stop and go traffic

- Individual guidiance
  - Control the planed taxi-sequence
Simulation Results

Inbound - EIBT

99% of predicted events

Flights arrived later than predicted

70% of predicted events

Outbound - EETT

Expected Value Median

Flights arrived earlier than predicted

30 min. before ALDT
15 min. before ALDT
0 min. before ALDT
2 min. before AIBT
45 min. before ASAT
5 min. before AOBT
0 min. before AOBT
2 min. before AETT
Simulation Results

**Arrival Sequence**

- 30 min. before ALDT
- 15 min. before ALDT
- 0 min. before ALDT
- 2 min. before AIBT

**Surveillance taken into account**

- 45 min. before ASAT
- 5 min. before AOBT

**PreDeparture Sequence**

- 0 min. before AOBT
- 2 min. before AETT

**Outbound - EETT**

- Inbound - EIBT
- Surveillance taken into account

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Company Introduction

- Orthogon GmbH founded 1987 in Bremen
- since 2002 100% subsidiary of Barco N.V.
- specialized in software for ATC, Airlines and Airports
- approximately 75 employees
- World wide business with system integrators and ANSP
Major Contributions

- Major contribution to TAMS:
  - Airside Tactical Working Position
  - ODS Open Platform
  - Airside performance prediction and performance assessment
  - Coupled Arrival & Departure Management (incl. “What-if” probing)
  - Interfacing of ATC tools with airport infrastructure (i.e. AODB)
Airside Tactical Working Position (ATWP)

Operational Requirements

- Focus on collaborative airport planning in APOC
- ATC agent in APOC needs specialized working position (ATWP)
- ATWP displays relevant information for ATC agent
- ATWP provides interface to tactical planning tools (AMAN / DMAN / SMAN)
- ATWP provides collaborative decision support functionality

System Requirements

- Modular HMI Framework to provide information in different situations / for different roles
- New and adapted views to show aggregated information
- Adaptations and enhanced queue management functionalities
ODS Open Platform

- Integration of HMI components from different contributors
- Centralized data model
- Adaptable layout
- Interaction between HMI components (e.g. highlighting)
- Consistent presentation (e.g. pre-defined color schemes)
- Modular and open architecture
Airside Tactical Working Position (ATWP)

- Airspace surveillance
- Arrival and departure sequence
- Pre-departure sequence
- Aggregated milestones
- Tactical Joint What-If
- Air Traffic Flow and Key Performance Indicators
Airside Performance Prediction

- Collaborative Decision Making at airport operations center for airside processes
- Demand Prediction for runways as well as arrival & departure routes (SID/STAR)
- Performance prediction based on standardized¹ ATM Airport Key Performance Indicators (KPI):
  - Capacity (runway throughput)
  - Arrival punctuality
  - Departure punctuality
  - ATC slot compliance
  - Additional time for ASMA²
  - Additional time in the taxi-out phase

¹ Airport Key Performance Indicators according to:
  - ATM Airport Performance (ATMAP) Framework (Eurocontrol, December 2009),
  - Performance Scheme for Air Navigation Services (EU Regulation No 691/2010, July 2010).
² ASMA: Arrival Sequencing and Metering Area
Airside Process Optimization

- **Coupled Arrival & Departure Management** (AMAN/DMAN)
- Runway capacity utilization improved and balanced in accordance with predicted demand:
  - Gaps in arrival sequence to handle departure peaks
  - Runway balancing for multiple runway systems
  - Pre-Departure Sequencing compliant to Airport CDM concept
  - “What-If” probing to judge different strategies
Integration with Airport Infrastructure

- **AMAN / DMAN coupled with AODB** as an integral part of TAMS
- **Procedures** (information exchange) and solutions (system interfaces)
- **Tactical Joint What-If** supports collaborative decision making
- **VTTC** and **Taxi-Sequencing** integrated with DMAN and SMAN
Exploitation of TAMS Results

- **Follow-up project “META-CDM”**¹ (Kick-Off in July 2012) focuses on close discussion with airport stakeholders aiming for:
  - Promotion of current TAM R&D status
  - Roadmap to bring R&D results into operations
  - Follow-up R&D to provide further benefits

- **OSYRIS Queue Management Demonstration System**
  - Will Integrate TAMS developments
  - Will allow stakeholders at worldwide airports to assess benefits

- Further **collaboration with TAMS partners** envisaged to make use of R&D results for future product development

¹ META-CDM: “Multimodal, Efficient Transportation in Airports and Collaborative Decision Making”, (Coordination and support action within the EU Seventh Framework Programme)
Company Introduction

Swiss Post

Parcel Centers

Hamburg CTB: Germany's largest container terminal

• Optimized Hospital Logistics
• Transport of patients and goods

Atlanta: World's largest passenger hub
Company Introduction

- focus on Advanced Optimization Systems
- best-of-breed solutions
- established in 1969 (university spin-off)
- since 1985 on average **22% annual growth**
- organically growing, no external investors
- since 1985 always profitable
- internal ownership (directors, staff)
- today more than **300 employees**
- principal corporate objective: **long-term sustainability**
Major Contributions

Courcontations to TAMS:

- Airline and Ground-Handler Working Positions
- Target Offblock Time Prediction
- APOC HMI Design
- A-CDM Empowerment/ CSA Tool for 16 Milestones
- Airline Preferences Determination
- Joint What-if Design and Prototype
## TMAN Turnaround Manager

![Flight List Screen](image)

### Flight List

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<th>Flight</th>
<th>Arrival</th>
<th>Departure</th>
<th>Aircraft</th>
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Integrated Airport Map
Joint What-If

- What-if capability
  - taking a time slice up to several hours in advance
  - real-time data basis, transferring it into a „sandbox“
  - keeping the real-time feed of events

- Joint What-If probing
  - across all tactical tools
  - immediate check of considered mitigations
  - mutual agreement on joint solution
JWI Data Flow

Operational AODB / Surveillance Data → comparing alternatives → Tactical Joint What-If SAODB

Operational / “Real World” XMAN

Create What-If Context:
- Flight Plans
- Monitoring
- State Transition

Join Joint What-If Context XMAN

Accept What-If Context
Joint What-If

Arrival and Departure Manager Live&What-if

Turn Around Manager Live&What-if

Surface Manager Live&What-if

Scenario AODB

Live AODB
What-If …..future extension?
Thank you for your attention ...

... Thank you very much....