MPMI: Model-based product manufacturing information

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Mechanical CAD vs. Shipbuilding/AEC CAD

• Most CAD platforms are designed to support mechanical CAD
  – Single product with components in part-of relationships
  – Assembly is primary data structure
  – One goal is to maximize part re-use

• Shipbuilding/AEC CAD
  – The end product is a container of loosely-related member components
  – Occurrence is the primary entity
  – One to two million occurrences per ship
  – Low production rate
  – More general approach to tolerances

MCAD supports a small number of parts with complex geometry; shipbuilding is comprised of a large number of parts with simple geometry.
Design authority/Build authority

• Design authority
  – Describes what to make
  – 3D model fully describes form and fit
  – DA deliverables may be devoid of PMI

• Build authority describes how to make it
  – Describes the critical dimensions which are the instructions for fabricators, installers, inspectors

Design authority and build authority should be loosely coupled.
MPMI defined

- A popular misconception is that the 3D model is what defines model-based enterprise.
- Model-based enterprise is actually defined by a digital model in which significant components have globally-unique, persistent identifiers.
- Model-based PMI (MPMI) is a methodology in which PMI objects have enterprise identifiers.

**MBE is defined not by 3D, but by ID.**
Lean work instruction

• Replaces multiple pages of text and engineering drawings
  – Planner consumes drawing sheets in work instruction
• Derived from the product model
• Reflects a detailed build plan
  – Possibly to the shift level
• Shows only the data and 3D graphics needed to accomplish a single operation

The lean work package reduces construction costs but may add significant planning labor.
New baseline process
BA autoviews

• Identifies critical dimensions
  – Rules-based (rather than consumption-based)
  – Divide and conquer
    • BA/TA :: fab/install :: piping/structures/electrical/HVAC

• Manages PMI presentation
  – Requirement for printed WP persists
  – Determines location of labels/dimensions
  – Finds the minimal set of views

• The new work instruction is still ‘paper-based’ with respect to PMI.
Tablet work instruction

• Enables more flexible presentation of PMI
• 2D vs 3D presentation of PMI
  – Draggable labels
  – 3D dimensions
    • 3D datums
• Interactive
  – Signoffs, etc.
Lean tablet work instruction
Pilot process

Design/Engineering and Planning → Manufacturing → Location Technology

CAD (NX) → Design Data/CAD (TC/NX) → MPMI → Automatic Workpackage Creator → eMap editor → Lean Workpackage → On Board Ship Workpackage → Vendor Workpackage

Planning product structures → MBOM (BOP) → MPMI

Manufacturing Data (SWSS, etc) → SFWP → VWP

Background Tracking Mobile Status Pickability Labels Data Retrieval

V12
eMap Editor Interface
eMap Editor Interface

- User selects what type of step they are creating
- An imported build plan allows the user to select what step they are going to work
- Actions that directly affect the above view
- ‘Push Canvas’ consumes the selected items and moves them to editing screen
eMap Editor Interface

- List of Parts and Joints associated with the selected model
- Each part or joint can be turned on or off
- Displays all previously created steps and canvas's
- User names the step and adds any addition information
- User captures the view displayed
eMap on tablet
Authoring MPMI

• New paradigm
  – Rules-based rather than consumption-based

• At design release:
  – Autoviews creates MPMI and stores in DB
  – Manual views are scanned for MPMI to be stored in DB.

• Automates much of the planning process to make it viable
  – Consumption step is replaced by DB query.
MPMI data architecture

- Occurrence
- Hull
- Build occurrence

- MPMI
- related

- Assembly Build occurrence
  - parent

- Installation Build occurrence
  - related
  - parent
New planning process

• Planner constructs the build plan by selecting occurrences and joints.
  – This reflects the traditional planning process.
• eMap editor creates visualization of the operation.
  – System brings in the relevant MPMI from the database.
• Result: less work for the planner than the fat work instruction process.

The new process depends upon enterprise identifiers for MPMI objects.