Lufthansa Group – The business segments

<table>
<thead>
<tr>
<th>Passenger transportation</th>
<th>Logistics</th>
<th>Catering</th>
<th>Other activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Lufthansa Group airlines rank among the world’s leading carriers.</td>
<td>Lufthansa Cargo – one of the world's leading cargo carriers in international air traffic.</td>
<td>LSG Sky Chefs – leading provider of airline catering and integrated in-flight solutions.</td>
<td>Lufthansa Aviation Training Lufthansa AirPlus Lufthansa Industry Solutions (and many more)</td>
</tr>
<tr>
<td>Lufthansa Technik – leading provider of MRO services in the world's airline business.</td>
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</tbody>
</table>
Lufthansa Technik AG – Product Divisions

Aircraft Services
(Maintenance, Overhaul)

Engine Services

Component Services

Landing Gear Services

VIP & Special Mission Aircraft Services

Coverage of any conceivable requirement of an aircraft owner or operator
We are experienced in fulfilling customer-specific requirements around the globe
Agenda

Engine Fleet Management

MATLAB GUI as Platform for Calculations

Core Functionality

Visualization and Reporting Functions

A growing number of Interfaces

Summary
Engine Fleet Management
A complex Task

- Removal forecast
- Work Scope forecast
- Scenario Analysis
Engine Fleet Management
A complex Task

Aircraft Fleet
- Engine Type Rating
- Utilization
- Flight Profile

Engine Fleet
- Hardware Version
- Module Data
- Part Data
- Spare Availability

Engine Fleet Management
- Removal forecast
- Work Scope forecast
- Scenario Analysis

Customer

Engine Service
Engine Fleet Management
A complex Task

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Service Contract
Commercial Parameter
- Price Model
- Customer Work Scopes
- Customer Requirements
- Lease Return Conditions

Customer

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Engine Shop
- Expert Knowledge
- Customized Work Scopes
- Cost Data

Maintenance Documents
- Manufacturer Recommendations
- Airworthiness Directives
- Technical Limits

Service Contract
Commercial Parameter
- Price Model
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- Customer Requirements
- Lease Return Conditions

Customer
Engine Service
MATLAB GUI as Platform for Calculations
Migration from Prototype to new Framework was performed

- Robust Framework
  - Developed and integrated with MathWorks Consulting
  - Quickly adjustable
  - Modular
MATLAB GUI as Platform for Calculations
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MATLAB GUI as Platform for Calculations

Migration from Prototype to new Framework was performed

- Robust Framework
  - Developed and integrated with MathWorks Consulting
  - Quickly adjustable
  - Modular

→ Migration from individual GUI to robust framework was worthwhile
Core Functionality – Removal Planning Algorithm
Simulation of Aircraft and Engine Fleet Operation for Contract Period

1. Work Scoping Decision
2. Send Engine to Shop
3. Remove Engine from Aircraft
4. Select an Engine for installation on Aircraft
5. Time Step to Removal Date
6. Calculate next Removal Date
7. Send Engine to Spare Pool
Core Functionality – Removal Planning Algorithm
Simulation of Aircraft and Engine Fleet Operation for Contract Period

- Growing complexity by introduction of new Features due to increasing user demand
  - Stagger Removals
  - Park Aircrafts
  - Insert additional Shop Visits
e.g. for Lease Return Requirements
Core Functionality – Removal Planning Algorithm
Simulation of Aircraft and Engine Fleet Operation for Contract Period

- Growing complexity by introduction of new Features due to increasing user demand
  - Stagger Removals
  - Park Aircrafts
  - Insert additional Shop Visits e.g. for Lease Return Requirements

→ Reorganization of Data Structure and algorithm in progress
Core Functionality – Work Scoping Decision
Decision making based on a Fuzzy Logic algorithm

- Combing hard Criteria and Expert Knowledge
- Transparent Decisions
- Dynamically adjusted Templates
- Modelling of Uncertainties
Core Functionality – Work Scoping Decision
Decision making based on a Fuzzy Logic algorithm

- Combing hard Criteria and Expert Knowledge
- Transparent Decisions
- Dynamically adjusted Templates
- Modelling of Uncertainties

→ Integration of Fuzzy Logic Toolbox
→ New algorithms and features can be integrated with a moderate effort
Visualization and Reporting Functions
Prepare Result for further Analysis

- Requirements
  - Prepare Overview of Fleet
  - Assessment of Scenarios
  - Support Decision Making
  - Export Results to internal and external Customers
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- Requirements
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  - Assessment of Scenarios
  - Support Decision Making
  - Export Results to internal and external Customers

→ Preparation of Graphical Output is challenging
→ Flexible Export Function are easy to use

Database
.xlsx, .pdf
A growing number of Interfaces
Monitoring of an Engine Fleet

Aircraft Fleet
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- Manufacturer Recommendations
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Service Contract
Commercial Parameter
- Price Model
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Customer
Engine Service
A growing number of Interfaces
Monitoring of an Engine Fleet

Aircraft Fleet
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Engine Fleet
- Hardware Version
- Module Data
- Part Data
- Spare Availability

Customer Updates
- Current Fleet Status

On Wing Maintenance
- Planned Inspections

Engine Fleet Management
- Removal forecast
- Work Scope forecast
- Scenario Analysis

Service Contract
- Price Model
- Customer Work Scopes
- Customer Requirements
- Lease Return Conditions

Maintenance Documents
- Manufacturer Recommendations
- Airworthiness Directives
- Technical Limits

Engine Shop
- Expert Knowledge
- Customized Work Scopes
- Cost Data

Shop Data
- Current Cost/Test Data

Engine Condition Monitoring
- Life Trend Data

Customer

Engine Service

Instandhaltungsplanung von Triebwerksflotten | N. Theilig | Contract Engineering | Engine Services

Lufthansa Technik
Summary
Challenges & Conclusions

🚀 Development Speed
→ Urgent Adaption to new Demands

🔗 Complexity of Decisions
→ Many Dependencies

📄 Data Import
→ Unsteady Input Files/Systems

💾 Data Management
→ Additional Parameter

❓ Testing of new Functionalities
→ Qualitative Assessment of Calculation result necessary
Summary
Challenges & Conclusions

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 ADVISED

Data Management
→ Additional Parameter

❓ Testing of new Functionalities
→ Qualitative Assessment of Calculation result necessary

➡️ Migration to new GUI
→ Completed and Worthwhile

➡️ Enhancement of Program Structure
→ Transfer to Object Oriented Programming

➡️ Modular Code

➡️ Consulting & Continuous Revision of Code Segments
Thank you for your attention!

Contact Information, e.g. for Internships or B.Sc / M.Sc Thesis within our department

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