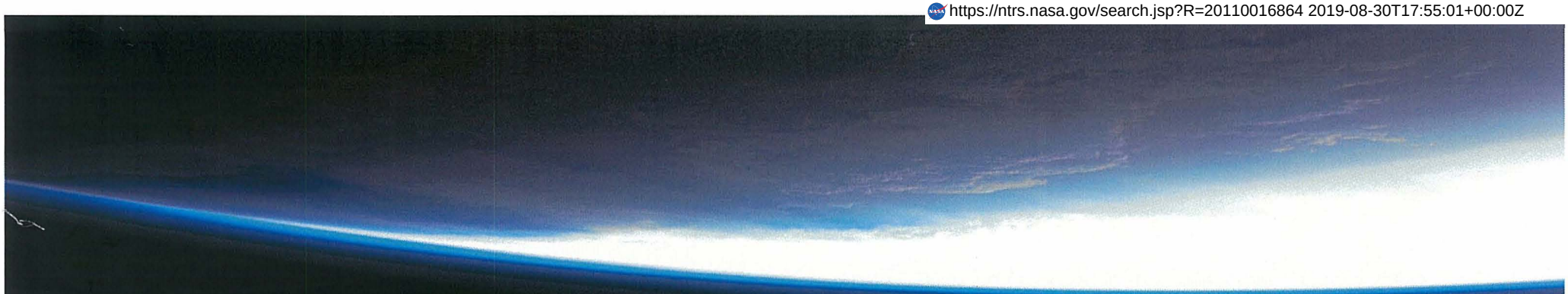

Integrated Procedures for Flight and Ground Operations Using International Standards

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United Space Alliance

About the Author

- **John Ingalls, United Space Alliance, LLC (USA)**
  - Senior Engineer, Launch & Recovery Systems
  - S1000D USSMG (U.S. Specification Maintenance Group)
    - International Specification for Technical Publications
  - AIA's SSFA (Strategic Standardization Forum for Aerospace)
  - AIAA Senior Member

- **About USA**
  - Joint venture, Boeing and Lockheed-Martin
  - Numerous services and products for space and defense
  - John is from the Florida division at NASA Kennedy Space Center

Outline

United Space Alliance

- Introduction
- Ground Processing Technical Publications
- On-Orbit Technical Publications – Shuttle
- On-Orbit Technical Publications – ISS
- Optimization Via S1000D Standard
- Space Industry Opportunities
- Integration Via Global Standards
- Conclusion

Introduction

Organization of Technical Data is Key to Efficiency & Safety

According to 2006 study of information/knowledge workers' time spent:

48 % – searching (9.5 hours/week) & analyzing (9.6 hours/week) information.

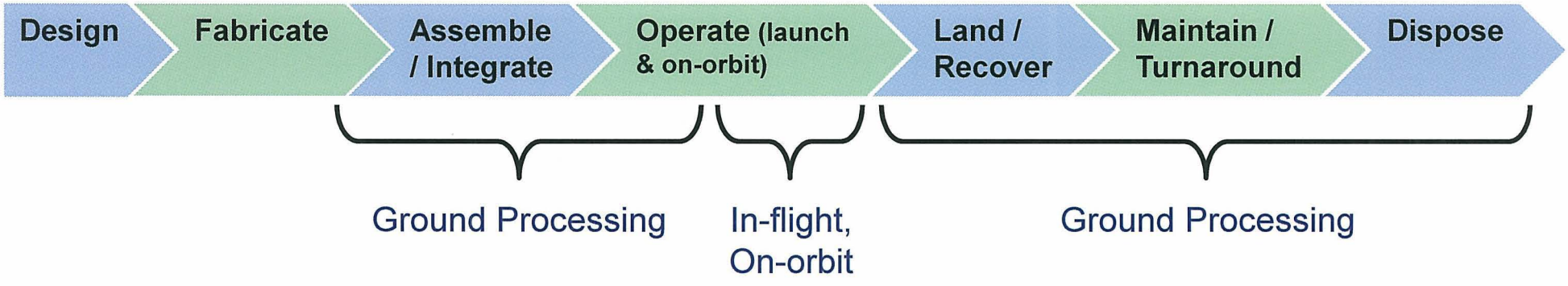
3.5 hours/week – in unproductive searches (info not found).

3 hours/week – recreating content that already exists.

- **Technical Data**
  - Part of Integrated Logistics / Product Support (ILS / IPS)
- **Technical Publications ("Tech Pubs")**
  - Procedures and manuals
  - Paper-based and non-interactive electronic documents
  - Interactive Electronic Technical Manuals/Publications (IETM / IETP)
  - Database-oriented paperless procedures
- **Space Industry Tech Pubs**
  - Used in ground processing
  - Used in-flight / on-orbit
  - Often unique types/sets for each program, mission, element

Ground Processing Technical Publications

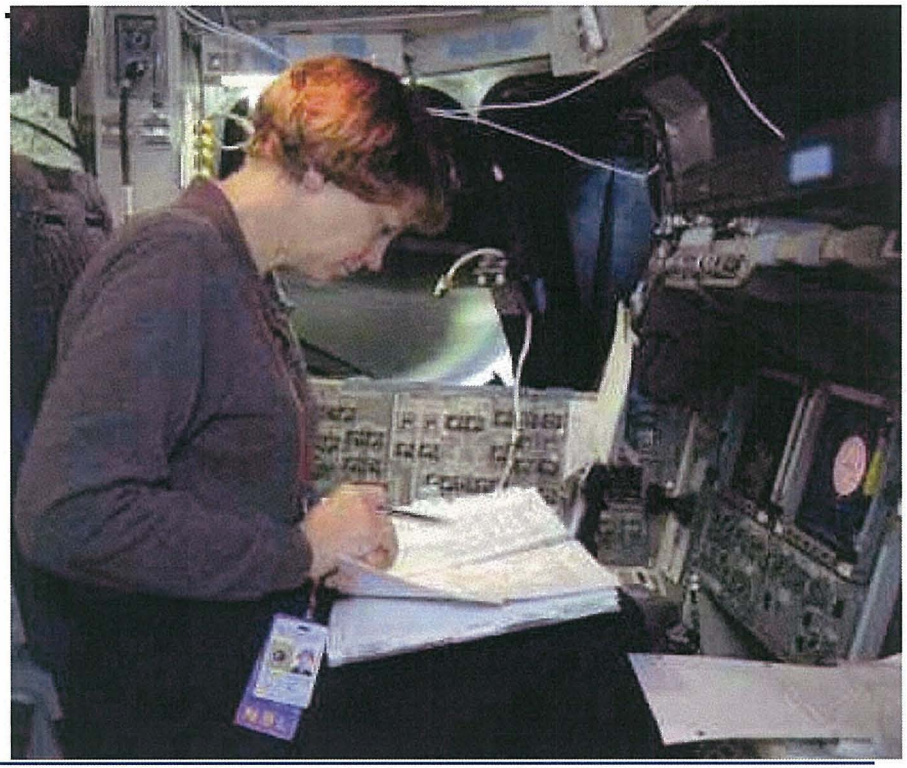
- **Ground Processing – Flight Hardware, Equipment, & Facilities**
  - "Manufacturing" assembly operations (-not part fabrication)
  - Integration and test
  - In-process maintenance and repair
  - Launch operations
  - Reusable / returnable vehicles also include post-flight activities:
    - Landing and recovery
    - Inspection, refurbishment, maintenance
    - Overhaul, modification, reconfiguration



- **Each Facet Often Has Different Technical Publication Types/Sets**

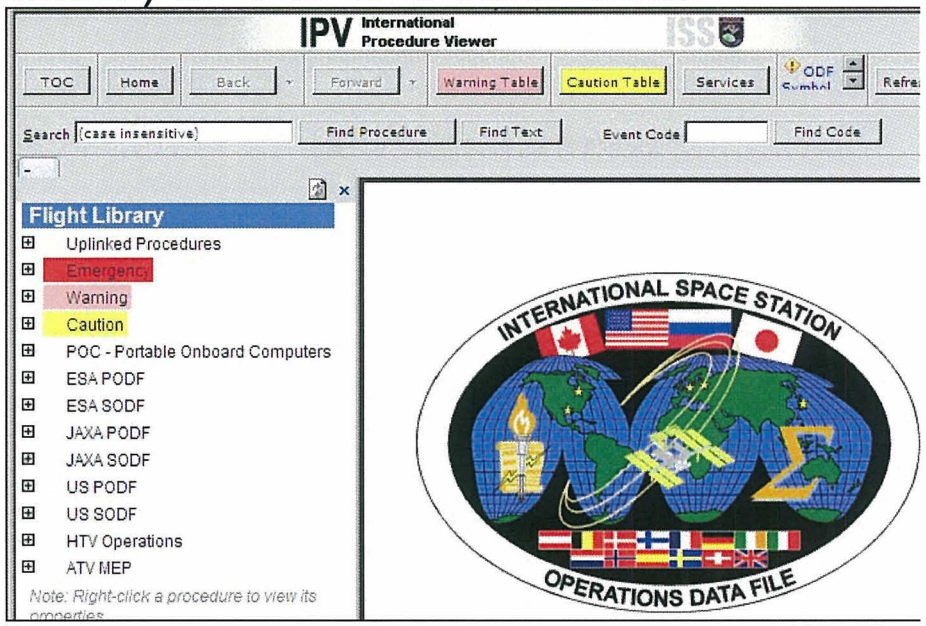
On-Orbit Technical Publications: Shuttle

- **Space Shuttle "Tech Pubs" for Astronauts**
  - Used for missions operations by astronauts and ground controllers
  - Flight Data Files (FDF)
    - 100% paper manuals/procedures for whole Shuttle program
  - Shuttle cockpit "resembles a library" (video)
  - Other special procedure types used:
    - Cuff checklists for EVA (spacewalk), on special paper
    - Large collection of cue cards, on cardstock
    - Pocket checklists: 5-min time critical procedures, small size



On-Orbit Technical Publications: ISS

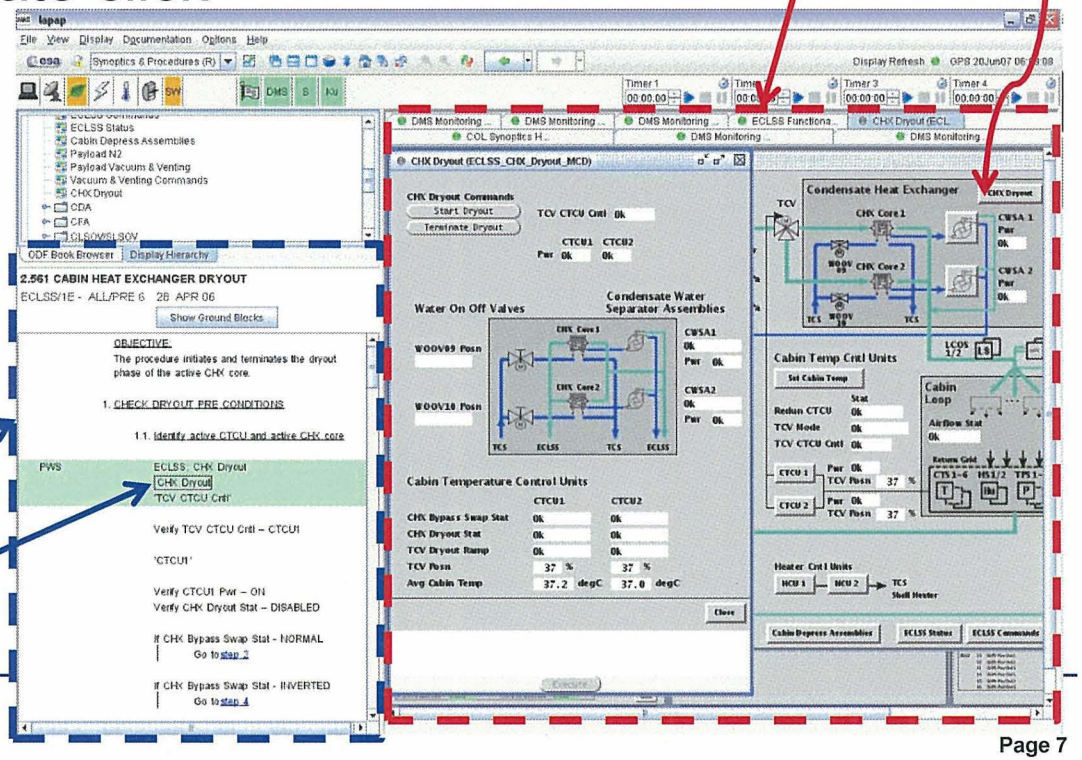
- **International Space Station (ISS) "Tech Pubs" for Astronauts**
  - Used to operate, maintain, resupply, including training
- **ODF = Operations Data File**
  - Procedures to operate and maintain ISS systems, payloads, ATV/HTV's
  - Used by ground controllers, on-board crew, & on-orbit executor software
- **IPV (International Procedure Viewer)**
  - IETM (Interactive Electronic Technical Manual) of ODF's & other data
  - Used by International Partners (IP)
  - Author ODFs in Word, convert to XML
  - Uses custom XML schema for ODFs



Major Features:
- XML viewer
- Interaction (links, data collection)
- Parameters (Applicability) custom views
- XML tags can enable other applications
  - e.g. – stowage database
- Favorite: Step marker, for placeholder and quick direct scroll to next step

On-Orbit Technical Publications: ISS

- **Flight Software Command & Control**
  - Read commands in IPV, execute on separate flight software display
  - European Space Agency (ESA) developed an integration of IPV / ODFs with flight software
    - Flight software station has 2 windows in one display
      - ODF step activates a flight display on same screen
      - Execution is a separate click
  - IPV could directly execute, but does not due to safety concerns
  - ESA is evaluating voice-activated commands

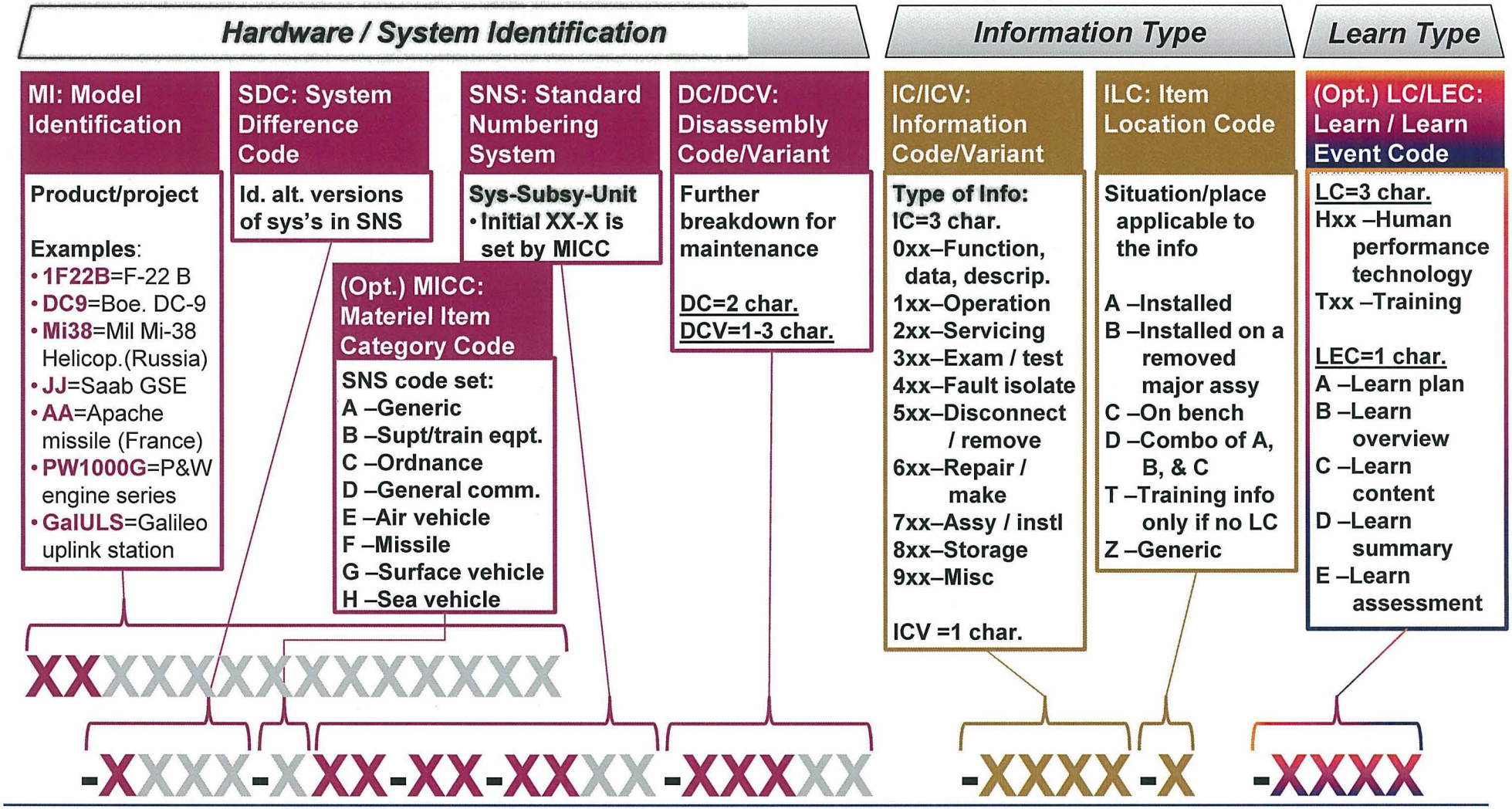


Optimization Via S1000D Standard

- **S1000D—the Next Generation in Tech Pubs**
  - 1985 European specification now global, via ASD, AIA, & ATA
  - Designed for air, land & sea vehicles & equipment—open to more
  - Examples of industry use:
    - Boeing 787, Global Hawk, AMRAAM missile, CH148 Cyclone helicopter, EMALS/AAG systems on CVN78 ship
- **S1000D Powerful Features**
  - Based on International Standards (W3C, ATA, ISO)
  - Electronic Publications (IETM/IETP)
  - Standard Numbering System (SNS) Product Breakdown Structure
  - Modularity for Reusability / Repurposing
  - Common Source Database (CSDB)
  - Illustrations, Hotspotting, Multimedia, and CAD
  - Applicability—Structured Configuration Varieties
  - Business Rules Exchange (BREX)
  - XML industry standard – interoperable with other applications

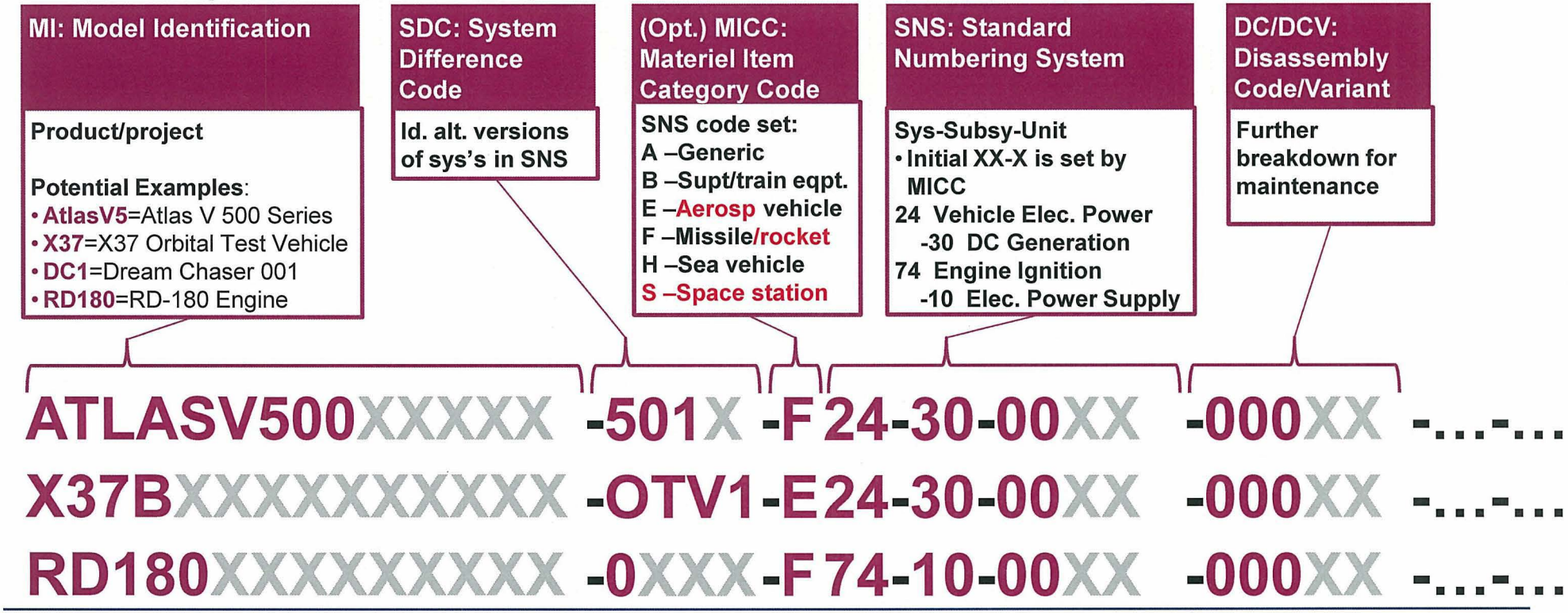
Optimization Via S1000D Standard

- SNS Structure in the S1000D Data Module Code (DMC)
- Variable Character Length: min. 17 to max. 41 (gray X is optional)



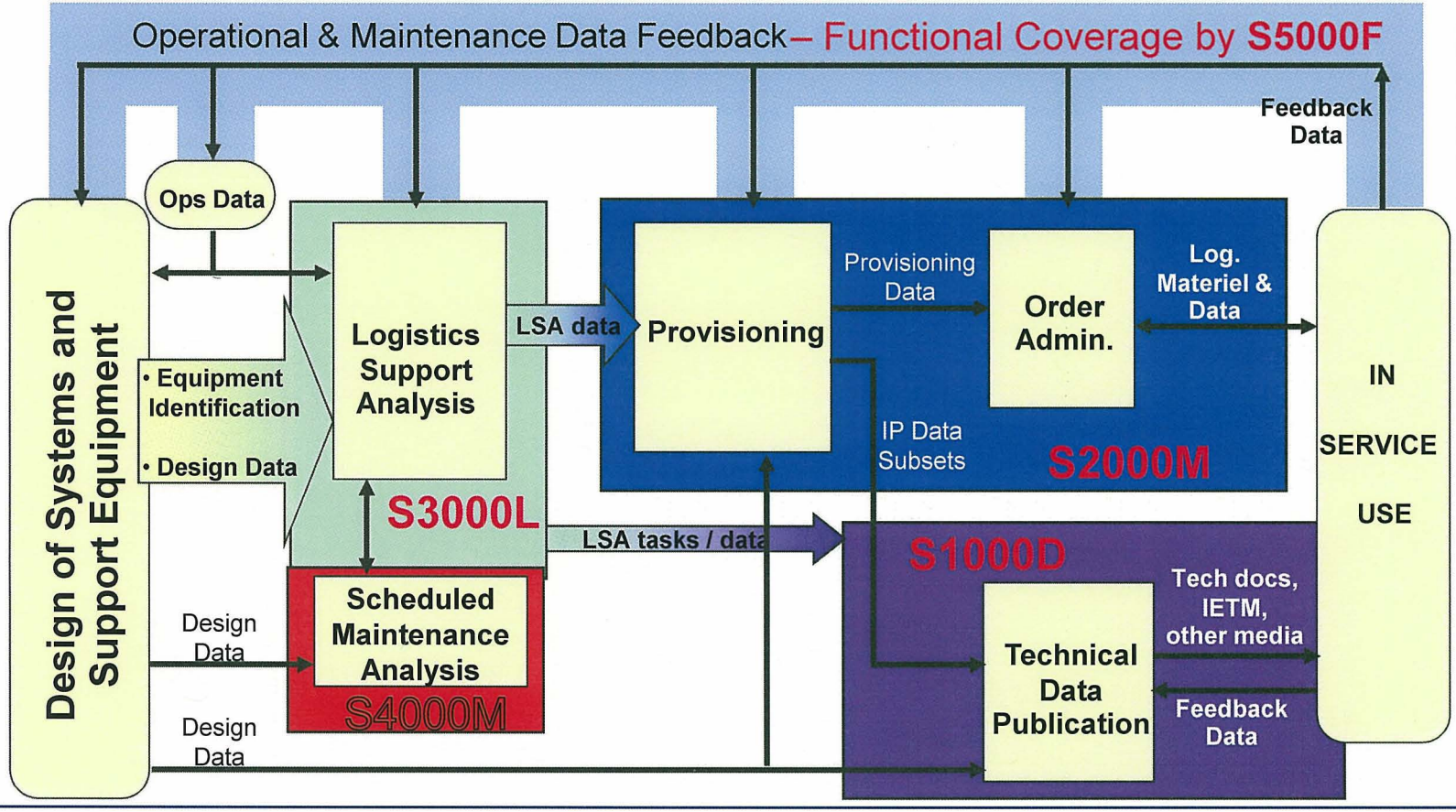
Space Industry Opportunities

- **S1000D Known Space Use**
  - (U.S.) SpaceLift Range System, (Germany) DLR's Galileo satellite ground station, (Italy) ESO's space telescope
- **S1000D Opportunities**
  - Applicable to any space product: flight hardware, equipment, facilities
  - Examples DMC / SNS product breakdown structures, if S1000D is used:



Integration Via Global Standards Suite

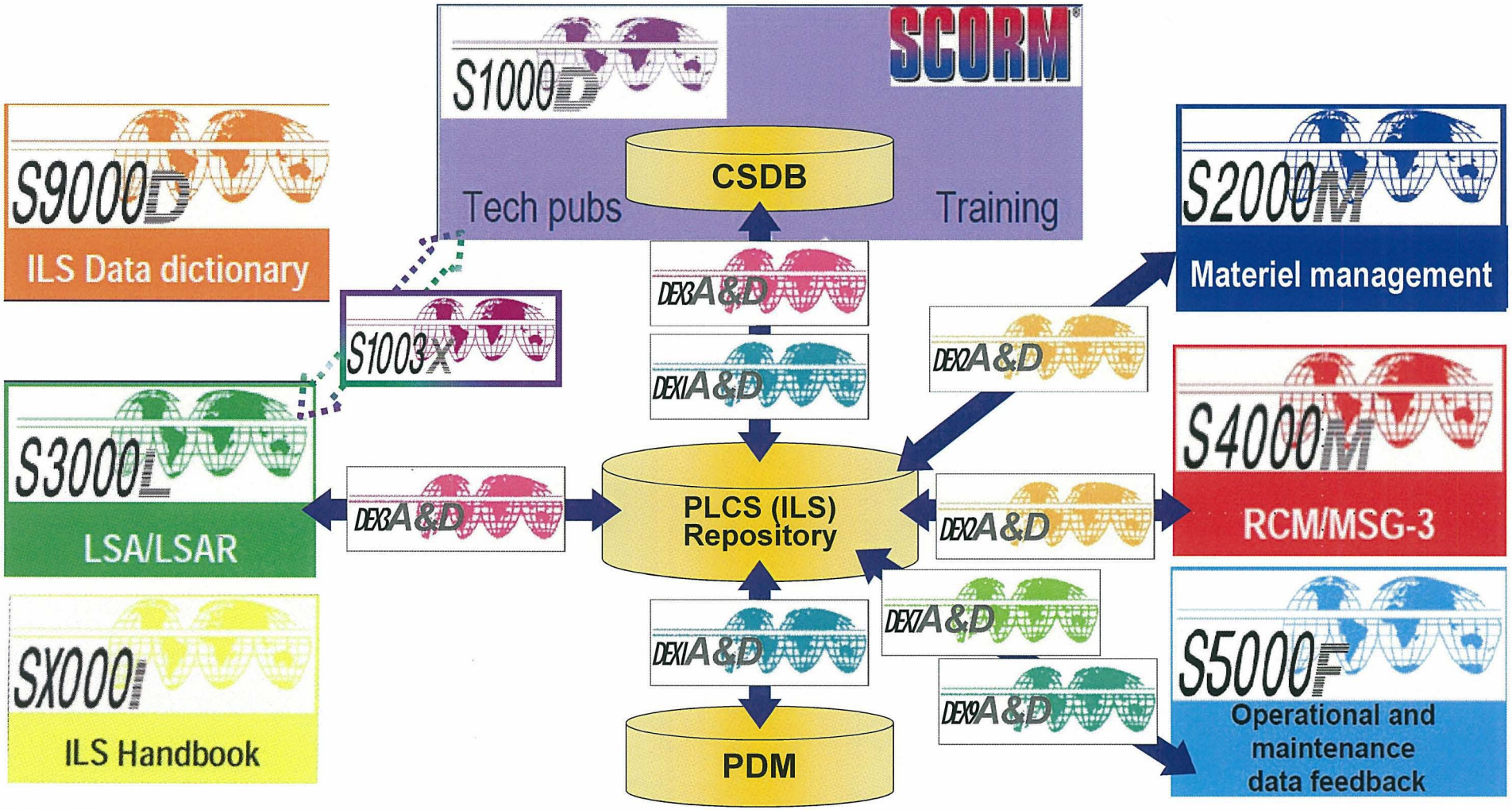
- **S-series Specifications (Companions to S1000D)**
  - Jointly managed by Europe's ASD & America's AIA
  - ILS (Integrated Logistics Support)/IPS (Integrated Product Support)
  - Goal: lifecycle interoperability, from design through sustainment



Optimize by data feedback

Integration Via Global Standards Suite

- Optimal Efficiencies with IT Integration to Enable Interoperability
- PLCS (Product LifeCycle Support) ISO 10303-239 Standard



Conclusion

- **Efficiency Requires Well-Organized Technical Data**
- **Non-Space Industry Standards Provide Optimized Solutions**
  - Ground processing and flight/mission operations can benefit
  - Standard interfaces with design data are available
  - S1000D for tech pubs: Emerging global standard; some space use
  - S-Series global specifications provide ILS/IPS functionality
  - PLCS standard integrates S-series for optimized interoperability
- **Recommend S-series + PLCS Standards**
- **Space Industry Opportunities**
  - Recommend to expand current ILS/IPS standards efforts
  - Utilize S-series/PLCS for new and some existing space products
  - Join working groups of standards organizations (S-series, PLCS)

Streamlined Product Support Standards: Organize, Build Once, Reuse, & Integrate

Questions?

"The heart of the prudent acquires knowledge, And the ear of the wise seeks knowledge."

Proverb

QUESTIONS?

Acknowledgements & References

• Acknowledgements

– Michael Hurt, United Space Alliance, LLC, ISS SODF Manager

• References

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BACKUP CHARTS

Integration Via Global Standards Suite

• S-series Specifications

S1000D — International Specification for Technical Publications

S2000M — International Specification for Materiel Management

S3000L — International Procedure Specification for Logistic Support Analysis (LSA)

S4000M — International Procedural Handbook for Developing Scheduled Maintenance Programs *(-scheduled to release in 2011)*

S5000F — International Application Handbook for Operational and Maintenance Data Feedback *(-developing to release in 2012)*

• Companion Standards to S1000D

ASD-STE100 SIMPLIFIED TECHNICAL ENGLISH — ASD STE 100: Simplified Technical English, International Specification

SCORM® Sharable Content Object Reference Model — SCORM (Shareable Content Object Reference Model), a standard for web-based e-learning

• All Can Integrate Via The PLCS Interoperability Standard

PLCS — ISO 10303-239 Product Life Cycle Support (PLCS)
—part of 10303 STEP standard (-203=3D config, -233=Sys engr data)