



Digital Twin Identifiers What Next?

Wednesday June 1st, 2022

Martin Hardwick

Convenor WG15



Universally Unique Identifiers (UUID)

- UUID is a large number that is unlikely to ever be duplicated
- There are four types of UUID
 - UUID.4 is generally preferred
 - UUID.5 retains some history
- Different opinions on how to use the UUID
 - UUID used for one value/entity
 - UUID links several values/entities
- This project is about using UUID's to identify digital twins
 - The digital twin is described in many places / data formats
 - The UUID identifies the twin in all the places.



Use cases for manufacturing

1. The digital twin is explicitly modeled
 - The design of a bolt
2. The digital twin is implicitly modeled
 - The six bolts in the AS1 assembly
3. The digital twin will exist at a future time
 - The holes that are going to be drilled and filled on a wing



Ideas explored - November 2021 to May 2022

- FAIR example – showing value of linking data
- EBOM vs MBOM issues
- Assembly breakdown and digital twin indexes
- UUID management methods
 - OT solution using Information model
 - IT solution using Linked data
- Digital Twin examples



FAIR Example

Example: QIF report.

ASME Y14.45 Single Part Data Report Example

Part Name: Boxy	Part QPid: f2d3ae2b-25da-4524-8694-32ece8d142d2	Part Serial #: 1	3D CAD Model ID: DMDII_test2_20170708				Report # QA-12345		
QPIs			3D CAD Model QPid: 9637e2e8-9be4-4cc3-8cb8-dc53ca07b6fa				Report QPid: 985eee8e-27c2-4ad0-8fd3-c3c05a1333de		
Characteristic Name	Characteristic QPid	Specification	Min Spec	Max Spec	Measured Value	Accept?	Tooling/Equipment	Non-Conformance #	Comments
FLATNESS_1	e04c20a3-4ed7-4ff9-909c-7ec645137ac2	ASME Y14.5-2009	0.000	0.100	0.001	PASS	CMM		
FLATNESS_2	e2cec972-a31c-44d7-bd25-bc77c7205b12	ASME Y14.5-2009	0.000	0.200	0.001	PASS	CMM		
FLATNESS_3	302fbc11-508d-411d-ac9b-fa3798297569	ASME Y14.5-2009	0.000	0.100	0.001	PASS	CMM		
FLATNESS_4	67b1647f-bfaf-417c-8de0-7e9b251ee5b4	ASME Y14.5-2009	0.000	0.100	0.001	PASS	CMM		
FLATNESS_5	b90ed429-2402-4556-872a-387034f57f2b	ASME Y14.5-2009	0.000	0.100	0.001	PASS	CMM		
PERPENDICULARITY_1	c0115e2c-6796-4db4-bb3d-7b6566980aa4	ASME Y14.5-2009	0.000	0.025	0.017	PASS	CMM		
PERPENDICULARITY_2	6007370c-e612-499c-983e-461c04e88bd7	ASME Y14.5-2009	0.000	0.025	0.015	PASS	CMM		
PERPENDICULARITY_3	0d5bd430-5428-49b2-b730-9eb82ae93dc3	ASME Y14.5-2009	0.000	0.025	0.010	PASS	CMM		
PERPENDICULARITY_4	cab7bbc5-34d1-47b5-bc8b-ff94f0b1ff2a	ASME Y14.5-2009	0.000	0.025	0.010	PASS	CMM		
DISTANCEBTW_1	8c5cad4e-5050-4d92-872e-ab688d320fd1	ASME Y14.5-2009	59.700	60.300	59.953	PASS	CMM		
DISTANCEBTW_2	310172d2-2d66-4efd-839f-6a47665d7b74	ASME Y14.5-2009	59.700	60.300	59.964	PASS	CMM		
DIAMETER_1	3c8cc944-a925-40fb-ba66-59f2f6f04a96	ASME Y14.5-2009	15.200	16.800	17.705	FAIL	CMM	NCR# 12345	
DIAMETER_2	641970ca-0394-4e84-9f32-efda80c048bc	ASME Y14.5-2009	15.200	16.800	18.002	FAIL	CMM	NCR# 12345	

Serial Number

Part Number

Model Based Product Characteristics

[ISO 23247 Demonstration Use Case 2](#)

Image on this page is used with permission from Mitutoyo America Inc.

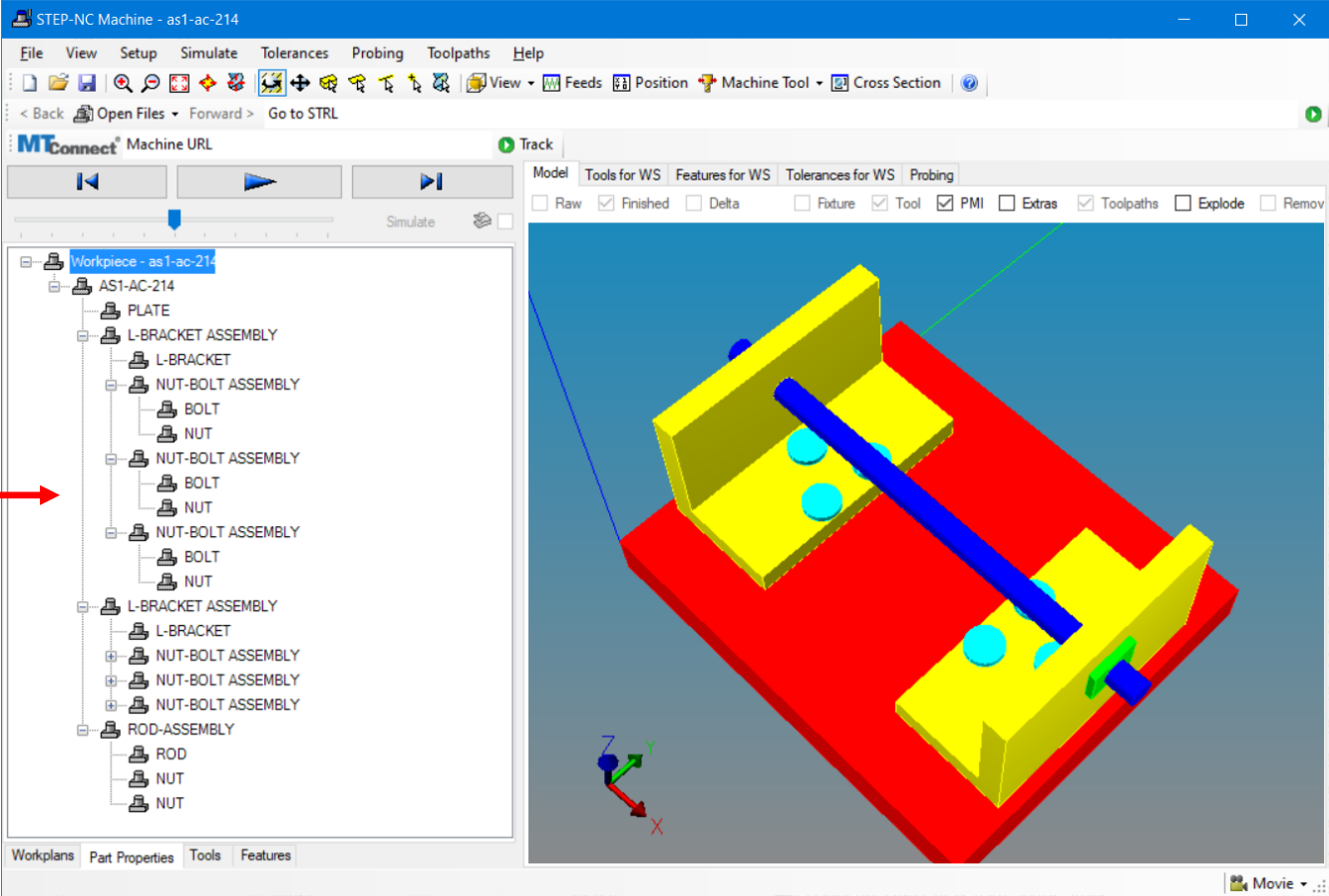


EBOM/MBOM test case

5 designed items have engineering requirements (plate, L-Bracket, nut, bolt, rod)

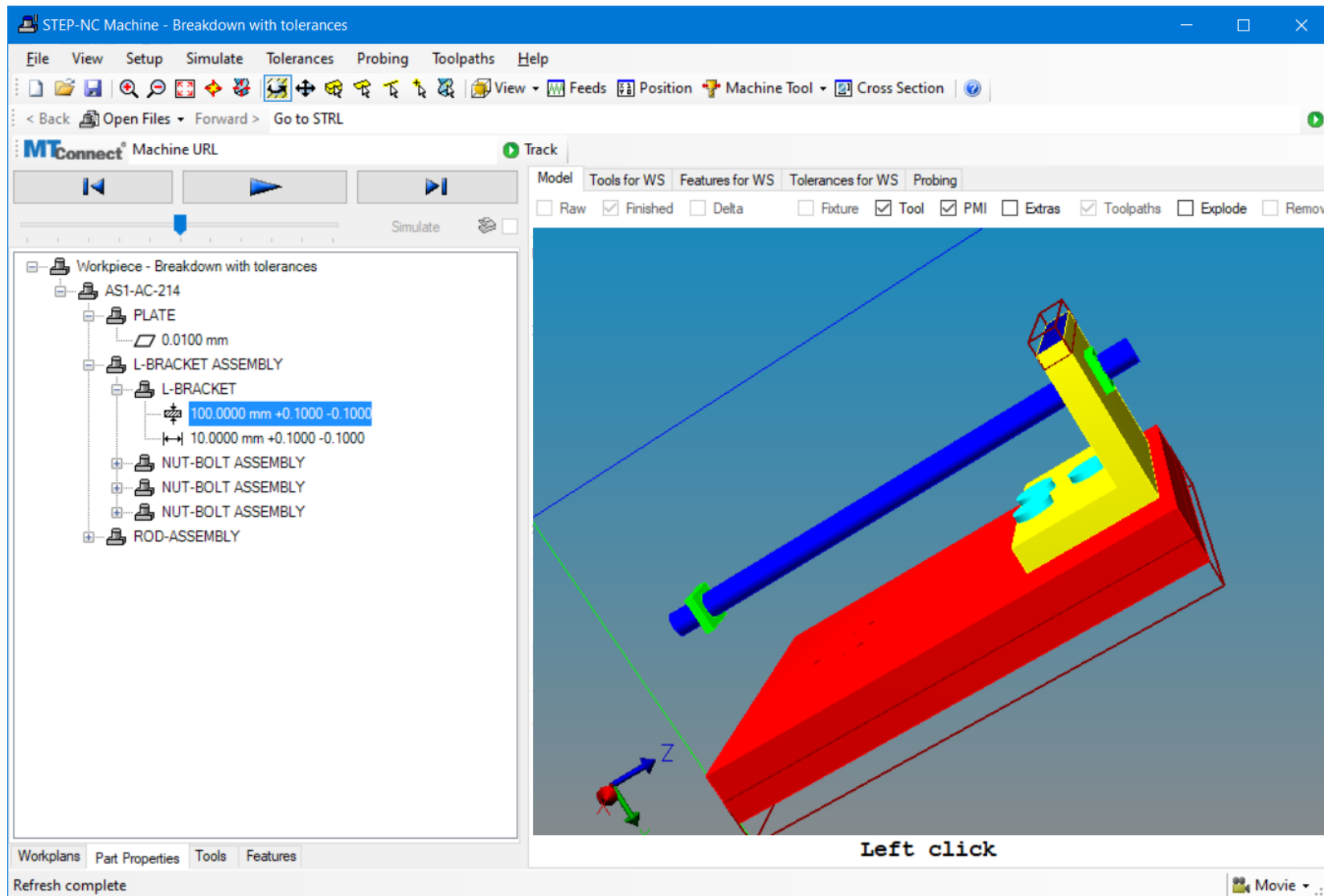
28 nodes in assembly tree

18 machined items (8 nuts, 6 bolt, 2 brackets, 1 plate, 1 rod)





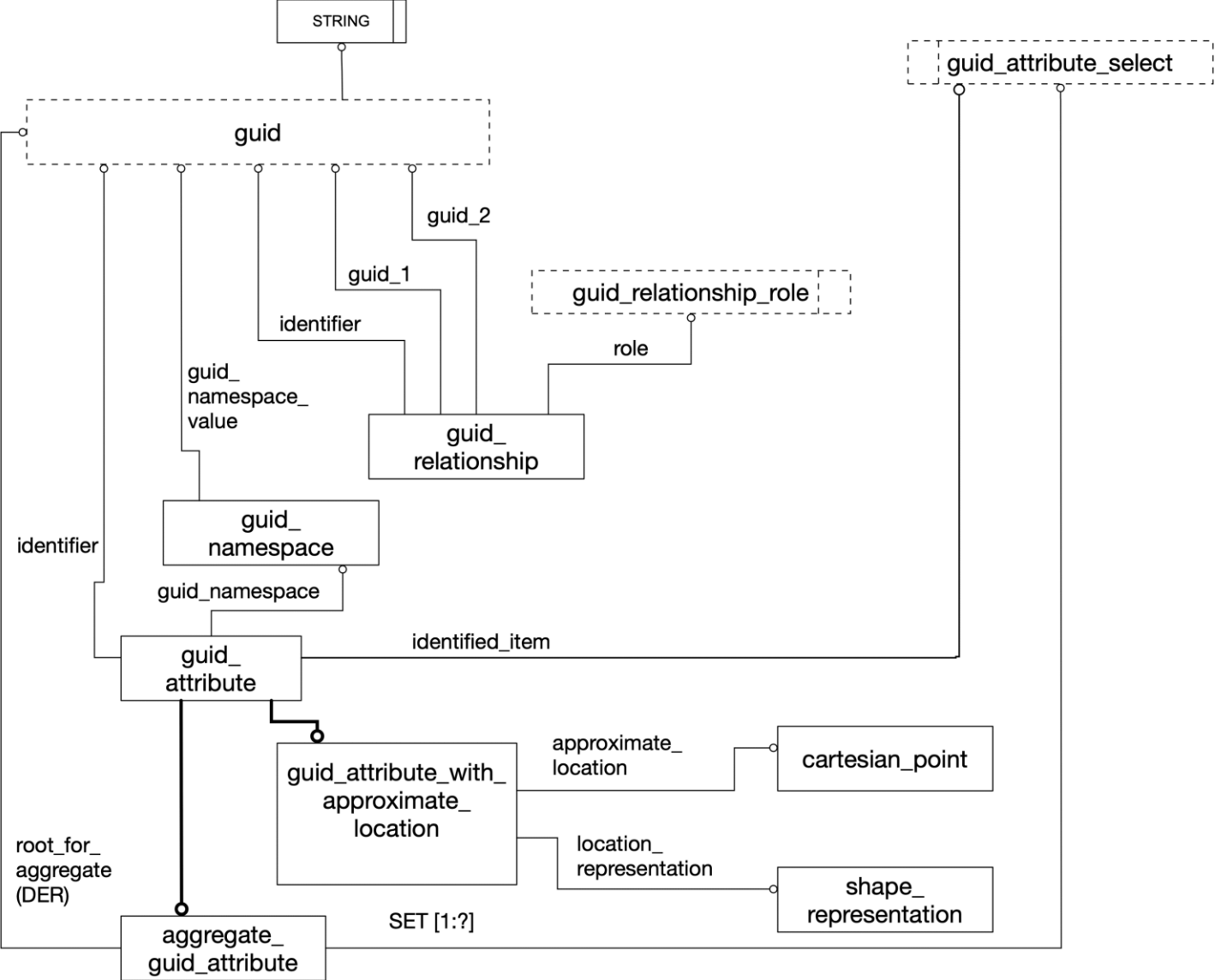
Assembly breakdown



Tolerances specific to this stage of the manufacturing.



UUIDs in an Information model



UUIDs in Linked data

- Anchor section adds additional IT data
- Reference section uses the anchors to link files

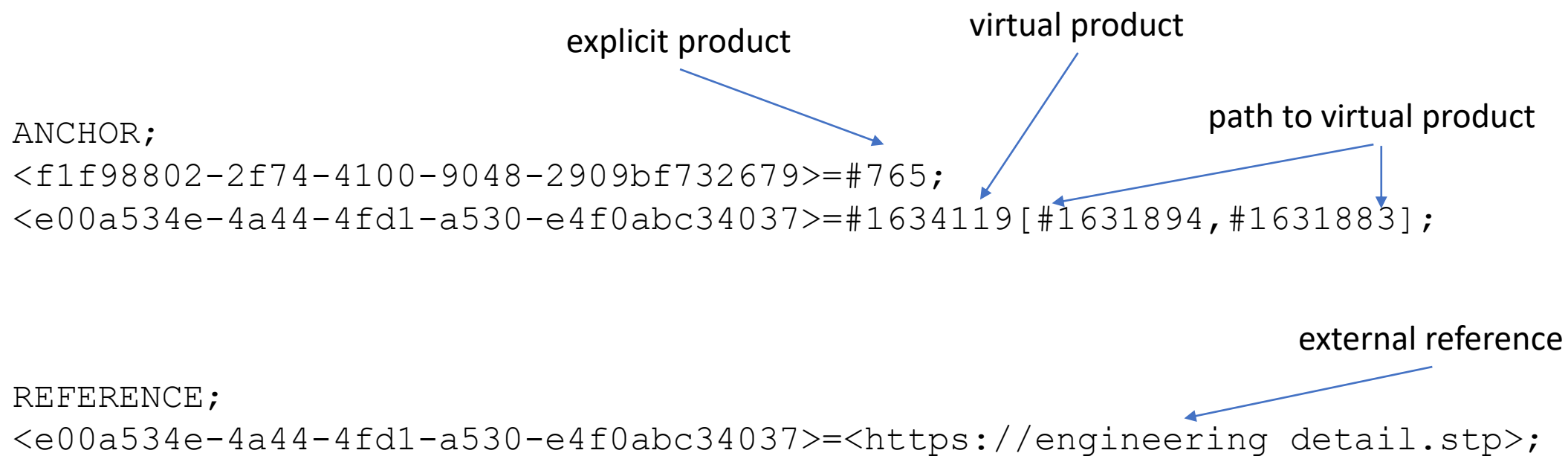
explicit product virtual product

ANCHOR;
<f1f98802-2f74-4100-9048-2909bf732679>=#765;
<e00a534e-4a44-4fd1-a530-e4f0abc34037>=#16341119[#1631894, #1631883];

path to virtual product

external reference

REFERENCE;
<e00a534e-4a44-4fd1-a530-e4f0abc34037>=<https://engineering_detail.stp>;



Comparison of UUID management methods

Information model

One big master file

- All data in one place
- With many views in data
- Additions and exceptions
- PLCS & MLRD describing relationships is complex
- Hard to tolerance
- Fragile because one error disables very large file

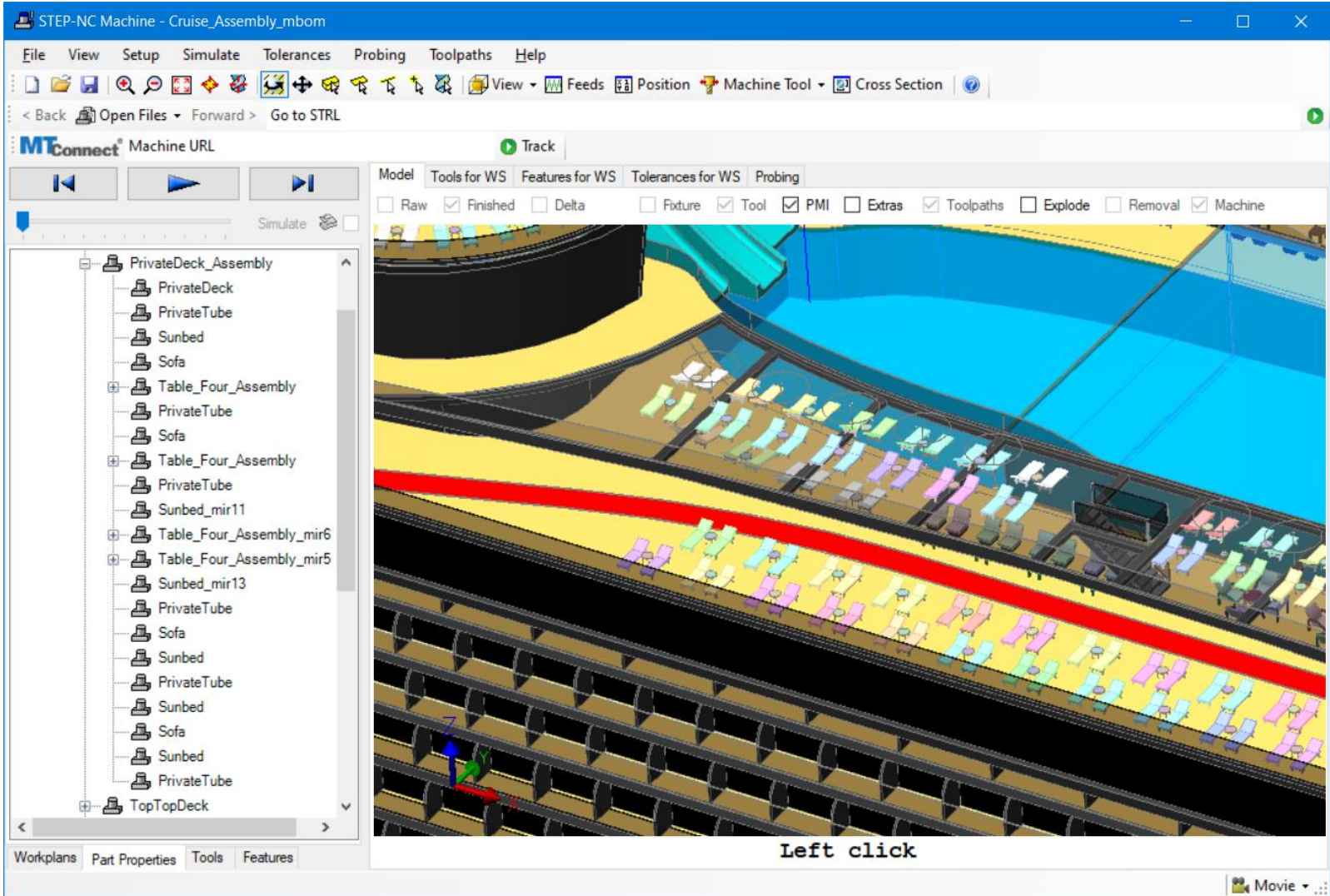
Linked data

Network of connected files

- Data in many detail files
- Detail file for each view
- Detail file for each breakdown
- Links describe relationships between master and details
- Easy to tolerance
- Robust because error in one file does not impact the others

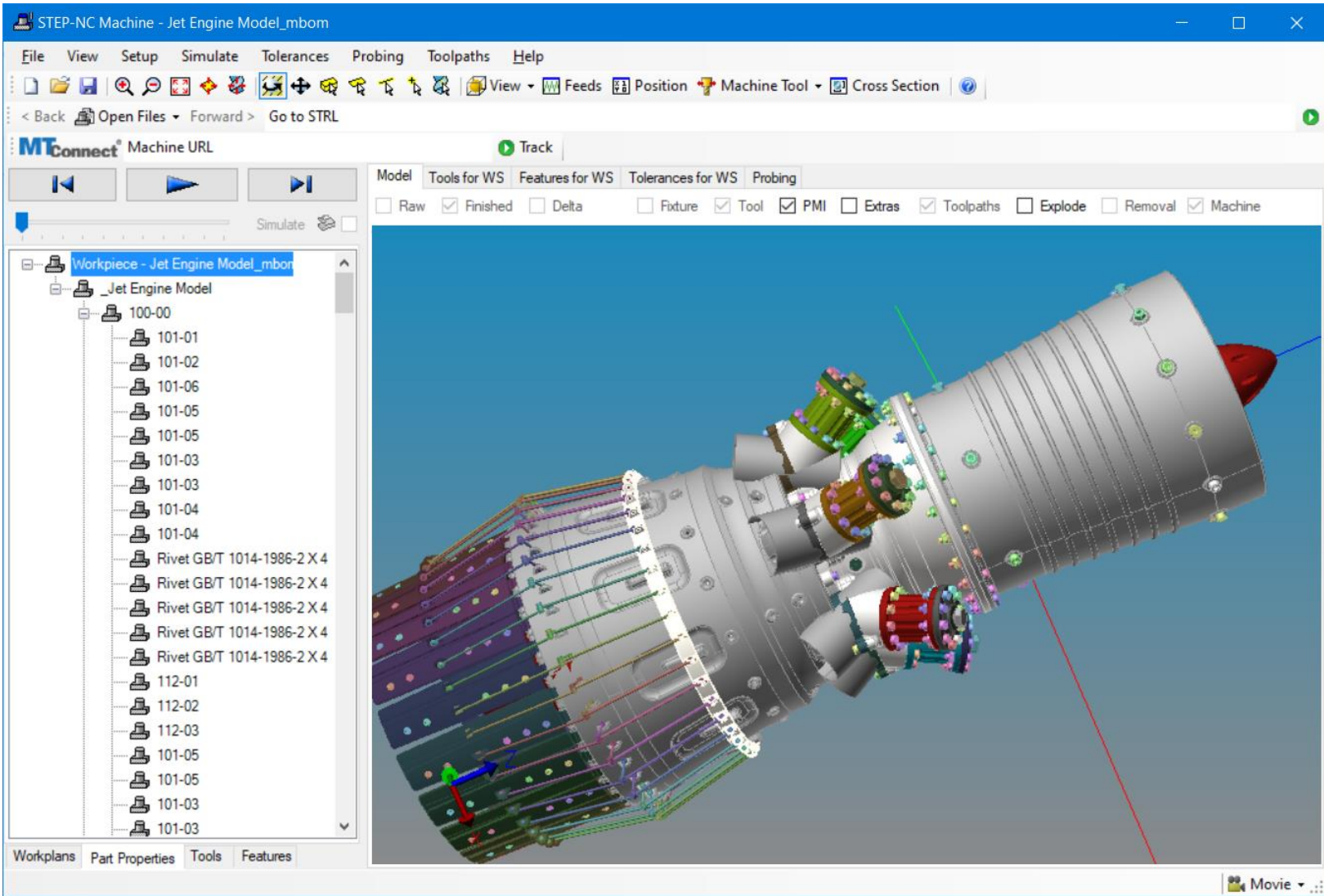


Digital Twinned example – Cruise Ship



Files sizes are doubled

Digital Twinned example – Jet Engine





Digital Twinned example - Stratocruiser

