Agenda

• Different Product Structures?
• Limitations of Basic PDMLink
• Additional functionality offered by MPMLink
• MPMLink can do even more
• Q&A
Different Product Structures?
One of the Product Lifecycle Challenges …

Managing the many different, but related product-related structures
Single Source of Truth for the Entire Product Lifecycle

- Concept
- Design
- Validate
- Production
- Support

- Requirements Structure
- System /Logical Structure
- Engineering Structure
- Simulation/Testing Structure
- Manufacturing Structure
- As-Supported Structure

Associative Structure
Single Source of Truth for the Entire Product Lifecycle

Plan > Concept > Design > Production > Support

Main focus of this presentation: Associative Structure

Requirements Structure > System / Logical Structure > Engineering Structure > Simulation / Testing Structure > Manufacturing Structure > As-Supported Structure

Main focus of this presentation
Concurrent Product and Manufacturing Process Design is Key to Drive Profitable Growth

Limited opportunity for Manufacturing to influence design and reduce cost

Manufacturing Process Management

Production Ramp-up

Full scale Production

Reduce Time To Market

Reduce Cost of Change

Reduce MFG Cost

“Manufacturing companies identified that the need to reduce manufacturing costs was driving their need to improve their manufacturing planning process at practically the same rate as compressed development schedules.”

Optimizing Product Development Processes is Critical

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Product Lifecycle

Hardware & Software Engineering

Supply Chain & Manufacturing

Sales & Service

Support
Limitations of Basic PDMLink
How one typically works …
Historically, Windchill proposes to use the “view” concept in order to manage mBOM Parts as it provides the following advantages:

- Allow to manage different BOM’s for the same Part (eBOM versus mBOM)
- Allow to manage different values for the same attribute of the same Part
- Allow separate configuration and approval between eBOM and mBOM for the same Part
- Allow concurrent work on eBOM and mBOM for the same Part
- Allow the re-use of eBOM parts into mBOM parts based on view network.
- Allow a traceability on the revision level between eBOM and mBOM using the revision label
Windchill organizes views as a hierarchy. A “New View Version” creates a downstream part version:
- Design → Manufacturing
- Manufacturing → Plant 1
- Design → Plant 2

Parts can be initially created in any view, and New View Version can only go downstream.

By default, the hierarchy has two views, Design and Manufacturing (EBOM and MBOM).
Applied to our assembly …
View Limitation – Assembly Splitting

- When an assembly is split, new Part Numbers are created in mBOM
- View mechanism cannot anymore ensure traceability/change process (Based on Part Number)

Where is the Brake System Assy in the mBOM?
Some customers are re-numbering Parts when creating their mBOM:
  - e.g. document-based eBOM
  - View mechanism cannot anymore ensure traceability/change process (Based on Part Number)
The “View” mechanism relates parts through revision scheme.
The revision schema can be rapidly obsolete.

Revision schema becomes irrelevant.
Previous work lost.

Which way to go?
Additional functionality offered by MPMLink
• **Practice:**
  – Create mBOMs directly from the eBOM
  – Start the creation of the mBOM before design release

• **Capabilities:**
  – Leverage 3D data
    • Create mBOM from engineering 3D mockup
    • Dynamically generate mBOM 3D mockup
  – Flexibility
    • Mfg equivalent parts
    • Plant specific BOMs
  – Traceability
    • Bidirectional associativity
  – Control and manage
    • Analyze and resolve BOM discrepancies
    • Change and Configuration Management
To over come the view mechanism limitations, MPMLink has introduced the **Equivalent Link** concept.

**Definition**: It relates an iteration of an *upstream Part (eBOM)* to its equivalent *downstream (mBOM)* iteration.
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**Purpose:** the *Equivalent Link* provides “associativity” between an *upstream Part* and its equivalent downstream one, for supporting:
- Traceability and Conformity
- Change Processes
- Concurrent Product and Process

---

![Diagram showing the relationship between eBOM and mBOM with Equivalent Links.](image-url)
Purpose: the **Equivalent Link** provides “associativity” between an upstream Part and its equivalent downstream one, for supporting:
- Traceability and Conformity
- Change Processes
- Concurrent Product and Processes
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- Traceability and Conformity
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- Concurrent Product and Process
For the **Equivalent Link**, the context is a pair of *Views* e.g. *upstream context* = design view and *downstream context* = manufacturing view. (*Upstream context* can be the same as the *downstream context* or be empty)

The same *Part* can have different equivalent *Parts* depending where it's used in mBOM.

- **eBOM**
  - WHEEL ASSY (Design)
  - WHEEL (Design)

- **mBOM (Plant1)**
  - WHEEL ASSY (Plant 1)
  - WHEEL (MFG)

- **mBOM (Plant2)**
  - WHEEL ASSY (Plant 2)
  - 450 (MFG)
- The **Equivalent Link** has a direction and it's owned by the downstream iteration.
- The **Equivalent Link** is a 1-N or N-1 relationship meaning one upstream iteration can have multiple downstream equivalent parts and vice versa.
- Upstream versus downstream contexts should (strongly recommend) follow the network view so that it is possible to reuse upstream parts and downstream BOM's.
When a new iteration of a linked downstream Part is created, the Equivalent Link is duplicated.

When a new iteration of a linked upstream Part is created, no Equivalent Link is duplicated (Out-of-date)
When an *Equivalent Link* is updated for a downstream Part:

- the system proposes to display differences between latest version and the currently linked iteration
- a new Equivalent Link is created to the latest upstream iteration

In future, the *Equivalent Link* could be used to propagate modifications from Upstream to Downstream.
Report differences between associated BOMs

- Quickly identify quantity discrepancies between associated BOMs
  - Compare two or more structures and supports multi-level comparisons
  - Part quantity comparison analysis using the associativity links
  - Highlight parts in Creo View or in the Process Plan Explorer
  - Displays quantity comparison results in a color coded table, which can be easily navigated by discrepancy type (equal to, greater than, less than)
– Indicators in Product Structure tree are used in order to assess the status of the Equivalent Links.
– Equivalent Links Status:
  • No Equivalent Link exist
Indicators in Product Structure tree are used in order to assess the status of the Equivalent Links.

Equivalent Links Status:

- No Equivalent Link exist
- Equivalent Link exist and points the latest iteration in the system
– Indicators in Product Structure tree are used in order to assess the status of the Equivalent Links.

– Equivalent Links Status:
  • No Equivalent Link exist
  • Equivalent Link exist and points the latest iteration in the system
  • Equivalent link exist but not on the latest iteration
Definition: The **Equivalent Occurrence Link** relates an occurrence of Part in an upstream context to its equivalent occurrence in a downstream context. (Path to Path Link)

**Purpose:** To allow monitoring discrepancies on the occurrence level between a *downstream BOM* and its *upstream equivalent one.*
– Allow to transform eBOM into mBOM by picking eBOM Parts and pasting them into mBOM.
– Copy of eBOM Parts can be done from any eBOM Tree (Selection or another Explorer) or from 3D but the paste with associative BOM Links is only possible in the tree
– When pasting an eBOM part into an mBOM assembly
– If an equivalent part exists for the downstream context, the system will reuse that equivalent Part.
– If no equivalent link exist, then the system displays a panel for the user to specify:
  • If a new view version is needed (“New View”)
  • If a completely different Part is needed (“Duplicate”)
  • If the Part should be used as is (“Same”)
– If an assembly has been pasted as-is (“Same”) in mBOM, associative BOM links are created only on pasted assembly, not on the children.
“Creo View for Windchill MPMLink” can read information from Manufacturing Product Structure Explorer:

- Structure: Leaf .ol positioned with values from the occurrence
- Upstream Equivalent Part
- Downstream Equivalent Occurrence
- Upstream Equivalent Occurrence
- Common Parent
- Representation
Associative eBOM – mBOM Practice

Storyboard Overview

- Analyze eBOM
- Restructure into mBOM
- Update and Maintain mBOM
- Ensure BOM conformity
- Release to production systems

Manufacturing Engineer

START

Use PLM system and directly access evolving engineering design

- Visualize multi-level eBOM
- Visualize 3D mockup

- Restructure eBOM into mBOMs, with maximum flexibility and detailed traceability links

Derive multiple mBOMs from eBOM
- Automatically generated mBOM 3D mockup

Release to production systems

- Standard integration with leading ERPs
- Flexible integration framework

- Stay informed through change process and update mBOM accordingly

- Derive multiple mBOMs from eBOM
- Automatically generated mBOM 3D mockup

Ensure all eBOM parts are accounted for

Multi level BOM compare

- Integral change and configuration management

- Visual indicators based on traceability BOM links
- Automatic propagation of part attributes and CAD viewables

Release to production systems

- Use PLM system and directly access evolving engineering design

- Derive multiple mBOMs from eBOM
- Automatically generated mBOM 3D mockup
MPMLink can do even more
Digitally define and manage process plan in Windchill MPMLink:

- Define plant-specific process plans with multiple sequences of operations (supporting sub-operations, parallel and alternates)
- Define different process plan types (machining, assembly, quality, maintenance, repair, …)
- View the in-process state of assembly at any operation using embedded Creo View 3D visualization
- Define process plan operations by allocating parts, manufacturing resources, skills, documents, operator instructions and time/cost breakdowns
- Reuse the same process plan to manufacture multiple parts (example for variant parts or left/right hand parts)
- Define alternate process plans for the same part
- Reuse standard process plans from a standards library
Define and manage manufacturing resources and skills with Windchill MPMLink:

- Define and manage resource libraries including plants, work centers, tooling, skills and process materials
- Reference resources within process plans to build parts
- Define technical compatibilities between resources and standard manufacturing capabilities
- Link CAD files to resources for reuse in process plan and work instruction 3D representations
Dynamically Generated Visual Work Instructions

Work instructions are dynamically generated documents.
Integral Change Management

- Change management of process plans, sequences and operations
- Manufacturing change as integral part of engineering change management
- Easily update as-planned BOMs and associated plans upon engineering change
- Reduce overall cost and eliminates miscommunication issues