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
Agenda

• **Introduction**
• Requirements on Data Model
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Why Do We Need an Data Model?

Usage of Computer-Aided Tools and Data Models

Disciplines of Aircraft Design Process

- Propulsion
- Configuration
- Profitability
- Structure
- Performance
- Flight Dynamics
- Aerodynamics
- Weights
- Configuration
- Design Knowledge and Information
- Design Flexibility
- PLC
- Conceptual Design
- Preliminary Design
- Detail Design

Usage of Computer-Aided Tools and Data Models

- Usage of Computer-Aided Tools and Data Models
- Aerodynamics
- Configuration
- Flight Dynamics
- Structure
- Performance
- Profitability
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- Design Knowledge and Information
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- Conceptual Design
- Preliminary Design
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- 1903
- 2013
Agenda

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Requirements on Data Model

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

Object Oriented Data Model
- Assemblies = Objects
  - Properties = Characteristics
  - Methods = Functions

User
- Specific Aerospace Nomenclature
- Engineer Way of Thinking
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

“MATLAB provides a fully OOP design environment”
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Aircraft Design Box ADEBO

ADDAM

Object
Object

Aircraft Configuration

Artificial Engineer

Data Storage

Cell Array

Tools

Design Chart

Airfoil Aerodynamics

Weight Estimation

Aircraft Aerodynamics

Mission Performance

Software

MATLAB

MATLAB

Software

Fortran

MATLAB

MATLAB

MATLAB

MATLAB
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

- Geometry
- Aerodynamics
- Weights
- Performance
- Noise
Workflow

- Initialize
- Customize
- Run by Method
- User Input required

Start

Progress

Object

Configuration

Object

Configuration

Object

Artificial Engineer

Initialize
Workflow
Workflow

1. **Object**
   - Configuration
   - Get Data
   - Run by Method

2. **Artificial Engineer**
   - Run Tool
   - User Input required

3. **Calculation**
   - Tool
   - Run Calculation

4. **Progress**
Workflow

- **Object**
- **Configuration**
- **Set Data**
- **Tool**
- **Result Data**
- **Artificial Engineer**
- **Object (random)**

- Run by Method
- User Input required
Workflow

Object
Configuration

Save Configuration

Artificial Engineer

Save Configuration

Object

*.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

Artificial Engineer

Tools

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Airfoil Aerodynamics

Software

MATLAB

Fortran

MATLAB

Software

MATLAB

MATLAB

Range

Fuel

Payload

TO Weight

Fuel
Back Up

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