MEMKO Aviation Aerospace & Defence

DIGITAL GAP - DESIGN, MANUFACTURING & MAINTENANCE

Miro Miletic, Managing Director
Overview

- About MEMKO
  - Presenter
  - Business Streams
  - Certifications and Accreditations

- Digital Gap, Design, Manufacturing & Maintenance
  - The Journey and Current status

- Design to Manufacturing
  - Engineering Assets
  - Manufacturing Derived Assets
  - The Supply Chain

- Design to Maintenance
  - Engineering Assets
  - Maintenance Derived Assets
  - The Supply Chain

- Conclusion and Recommendations
Extensive record of leadership and achievement over 30 years in the global aerospace industry recognised by the award of an Honorary Doctorate in Engineering (Aerospace) by RMIT University, Melbourne Australia.

Worked on large commercial and military aircraft projects:
- Boeing 737, 747, 757, 767, 777, 787, F/A-18, 737AEWC, JDAM-ER
- Lockheed C-130 and F-35
- Airbus A320, A330, A340 and A380

Active involvement in aircraft design, manufacturing, maintenance and support of aircraft entry into service.
About MEMKO

10th Anniversary
May 2007 – May 2017

Customers

Aerospace
AS 9100
SAI GLOBAL

Products – Technology – Training – Engineering Solutions
Business Streams

Aviation, Aerospace & Defence
- Consulting and Regulatory Support
- Design, Analysis, Test and Certification
- CAMO Services
- Part 21.M Engineering
- Aircraft CoA
- R&D

Systems
- Software Products
- Deployment Services

Training
- Aviation & Aerospace
- Product Life Cycle Management (PLM)
CASA Instrument of Appointment for CASR Subpart 21.M
- Repair and Modification Subpart 21M
- FMS CASR Reg 21.006A
- Tech Data CASR Reg 21.009
- Type Data changes CASR Reg 21.095
- Weight & Balance Authority CAO 100.28 (A319/A320/A321)
- MRB authority under affiliation with local manufacturers

CASA Instrument of Appointment for CASR Subpart 21.H
- Certificate of Airworthiness Reg 21.178
- Export Certificate of Airworthiness Reg 21.324
- Special Flight Permit Reg 21.200

Closing the Digital…
1950’s

Engineering

Manufacturing Planning

Production

IP Continuity

As-Designed → As-Planned → As-Built → As-Maintained

IP Maturity
1970’s

IP Maturity

As-Designed

As-Planned

As-Built

As-Maintained

IP Continuity

Engineering

Manufacturing Planning

Production

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Products – Technology – Training – Engineering Solutions
# Engineering and Manufacturing Derived Assets

<table>
<thead>
<tr>
<th>Master Data</th>
<th>Derived Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data created by OEM in order to manufacture the aircraft</td>
<td>Data created by the OEM and supplier</td>
</tr>
<tr>
<td>Model Based Definition – 3D</td>
<td>Project Plan</td>
</tr>
<tr>
<td>Process Specification</td>
<td>Manufacturing Plan</td>
</tr>
<tr>
<td>Materials Specification</td>
<td>Quality Plan</td>
</tr>
<tr>
<td>Standards</td>
<td>Work Instructions</td>
</tr>
<tr>
<td></td>
<td>NC Data</td>
</tr>
<tr>
<td></td>
<td>Tooling Data</td>
</tr>
</tbody>
</table>
Process, Quality and Resource Planning (OEM)

- **Resource Planning**
  - Define Resource Layout and line balancing on resources / check resource occupation

- **Simulation Engineer**

- **Conceptual & Detailed Design**
  - Work instruction definition
  - Time Analysis
  - Material Flow optimization
  - Assembly Process Simulation
  - Mfg System/Workplan definition and optimization

- **Process Planner**
  - Manufacturing Project and Governance
  - Program Assistant

- **Program Manager**
  - 3D Process Feasibility

- **Assembly Process Designer**
  - 3D Process Feasibility
  - Mfg System/Workplan definition and optimization

- **Manufactured Product definition**
  - Process Planner

- **Program Assistant**

- **Mfg Product Planning**
Future – Design, Planning, Manufacturing

- As-Designed
- As-Planned
- As-Built
- As-Maintained

IP Continuity

Design Intent

CAD/PLM MBD/MBSE

Planning, Offline Programming, Simulation and Validation

Various tools with limited integration and functionality

Work Instructions, Condition of Supply, Technical Publications

Shop Floor Operations

MES/ERP/MIS

Design, Engineering Simulation and Analysis
Manufacturing – The Supply Chain

- Manufacturing supply chain is evolving from a tiered structure to one aligned to commodities
  - Machined components and sub assemblies
  - Composite components and sub assemblies
  - Systems

- Digital continuity between OEM’s and suppliers is limited
  - Cyber security and export control requirements
  - Use of multiple CAD/PLM systems by OEM’s
  - Cost of CAD/PLM/MES/ERP software
  - Supplier skills in digital technology
## Engineering and Operator Derived Assets – The Earth is Flat

<table>
<thead>
<tr>
<th>Master Data</th>
<th>Derived Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data provided by OEM and Regulatory policies in order uphold the aircraft’s</td>
<td>Data created by the Operator, usually customised / derived from OEM data is used</td>
</tr>
<tr>
<td>airworthiness and provide improvements to reliability of the aircraft.</td>
<td></td>
</tr>
<tr>
<td>Due to the extended down time, it is incorporated into a heavy maintenance</td>
<td></td>
</tr>
<tr>
<td>event</td>
<td></td>
</tr>
</tbody>
</table>

- AD – Airworthiness Directives
- SB – Service bulletins
- ALS – Airworthiness limitations Section
  1. Life Limit Parts,
  2. Airworthiness Limitation Items,
  3. Component Maintenance Requirements,
  4. System Equipment Maintenance Requirements,
  5. Fuel Airworthiness Limitations
- AOT – Alert Operator Transmission
- AMM – Aircraft Maintenance Manual
- ASM - Aircraft Schematic Manual
- AWM - Aircraft Wiring Manual
- CMM – Component Maintenance Manual
- IPC – Illustrated Parts Catalog
- MMEL – Master Minimum Equipment List
- MPD – Maintenance Planning Document
- MRBR – Maintenance Review Board Report (Initial minimum maintenance requirements)
- NTM - Non-destructive Testing Manual
- SRM – Structural Repair Manual
- TEM – Tool and Equipment Manual
- TSM – Trouble Shooting Manual

AMP – Aircraft Maintenance Program (Operator customised)
OMEL – Operator Minimal Equipment List (Operator customised)
EO – Engineering Orders (Operator customised)
Reliability Report – (Operator produced on quarterly basis as required by regulatory requirement for OEM’s fleet reliability record)
WO – Work Order with individual task cards (Operator customised)
- Fragmentation of the supply chain between OEM, Operator and Maintainer
- Access to OEM CAD/PLM data is not available
- Cost of re-creating digital 3D assets is extensive
- Evolving business models
  - Engines
  - Airframes
  - Systems
SALZER ELECTRONICS LIMITED
ASSEMBLY – WORK INSTRUCTIONS

NO: FORM NO: QS-06

STAGE ASSEMBLY:

1. TAKE PANEL REF #4520-42 AND PLACE 2 WOODEN ERGOTS AT THE MOST EXTREME HOLES OF THE LOWER SIDE. MAKE SURE THAT HOLES ON INNER SIDE FACE THE INSIDE.
2. TAKE PANEL REF #4520-41 AND PLACE 2 WOODEN ERGOTS AT THE MOST EXTREME HOLES OF THE LOWER SIDE. MAKE SURE THAT HOLES ON INNER SIDE FACE THE INSIDE.
3. VERIFY THAT PANELS #4520-42 and #4520-41 ARE PROPERLY ALIGNED.
4. MOUNT LOWER PANEL REF#69303 AND USE 4 SCREWS REF BFT-56 TO COMPLETE ASSEMBLY.

CONTACT SLIDE, MOVING CONTACT, CONTACT SPRING ASSEMBLY
CONTACT PRODUCTION SUPERVISOR IN CASE OF PROBLEM

PREPARED: G. Hamani
APPROVED: DATE: 11.10.2006

REV: 3
A better way to Communicate

Revolutionizing documentation content creation, publishing, and maintenance

Authoring System for creating linked graphical and interactive documentation:

- Traditional 2D images
- Interactive Documents
- 3D On-line Experiences

Technical Illustrations

Operation and Training Instructions

Maintenance and Service Instructions

Assembly Instructions

Interactive On-Line Catalogs

A better way to Communicate
Product System Modelling

Input Data
- Parts Lists and Scheduling Data
- Process Flow and Behavior
- Material Flow
- Part Routing Logic
- Labor and Shift Schedule
- Model Duration

Outputs: Complete Analysis
- Capacity Analysis
- Throughput Analysis
- Bottleneck Analysis
- WIP Evaluation
- Labor & Equipment Utilization
- Manpower Requirements & Allocation
- 3D and 2D Graphics
- Dynamic Business Statistics/Graphs
Virtual Control Validation

Objectives
- Validate the Control of a Workcell or entire line (Electrical / Pneumatic / Hydraulic / Logic Control)
- Validate all external PLC Control Programs
- Analyze performances of the controlled system

Project Deliverables & Benefits
- Reduce ramp-up time on manufacturing floor
- Validate the PLC program changes required for a new equipment set-up
- Optimize the performance of your production system

Validate in 3D context all Control Systems
Reduce time to ramp-up and risks of error on the manufacturing floor
Optimize the performance of Production systems
Human Work Analysis

Optimize workplace environment for better worker efficiency

**Enablers**

- Remove the need for costly physical prototypes and real human simulations
- Reduce teach and set-up time by using pre-defend catalog posture
- Optimise human-workplace interactions
- Evaluate/predict human performances
- Perform accessibility, vision analysis
- Layout optimisation
- Posture analysis (RULA / NIOSH)
Model-Based Inspection
The Opportunity

• Each stage is being optimized:
  • Product Engineering, Design Office
  • Manufacturing Engineering
  • Production
  • Support / MRO

The *New Frontier* lies in tearing down the walls and aligning each stakeholder on a unified value stream.
Conclusions and Recommendations

- Digital (3D plus System) design of product, resources and process has been adopted partially by OEM’s and larger supply chain partners

- Re-use of digital data for validation and execution of resources and process is significantly lagging behind digital data utilisation for product design validation

- Aircraft operators and maintainers have limited or no digital data access for efficient operation and maintenance

- Key issues to adoption of digital simulation, validation and execution are:
  - Awareness, skills and knowledge
  - Data access, commercial and regulatory constraints
  - Technology readiness
Conclusions and Recommendations

- OEM’s
  - Define and adopt technology for process and resource modelling and validation
  - Maintain a digital repository of products, processes and resources
  - Consider supply chain implications during the product, process and resource definition
  - Plan employee skill enablement and skill transfers for suppliers

- Operators
  - Request greater access to digital product, process and resource information
  - Maximise the use of digital assets for the operation and maintenance of aircraft

- Training Organisations
  - Revise curriculum to reflect industry best practice

- Technology Vendors
  - Develop and improve applications to support downstream processes