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ISMAR 2021: AR Standards as Tools

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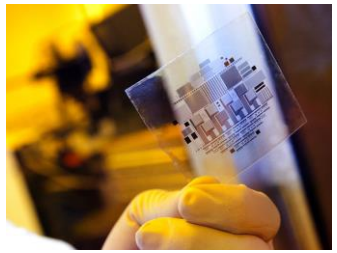
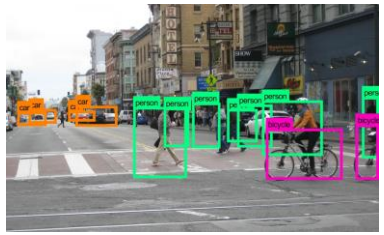
Industry 4.0 ~ Smart Manufacturing

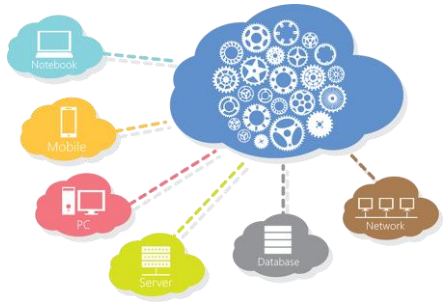
- Combines advanced manufacturing services with digital infrastructure
- Represents a **fourth industrial revolution** taking advantage of the ubiquity of digitalization
- Promotes interconnectivity, information transparency, and decentralized decision-making

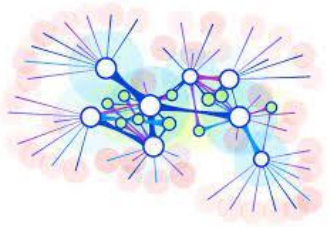
Advanced Manufacturing Services (e.g.)



Digital Infrastructure (e.g.)







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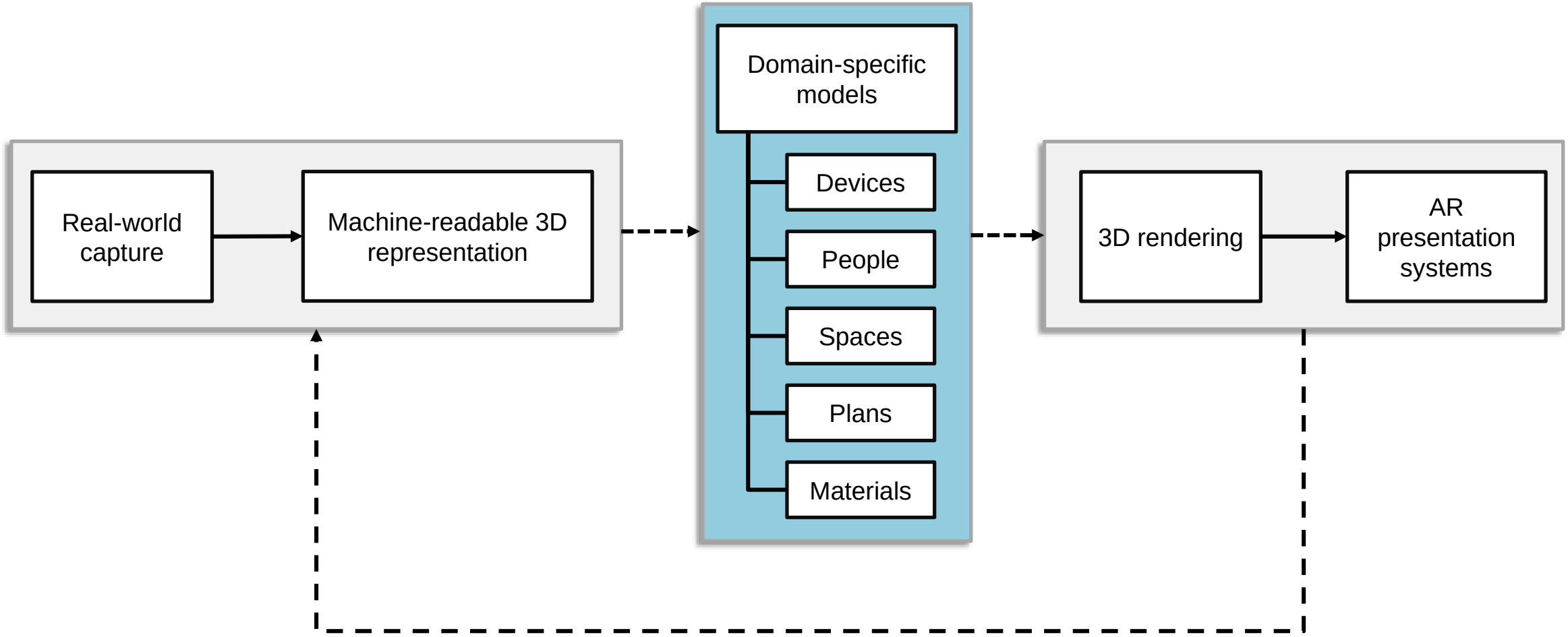
Conceptual Framework for Industrial Augmented Reality



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Acknowledgements: Christine Perey

Industry 4.0 Standards Activities

Challenge:
Harmonizing Industry 4.0 standards at scale

ASME SETTING THE STANDARD

ISA

OMG OBJECT MANAGEMENT GROUP®

OPC FOUNDATION The Industrial Interoperability Standard™

ISO IEC

ASTM ASTM INTERNATIONAL

MTConnect®

IEEE

OAGi Open Applications Group

Digital Metrology Standards Consortium DMSC

IPC

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Lu, Y., Morris, K.C. and Frechette, S., 2016. Current standards landscape for smart manufacturing systems. *NIST, NISTIR, 8107.*

Augmented Reality Standards Activities

Challenge:
Harmonizing within AR and across to I4.0 standards at scale

OGC® Making location count.

ETSI

SAE INTERNATIONAL

Consumer Technology Association™ CES

W3C® WORLD WIDE WEB consortium

bsi.

KHRONOS® GROUP

ISO JTC1 IEC INFORMATION TECHNOLOGY STANDARDS

IEEE®

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EPRI funded an AR standards landscape paper. Find it here: https://www.epri.com/research/products/3002010514

Example: Design and Inspection Data in AR

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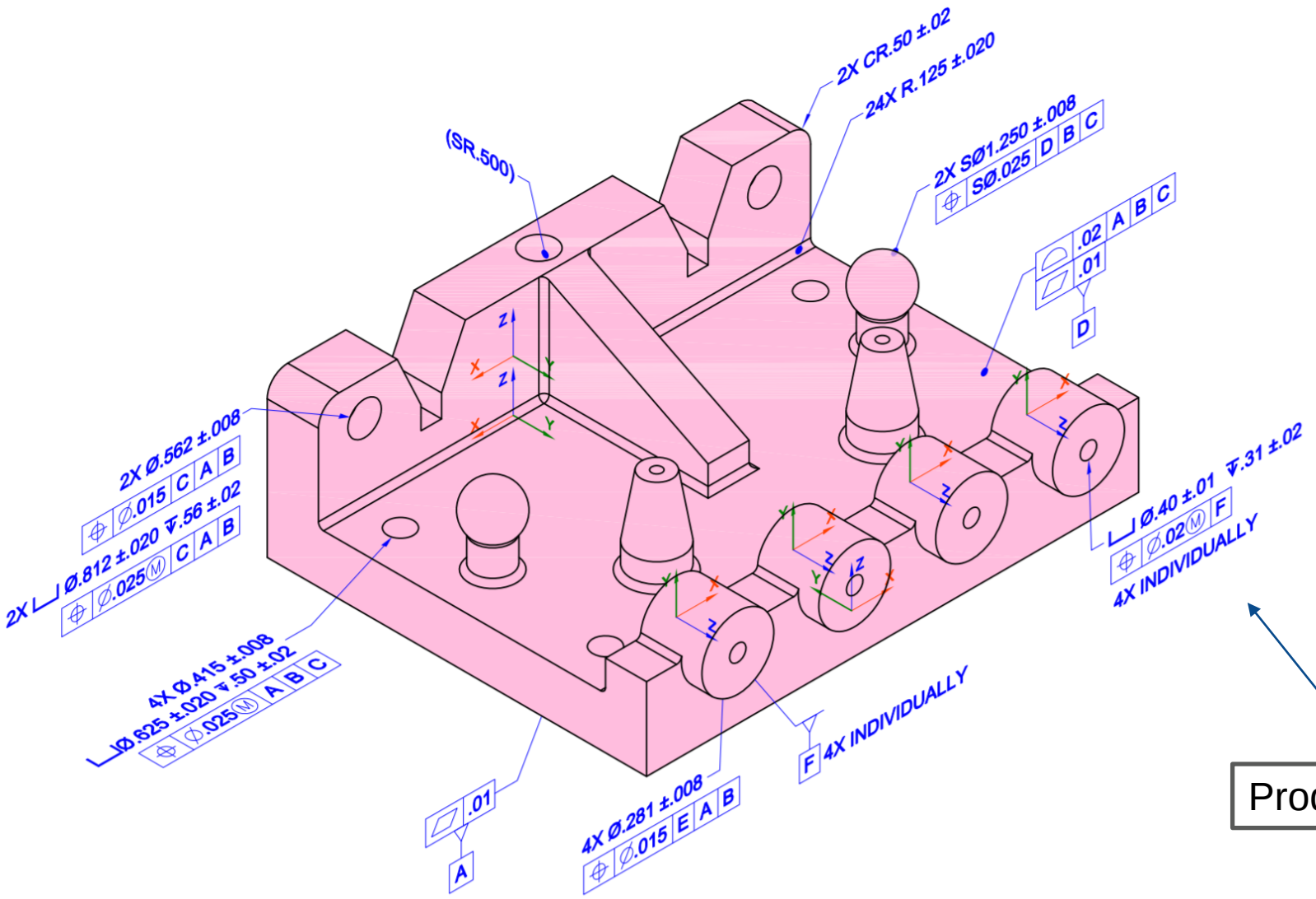
Design Data | STEP + PMI



Standards:
- ISO 10303 series
- ASME Y14.5
- ASME Y14.41

Product Manufacturing Information (PMI)

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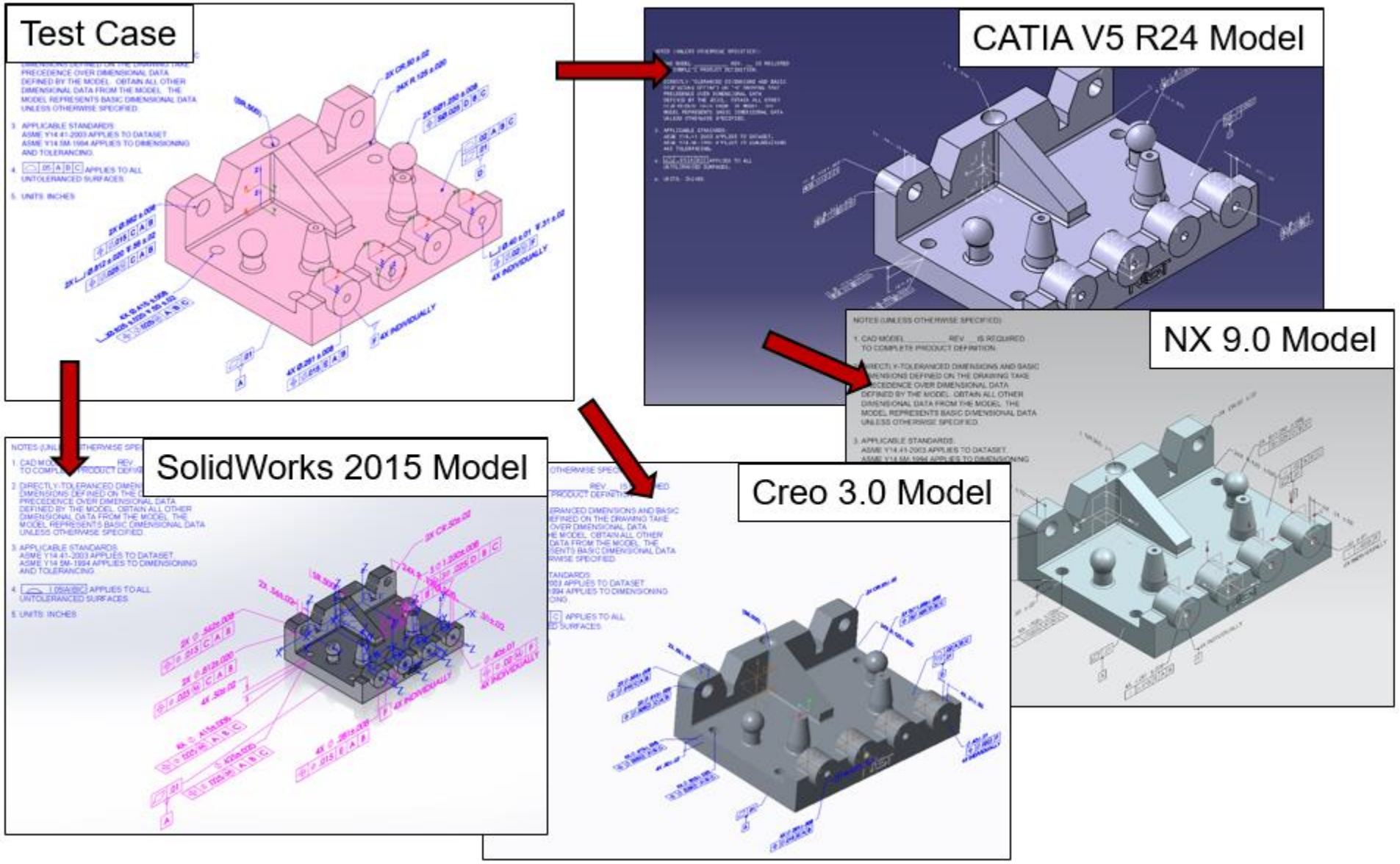

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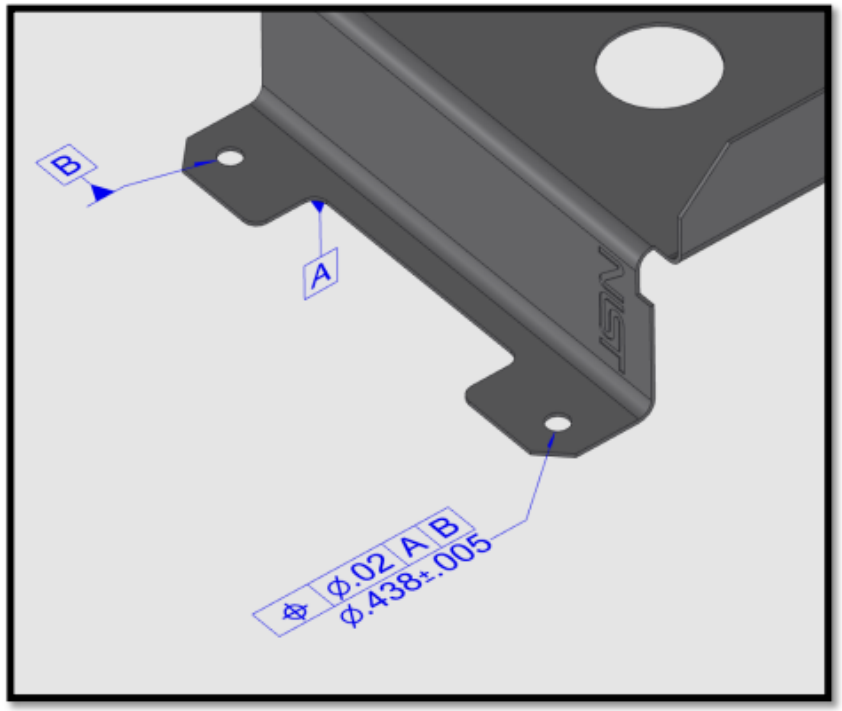
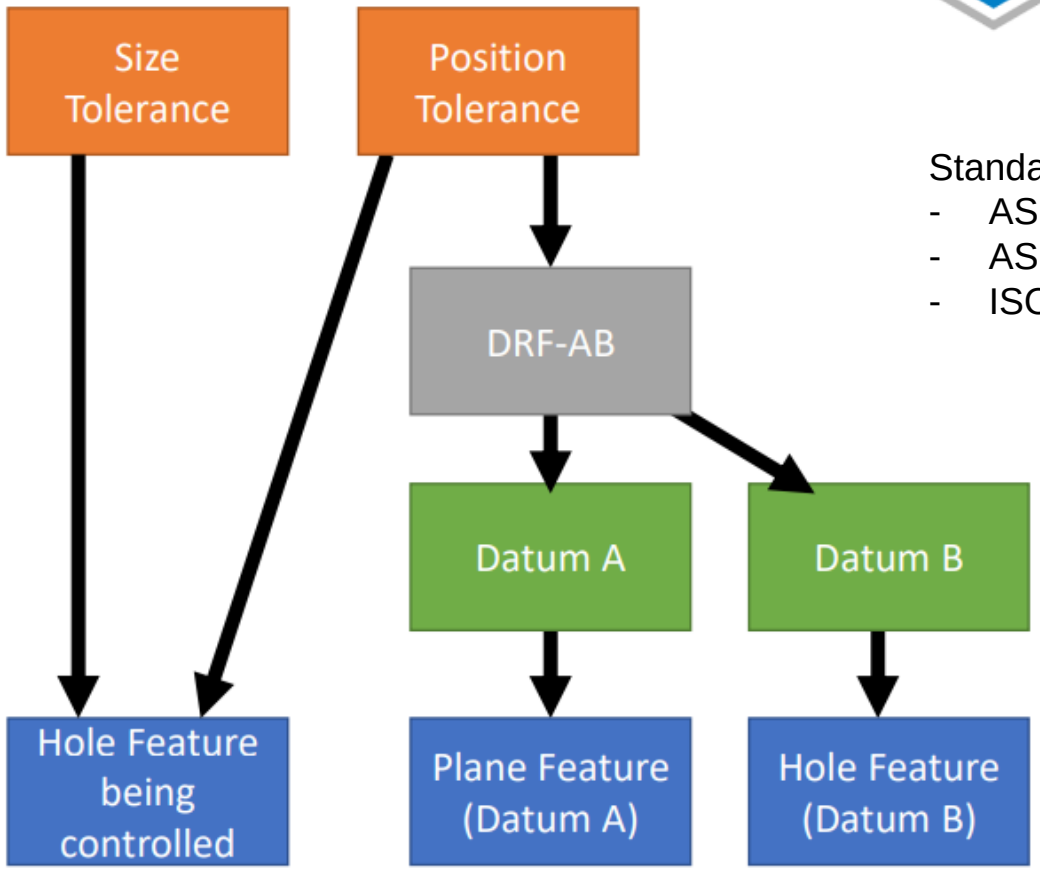
https://www.nist.gov/el/systems-integration-division-73400/mbe-pmi-validation-and-conformance-testing-project

Inspection Data | QIF (just a small taste)

Datums and DRFs are data structures used to help define the geometric controls implied by a GTol. This is how Features, Datums Features, and GTols are linked.





Standards:
- ASME Y14.5
- ASME Y14.41
- ISO 23952

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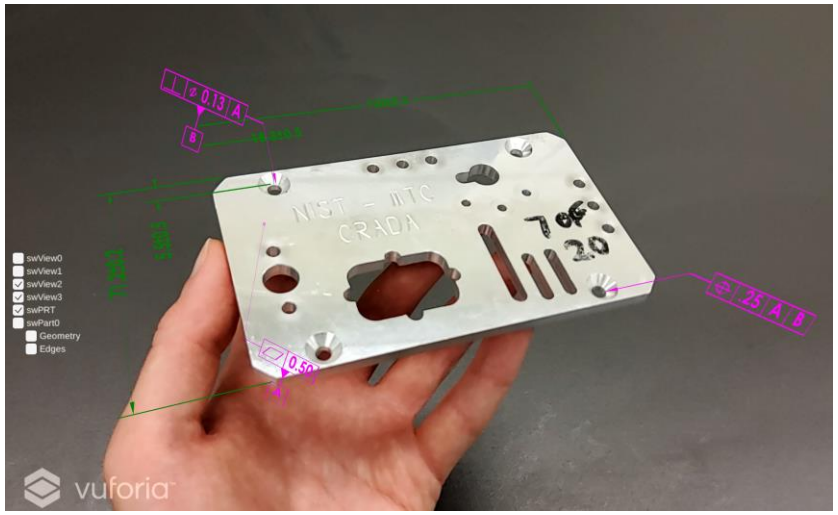
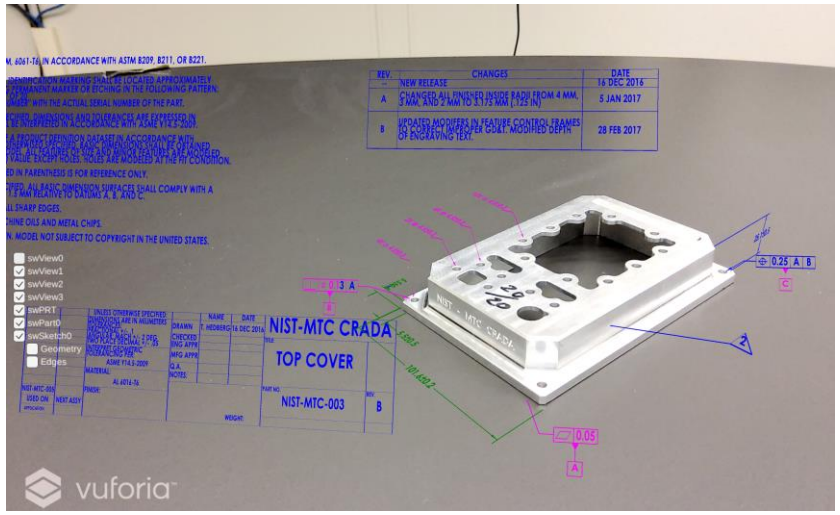
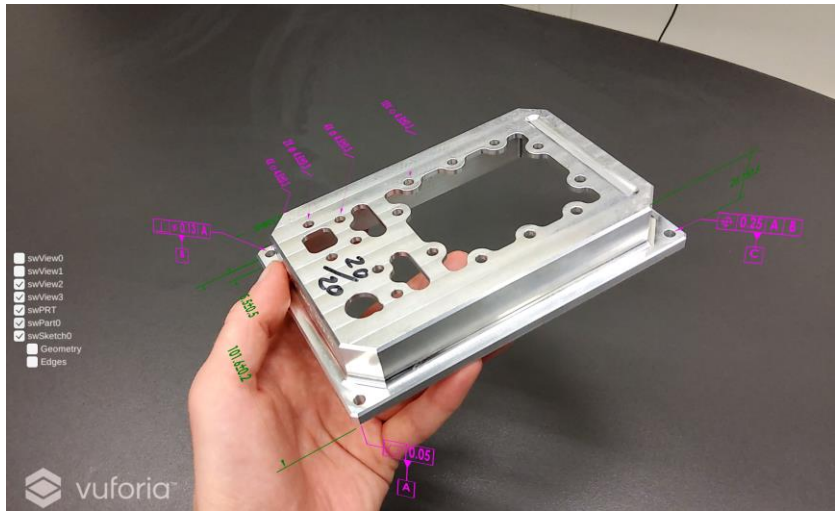
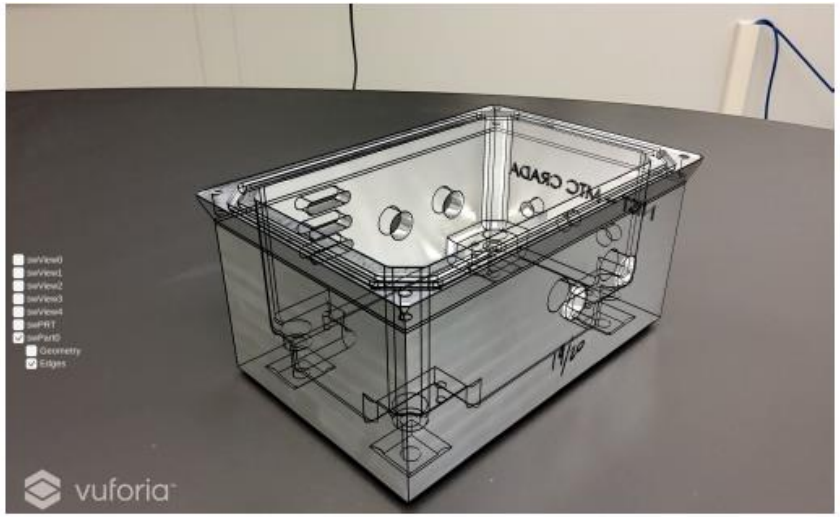
https://qifstandards.org/qif-implementation-tutorials/

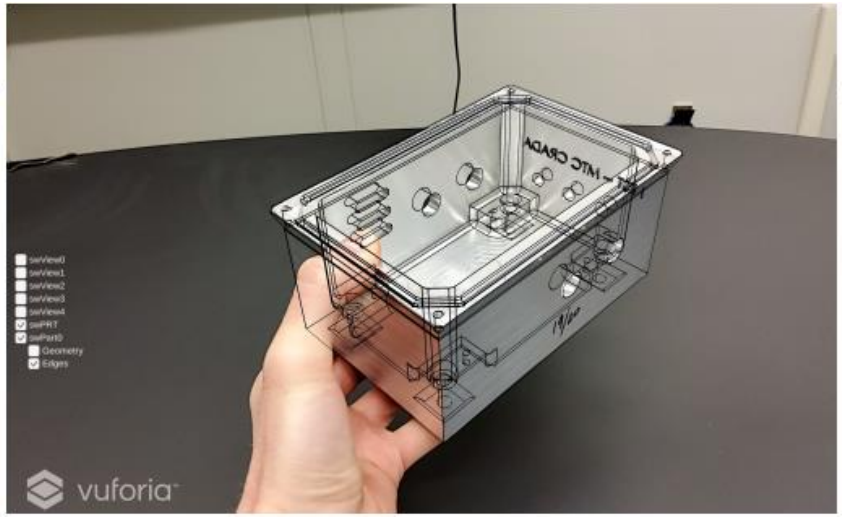
Visualizing in AR using the Industry 4.0 standards

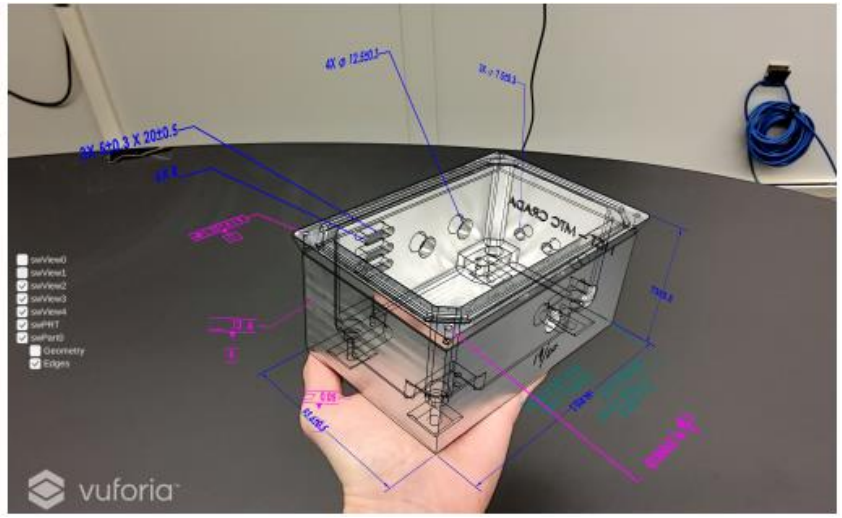












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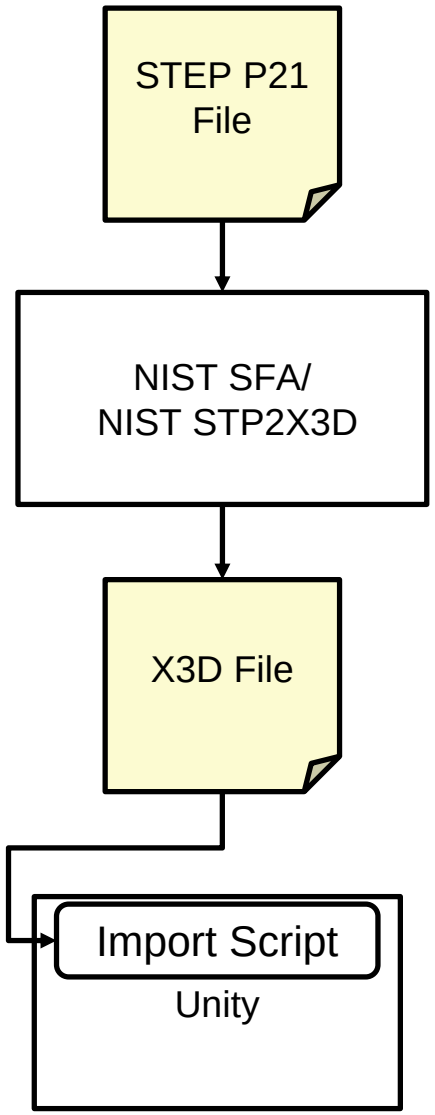

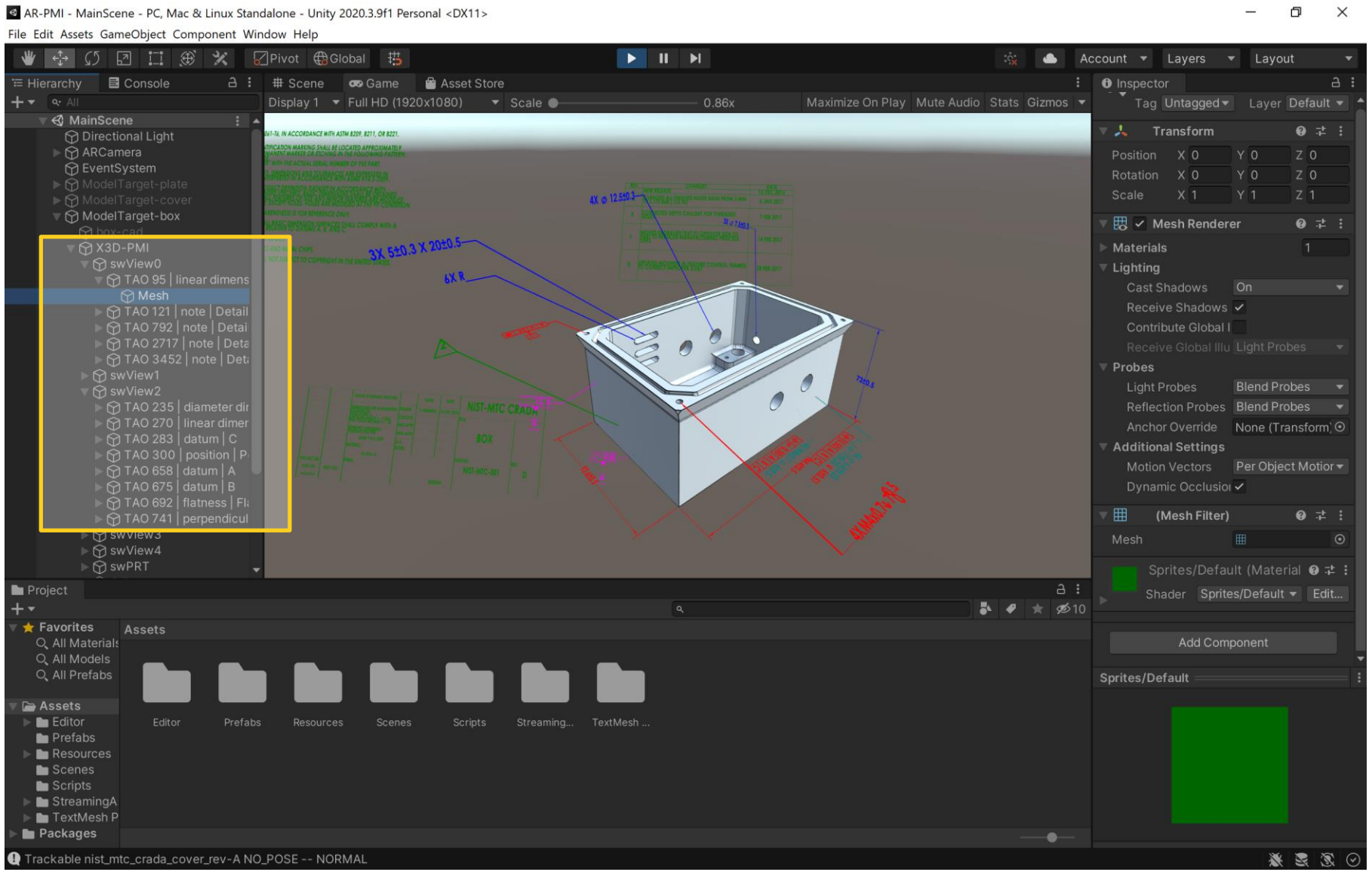

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Viewing Inspection Results (QIF) on geometry (STP) in AR

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Example: Spatially orienting manufacturing equipment

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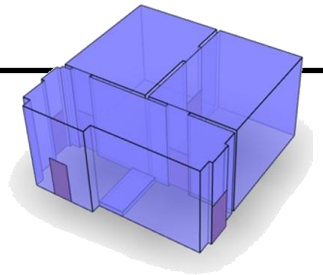
Merging geospatial and manufacturing representations

OGC IndoorGML

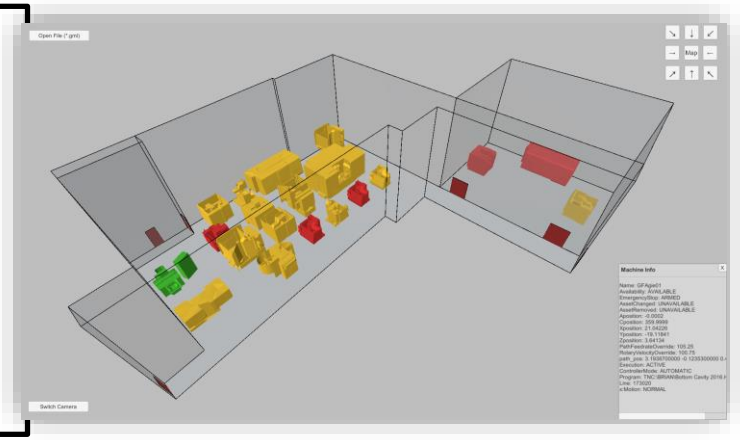
- Standard for describing **indoor spaces**
- Open **XML**-format
- Provides **semantic** and **geometric** representation of indoor spaces



MTConnect

- Standard **semantic vocabulary** for manufacturing equipment
- **Structured**, **contextualized** data
- No proprietary format

- Creating **IndoorGML-data** from **workshops**
- 3D-visualization for IndoorGML-data and combining it with data from MTConnect
- Creating a standardized way of creating **geospatial representations** of workshops with a relationship to **actual machine data**



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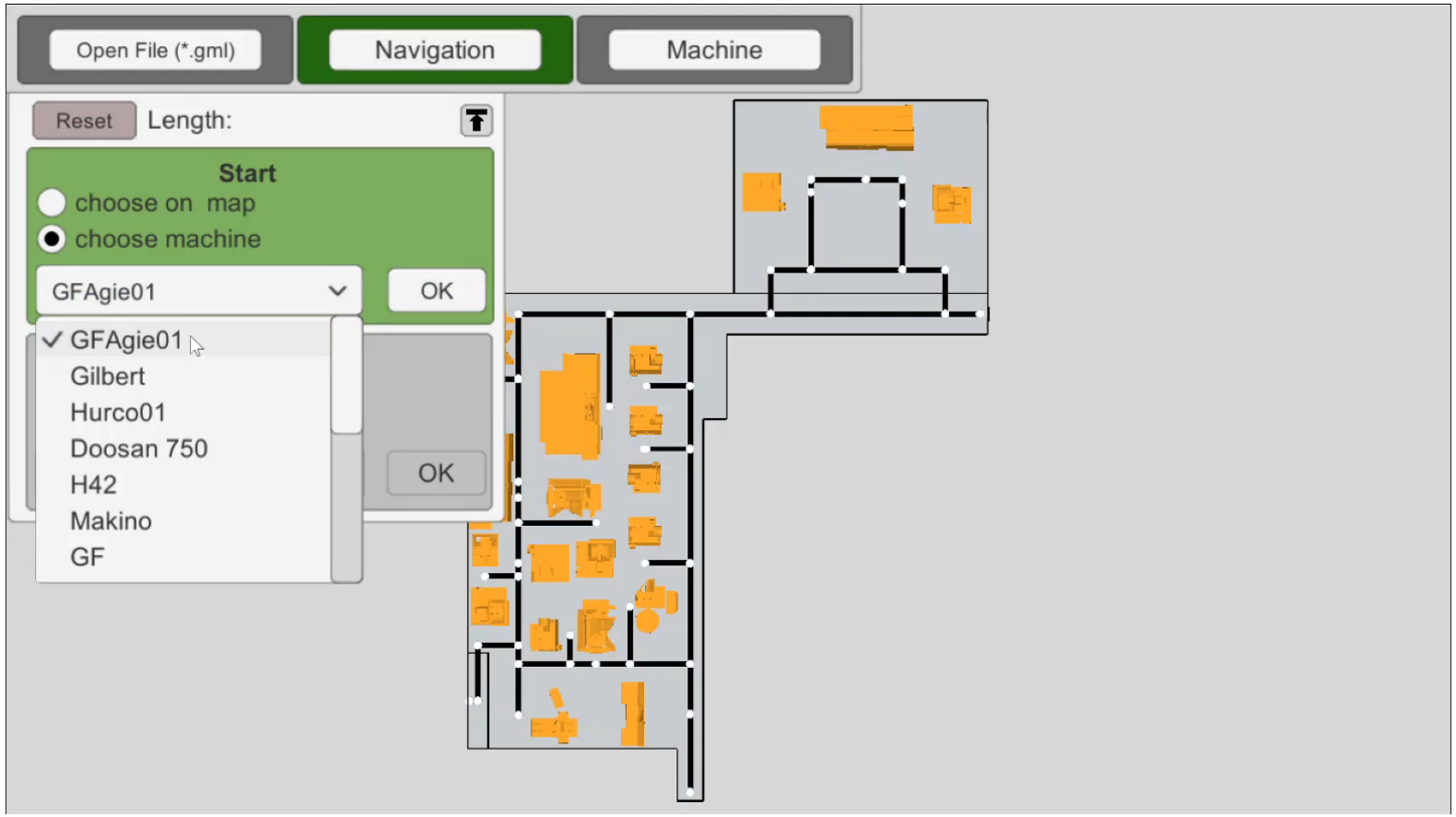
Tested IndoorGML with the NIST SMS Test Bed



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https://github.com/usnistgov/sms-test-bed-unity-demo

Big Picture Takeaways: Standards as Tools

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Big Picture Takeaways

- Industrial AR workflows require flexibility
- Standards as tools can provide that flexibility
- Working across standards uncover value (e.g., interoperability)
- Use what's already out there!

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Questions?

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