

MPMI: Model-based product manufacturing information

Tom Rando
Heidi Preston
Electric Boat Corp.
April 4, 2017

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.

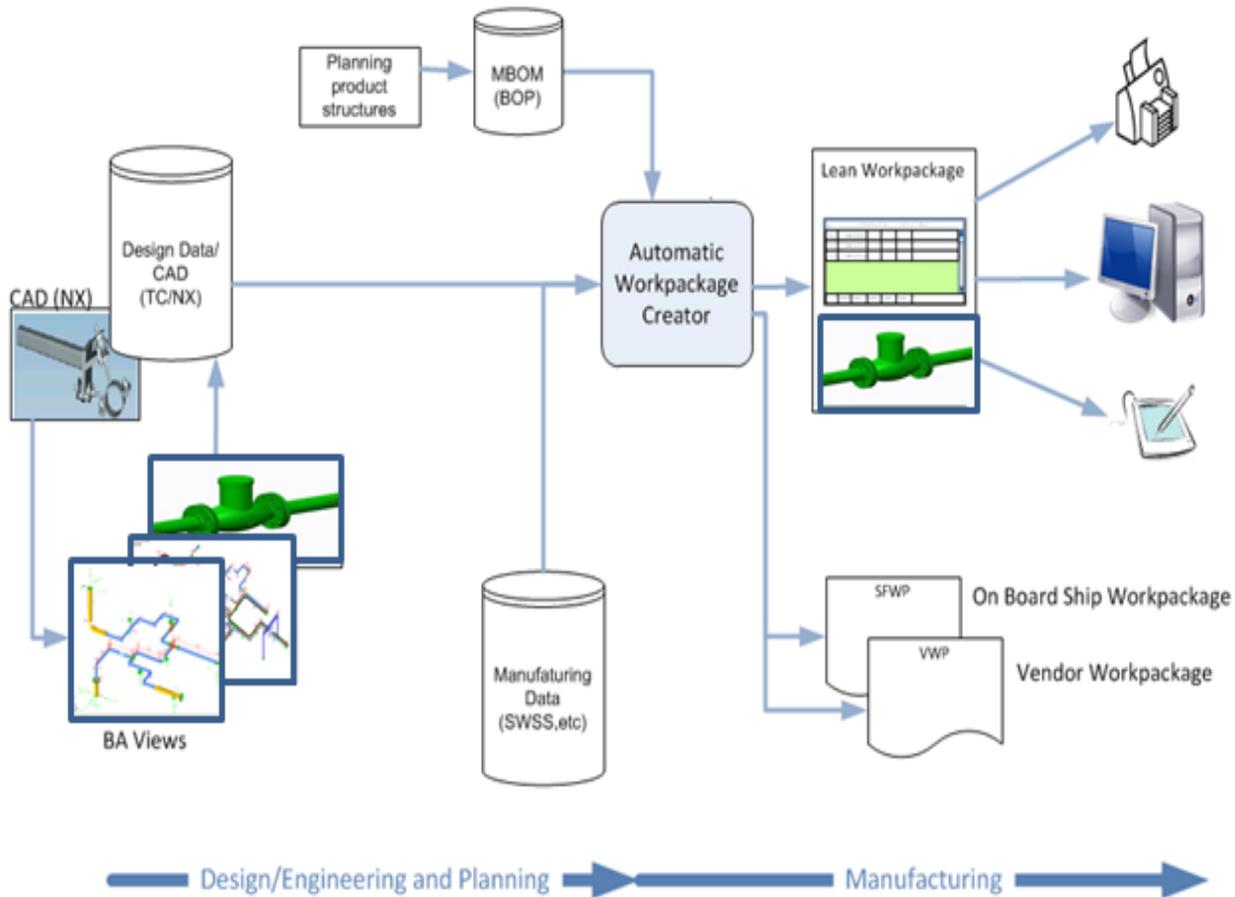
MBE is defined not by 3D, but by ID.

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



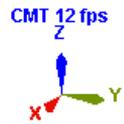
BA autoviews

- 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.*

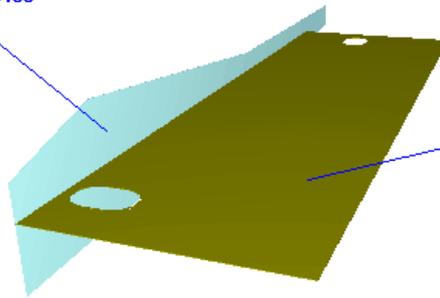
Tablet work instruction

- 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

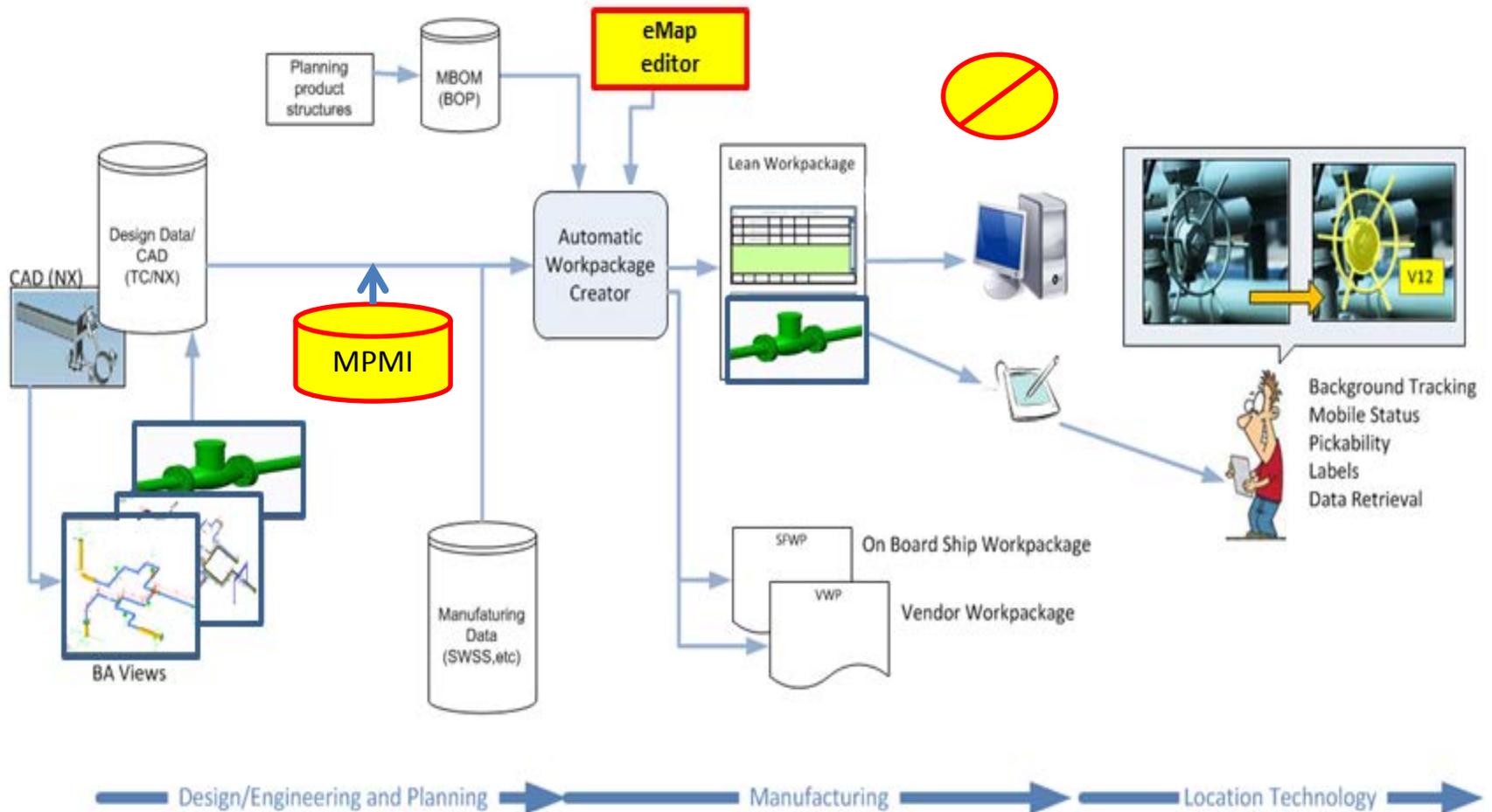


MDLPRT003698450

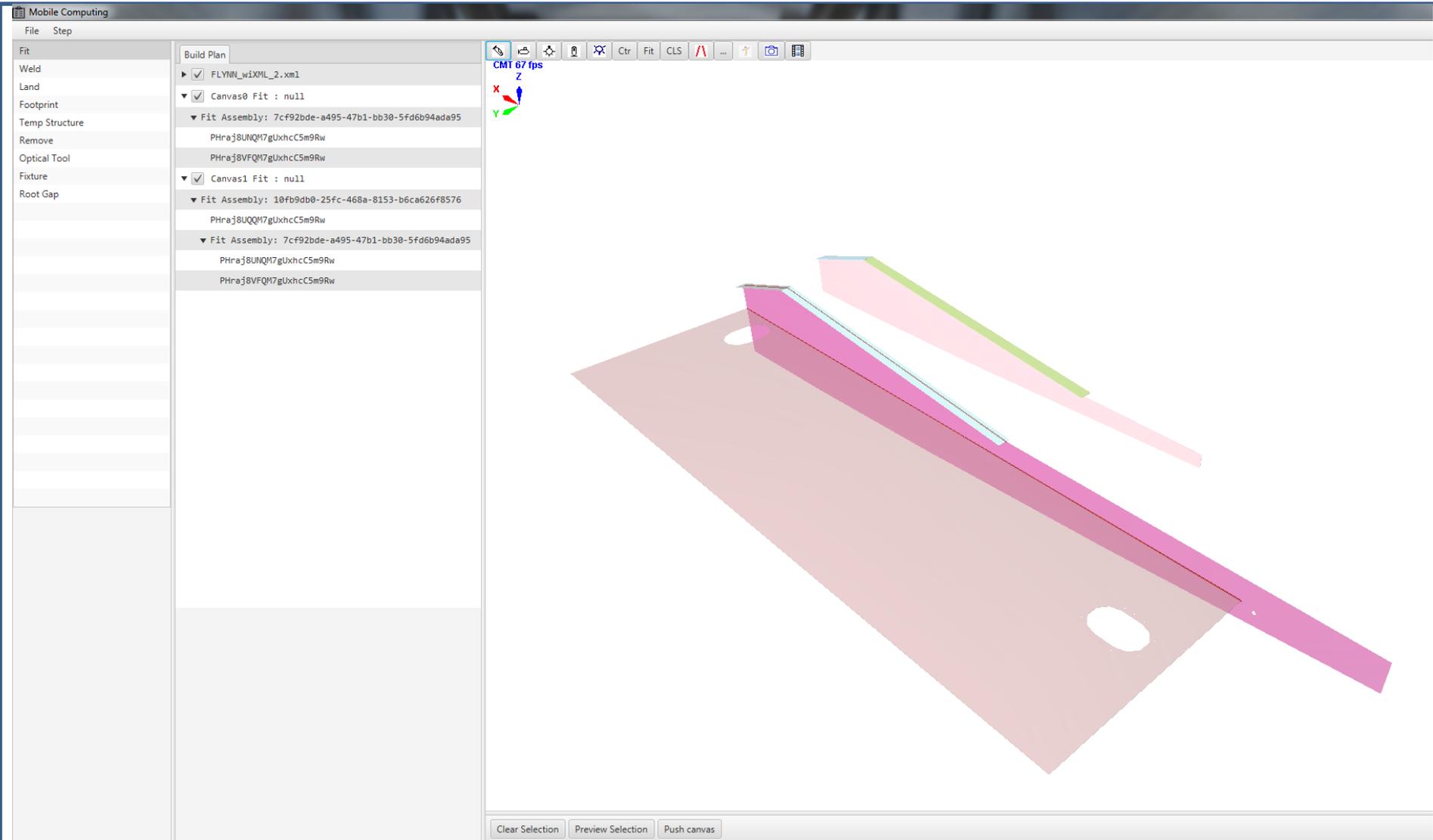


MDLPRT003698433

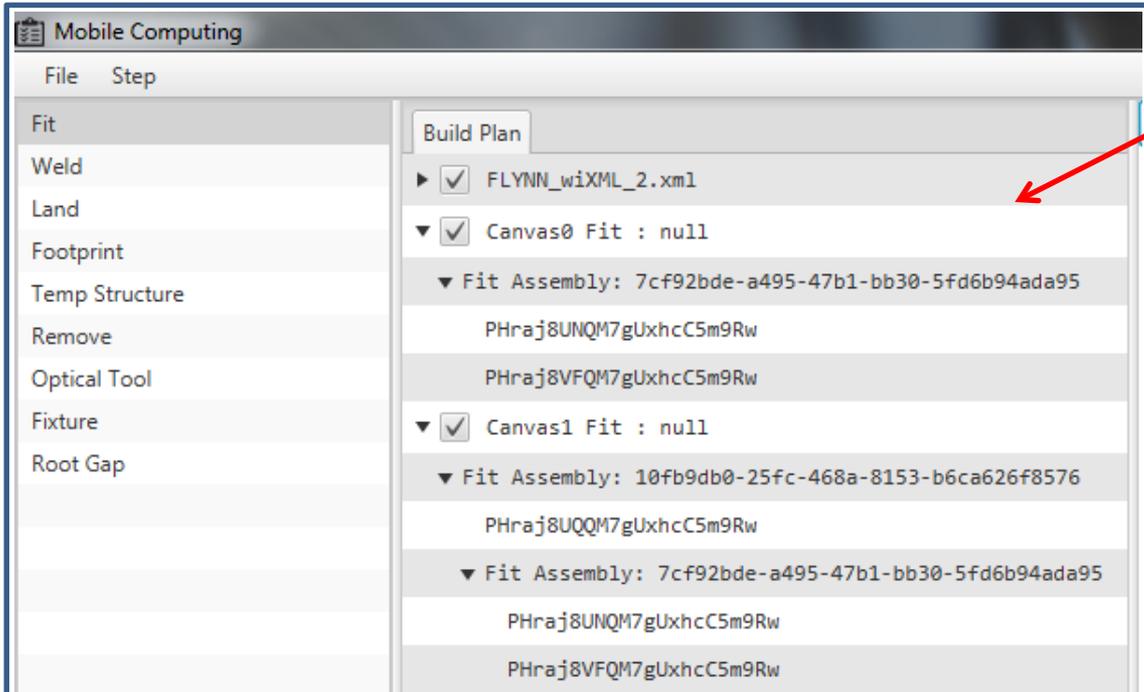
Pilot process



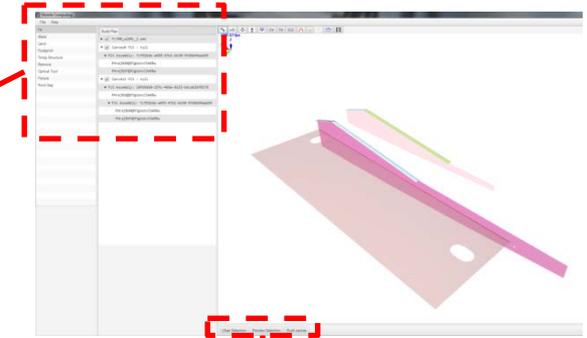
eMap Editor Interface



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



Clear Selection Preview Selection Push canvas

- Actions that directly affect the above view
- 'Push Canvas' consumes the selected items and moves them to editing screen

eMap Editor Interface

Parts X		Joints	
ID	Phantom	Addressable	
PHraj8UQQM7gUxhcC5m9Rw	false	true	
7cf92bde-a495-47b1-bb30-5fd6b94ada95	false	false	

- List of Parts and Joints associated with the selected model
- Each part or joint can be turned on or off

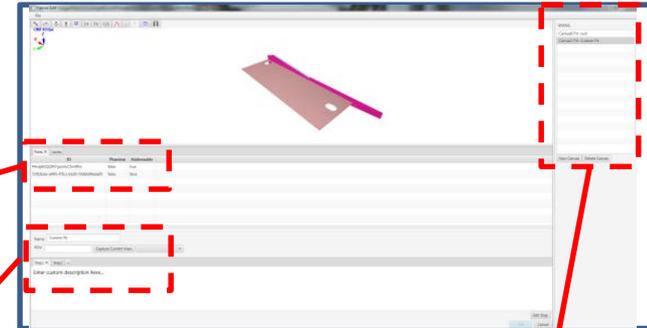
Name:

POV:

Step1 X Step2 +

Enter custom description here...

- User names the step and adds any addition information
- User captures the view displayed

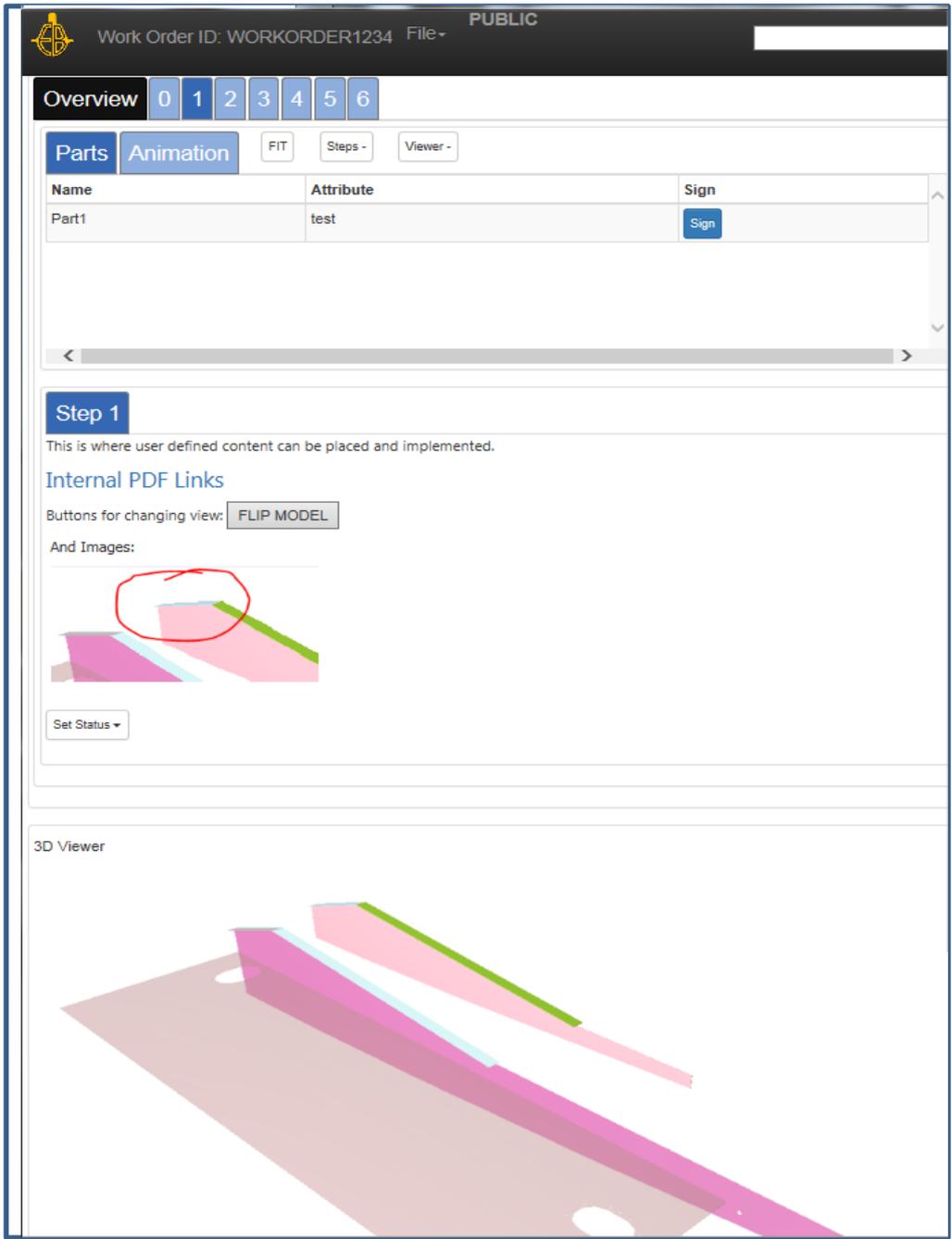


- Displays all previously created steps and canvas's

WiXML:

Canvas0 Fit : null

Canvas1 Fit : Custom Fit

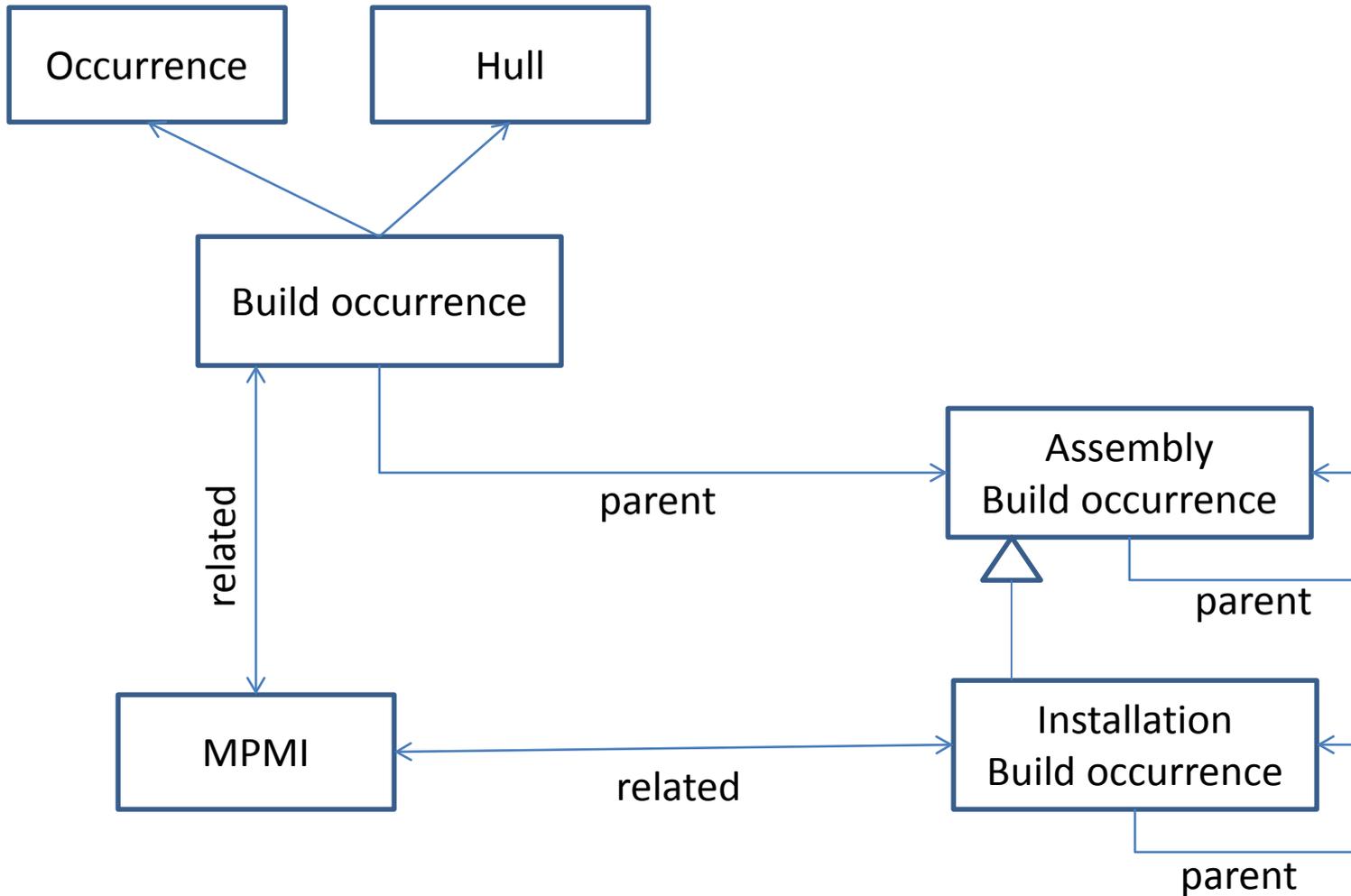


eMap
on
tablet

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



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.