Development of an Object Oriented Data Model *ADDAM* for Applications in Aircraft Design

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Agenda

- Introduction
- Requirements on Data Model
- Aircraft Design DAta Model ADDAM
- Example Airbus A320
- Conclusion
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• Introduction
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Why Do We Need an Data Model?

Usage of Computer-Aided Tools and Data Models

Disciplines of Aircraft Design Process

Conceptual Design | Preliminary Design | Detail Design

Design Knowledge and Information

Design Flexibility

PLC

Usage of Computer-Aided Tools and Data Models

Conceptual Design: 100%
Preliminary Design: Decreasing
Detail Design: Increasing

Design Knowledge and Information: Increasing

Disciplines of Aircraft Design Process:
- Propulsion
- Configuration
- Weight
- Performance
- Aerodynamics
- Profitability
- Structure
- Flight Dynamics
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Requirements on Data Model

**Software**
- Uniqueness
- Consistency
- Transferability
- Expandability
- Compatibility
- User-friendliness

**User**
- Specific Aerospace Nomenclature
- Engineer Way of Thinking

**Object Oriented Data Model**
- Assemblies = Objects
  - Properties = Characteristics
  - Methods = Functions
Why it is programmed with MATLAB?

“MATLAB provides a fully OOP design environment”

User

- Availability @ Universities and Industry
- Programming Knowledge of most Students, Research Associates and Industry Employees

Software

- Use Inheritance to Minimize Sum of Classes
- Use Handle Classes similar to Pointer
- Use Events and Listeners for Integrated Functionality
- Define Different Accessibility Rules
- Compatibility to other Software
- Exportability into other Programming Languages
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Aircraft Design Box ADEBO

ADDAM

- Aircraft Configuration
- Data Storage
- Artificial Engineer
- Cell Array

Tools

- Design Chart
- Weight Estimation
- Mission Performance
- Aircraft Aerodynamics
- Airfoil Aerodynamics

Software

MATLAB

Object

MUNICH AEROSPACE

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Development of an Aircraft Design DAta Model ADDAM

Institute of Aircraft Design
26.08.2014, slide 8
Artificial Engineer

Tasks:  
- Process Control  
- Data Administration

- Knowledge of Tools  
- Calculation Schedule  
- Public Get Access  
- Private Set Access  
- Initialize Tool Specific Data  
- Start Calculations  
- Set & Get Data  
- Save Data

"links the tools with the configuration object"
Configuration

“consists of objects, arrays, chars and cell arrays”

- 50 different Classes available
- User Specified Object Names
- Timestamps
- Public Get Access
- Private Set Access
- Mass Update Listener
- Administrative Methods

Types of Classes

- Assemblies
- Characteristics
- Mission
- Tool Specifics
- Coordinate System
- Flight Condition
Configuration Characteristics

- Geometry

- Aerodynamics

- Weights

- Performance

- Noise

- Kerosene

- Battery

- H₂

- Fuel Cell
Workflow

Initialize → Configuration → Customize → Object → Configuration → Object → Artificial Engineer → Initialize

- Run by Method
- User Input required
Workflow

- Object
- Configuration
- Set Data
- Define Type of Set Data
- Artificial Engineer
- Set Calculation Schedule

- Run by Method
- User Input required
Workflow

1. **Object**
2. **Configuration**
3. **Get Data**
4. **Artificial Engineer**
5. **Run Tool**
6. **Calculation**
7. **Tool**
8. **Run Calculation**

- **Run by Method**
- **User Input required**
Workflow

- Object
  - Configuration
  - Set Data
  - Artificial Engineer
  - Result Data
  - Tool
    - random

- Run by Method
- User Input required
Workflow

- Object
- Configuration
- Save Configuration
- Artificial Engineer
- Save Configuration

- *.mat File
- Name_ID_Date.mat

- Run by Method
- User Input required
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Airbus A320

- Comparison of aerodynamic data with PAWAT and Datcom
- Based on same configuration object
  - identical geometry input data
  - Different calculation tools and methods

Solved Issues:
- Different tools need additional input data
- Add information flag for used tool
- Convert input data into required format

- Check if data already exists
- If format and length is correct
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Conclusion

- Applicable for all Fixed Wing Aircrafts
- Focus on Engineering Tasks
- Save Data of Product Life Cycle

**Why Using MATLAB?**

- Using OOP and Functional Programming in one IDE
- Compatible to other Programming Languages via OpenCDT
- Integrated Data Management Methods
- Integrated Possibility for Data Visualization
- User Friendliness
..More Time for Aircraft Design..

ADDAM

Object

Aircraft Configuration

Data Storage

Cell Array

Object

Artificial Engineer

Tools

Design Chart

Airfoil Aerodynamics

Weight Estimation

Aircraft Aerodynamics

Mission Performance

Software

Software

Software

MATLAB

MATLAB

MATLAB

MATLAB

MATLAB
Back Up

How's the Big Data project coming along, Hoskins?
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