Key Enablers of a successful and profitable MBD process

Ken Abbott
GE Oil & Gas

Kenneth.Abbott@ge.com

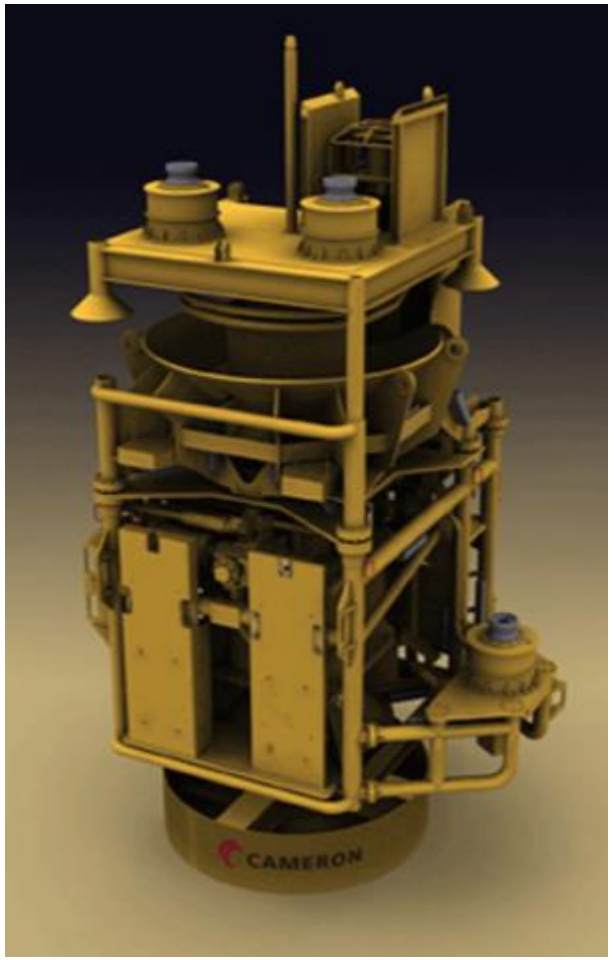
Mark Nielsen
TechAzul
310-729-6275
marknielsen1@gmail.com

Key Enablers Overview

Agenda

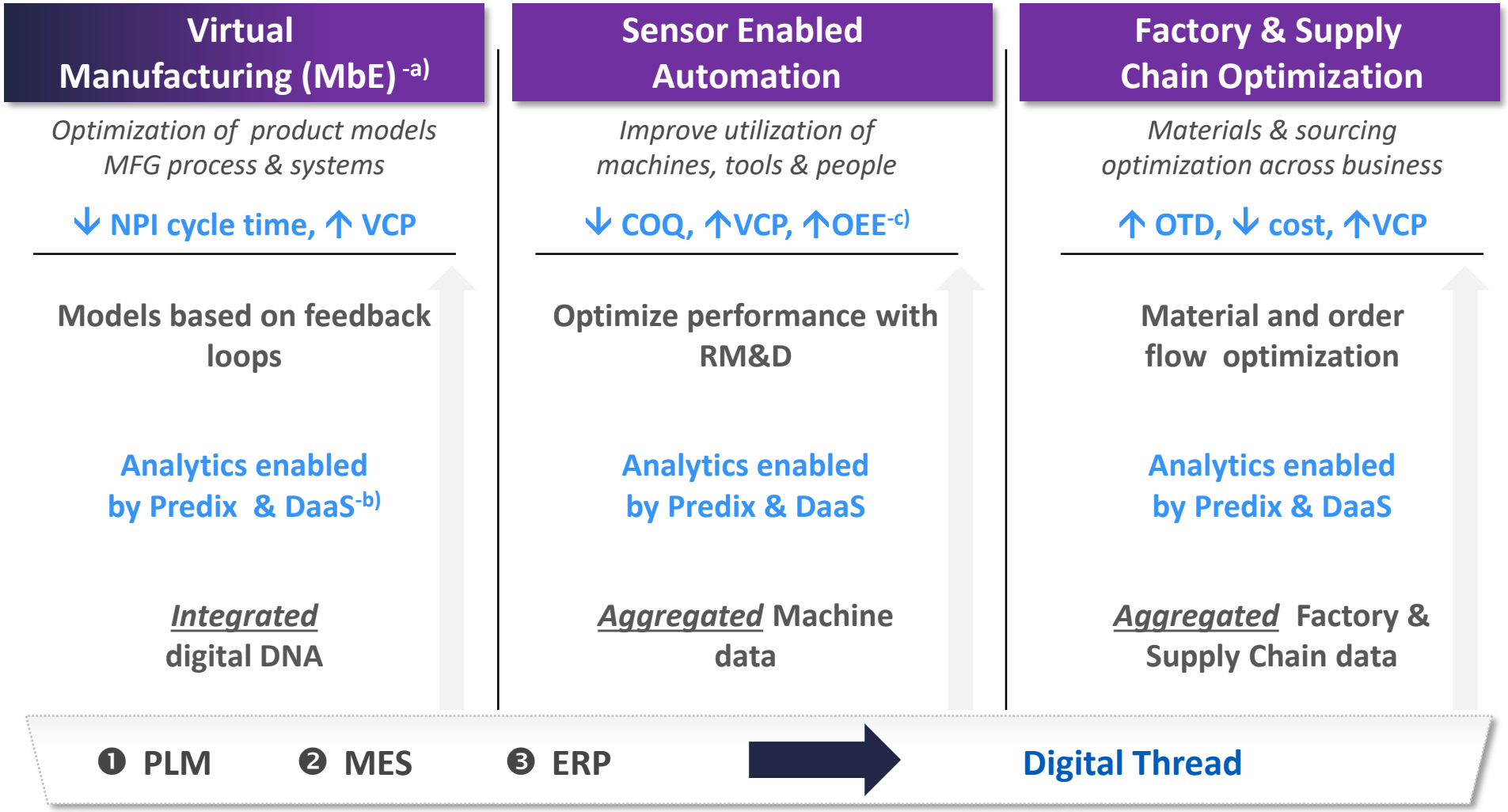
- GE Digital Thread Goal
  - **“We want the Digital Thread to go from Engineering all the way through our Installed Base…”**

- Agenda
  - History of MBD at GE Oil & Gas
  - The Vision
  - The Reality
  - The Solution
  - Demonstration video
  - The Next Steps



Subsea Tress, Manifolds & connection Systems

Brilliant Factory Framework



Significant change to the way we work, deeply leveraging technology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Merging Virtual & Physical Worlds

Leveraging the Power of Digital for Outcomes

SHAREOWNER

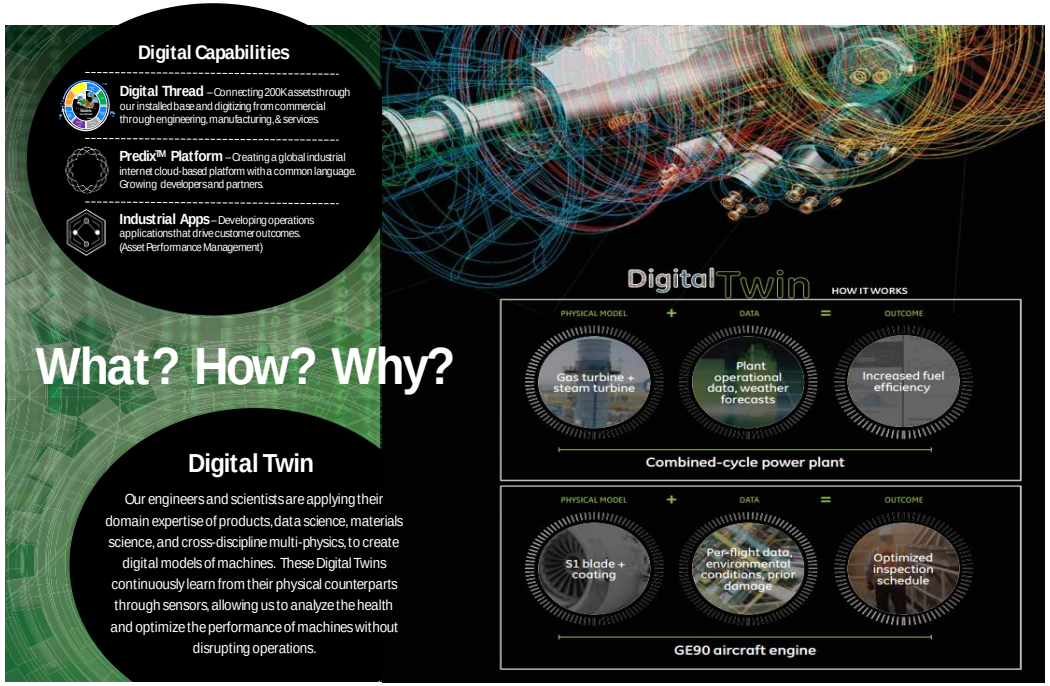
+ REVENUES
+ MARGIN
+ RETURNS

GE for GE

↑ Increase CM
↓ Reduction Eng Cycle
↓ Reduction Mfg Cycle
↓ Reduction in Defects
↓ Reduction in COQ
↑ Increase OTD

GE for CUSTOMERS

+ GROWTH
+ UPTIME
+ EFFICIENCY
+ SAFETY
+ CAPACITY



Jeff Immelt – CEO GE

We need to make sure that we implement our own Industrial Internet

"…For GE to be credible, we also need the Digital Thread within GE, (in) our own Engineering; **We want the Digital Thread to go from Engineering all the way through our Installed Base…**"

Becoming a Model Based Enterprise - Vision

…Digitizing within, & Connecting across…

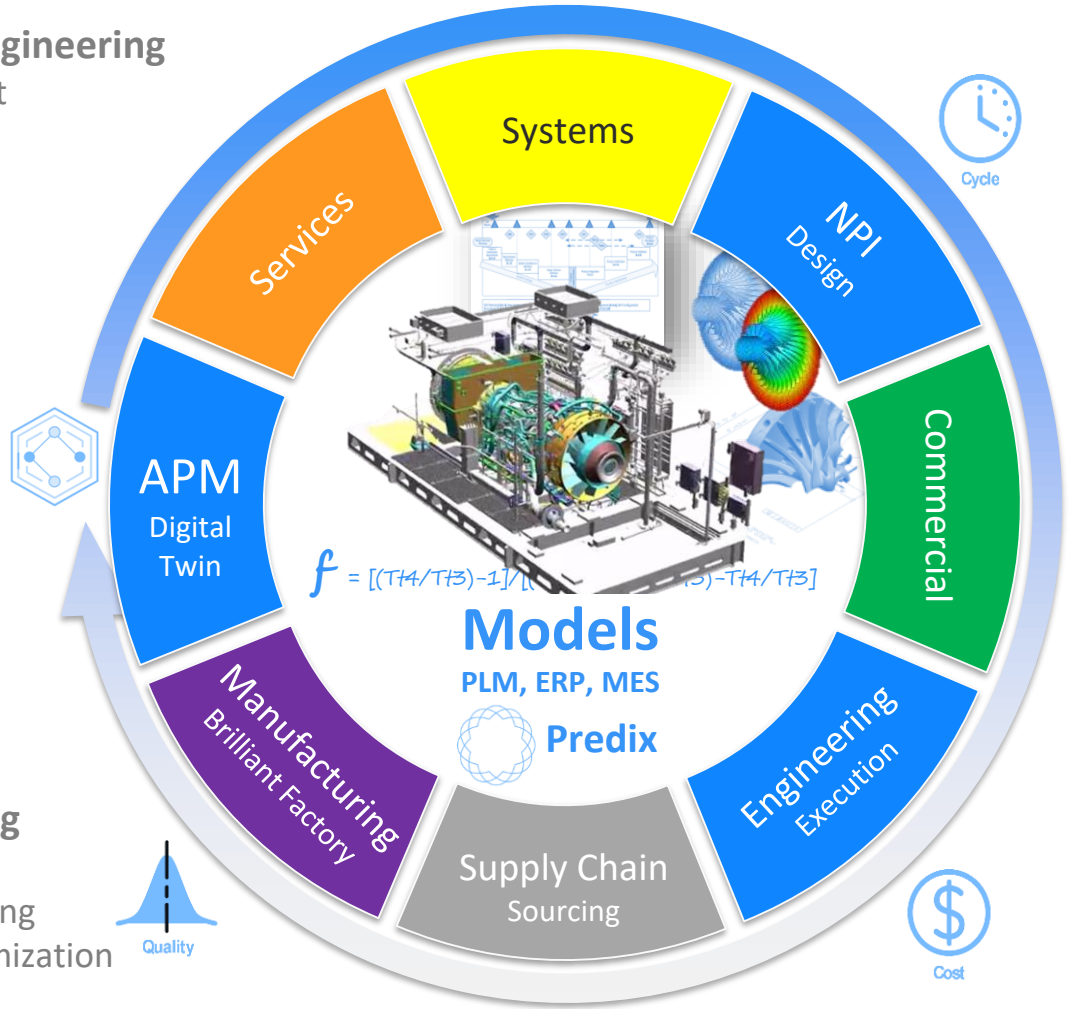
Model Based Systems Engineering
- Requirements Management
- Systems Modeling
- Materials Management

Services
- Serialization & Tracking
- Condition Based Maintenance
- Digital Data Books

Digital Twin

APM
- Asset Performance Management
- Remote Monitoring & Diagnostics
- Predictive Maintenance
- Performance Optimization

Model Based Manufacturing
- CAD to CAM to Inspection
- Digital & Additive Manufacturing
- Brilliant Factory: Lean & Optimization

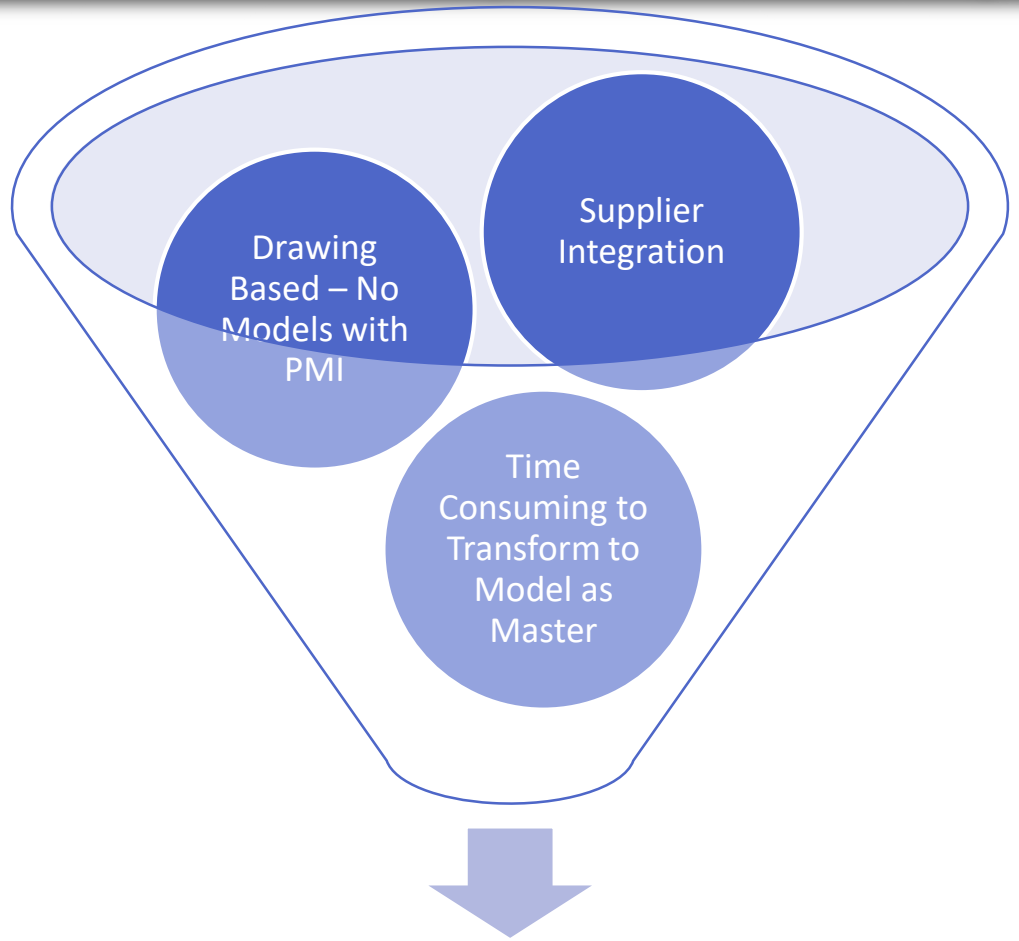


Model Based Definition & Design System Integration
- Analysis & Optimization
- 3D Model as Master, w/ Intelligence
- Mathematical & Simulation Models

Product Management & Structure
- Product Selection Tools
- Program Planning & Timing
- Configuration Management
- Product Cost Management
- Part Bill of Material Management
- CAD Bill of Material Management
- Digital Product Libraries

Product Design & Validation
- 3D Model Design in Context
- 3D Virtual & Test Validation
- Requirements Conformance

Becoming a Model Based Enterprise – Reality Starts at the Model



Need Tools to get there faster!

Design

Benefits

1 | Accelerate 3D PMI
- Automatically Synchronize 2D to 3D
- Automatically, Integrate Schema
- 75% + Reduction vs. Manual

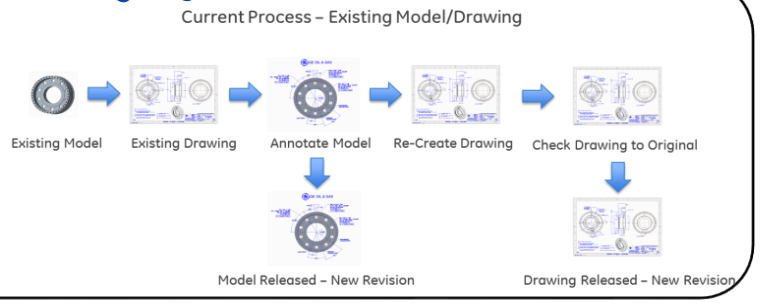
2 | Improve PMI Quality
- Detect Duplicate Dimensioning
- Ensure Completeness
- Optimized Checking for Completeness

3 | Simplify Release Process
- No Need to Redo Drawings
- Simple one button application

Benefits
- 90% reduction in engineering hrs
- Automated checking – No errors

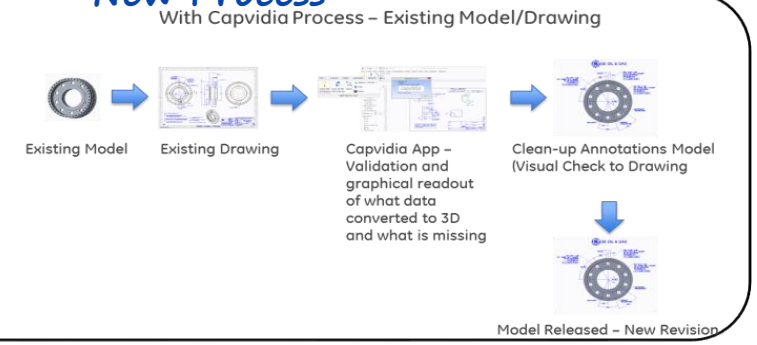
Legacy Process

1. Manually add all views & PMI to existing non MBD models
2. Updated existing 2D drawing with MBD model
3. Check & Release new model & drawing (Manual)
4. **Average Hours for Current Process = 12 hrs**



New Process

1. Automatically update exiting models to MBD status (addition of views & PMI)
2. Automatically Check New Drawing against 3D model (Option - create 3D PDF)
3. Re-release model & Drawing
4. **Average Hours = 1.2 hrs**



Design
- 3D MBD Model PMI automation
- Increased PMI Quality

Consumption

3D Models utilized across Manufacturing / Supply chain

Manufacturing

Full CMM Utilization

Additional features = Conversion to AP 242 & QIF format for Manufacturing & Supplier consumption

| Resource & Timing ↓ | Model & PMI Quality ↑ |

Digital Thread for GE, Customers, & World

Becoming More Productive With Data, Models, & Analytics

COMMERCIAL | ENGINEERING | SUPPLY CHAIN | MANUFACTURING | PROJECT MANAGEMENT | SERVICES

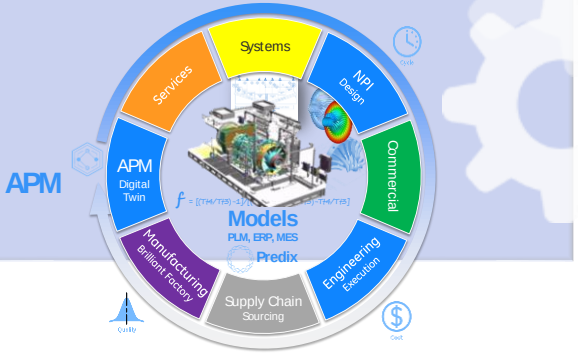
CONNECTED BY THE DIGITAL THREAD | PLM | MBE | ERP | MES | & PREDIX

Connectivity of data starts with customers, flows across our engineering, supply chain, manufacturing, project management, & service operations.

MODEL BASED ENTERPRISE

ENGINEERING FACTORY

The Digital Thread is creating models of our assets and operations to increase efficiency & productivity = competitive advantage.



BRILLIANT FACTORIES

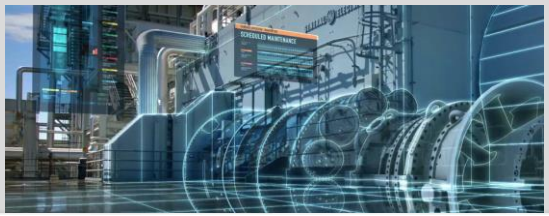
Combining the Industrial Internet and Advanced Manufacturing to digitize our plant operations – capturing and utilizing data from software, sensors, controllers and robotics for:

- INCREASED PRODUCTIVITY
- OPTIMIZED ASSETS & OPERATIONS

Our manufacturing plants will become showcase Brilliant Factories through a combination of LEAN principles and Digital Tools.

MODELS & DIGITAL TWINS

Digital Twins are data models of assets or even a whole process, built from a collection of data that we can analyze and use as comparison to actual performance. We can help predict and optimize how they perform in the field.



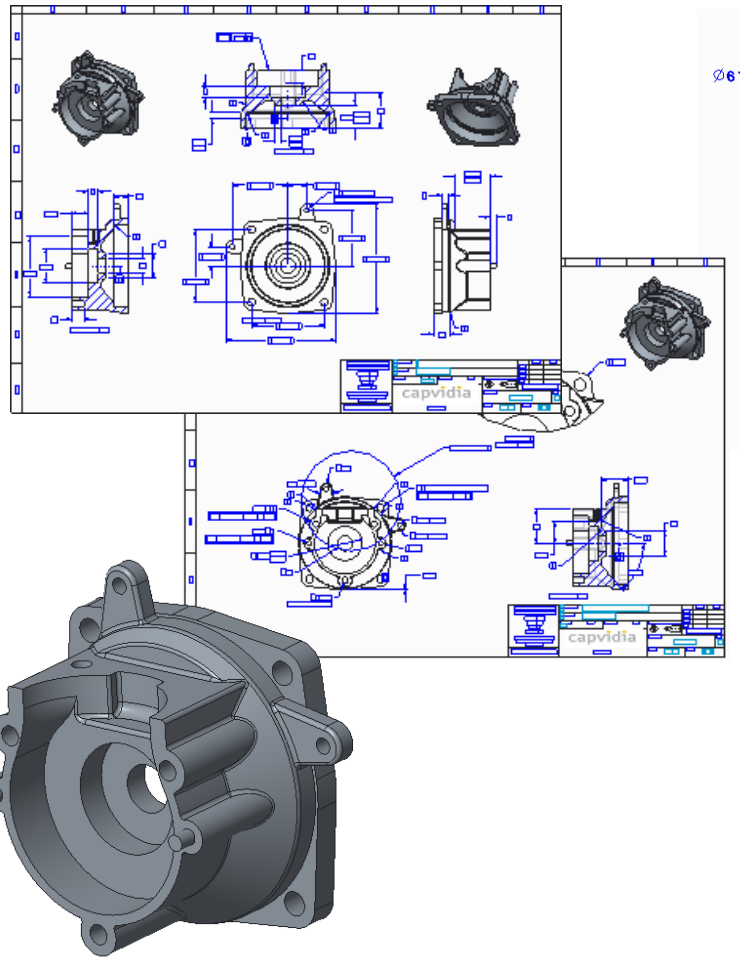
Demonstration/Video 2D drawing to CMM

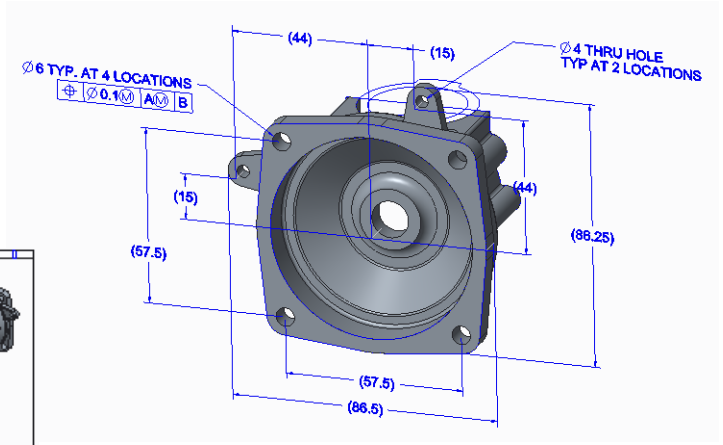
2 sheet drawing & assoc model

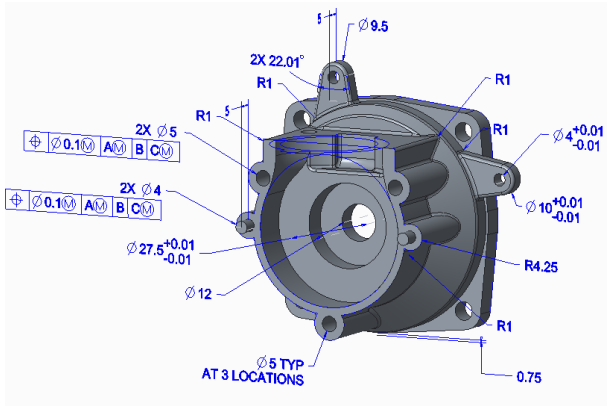
MBD model w PMI & organized schema

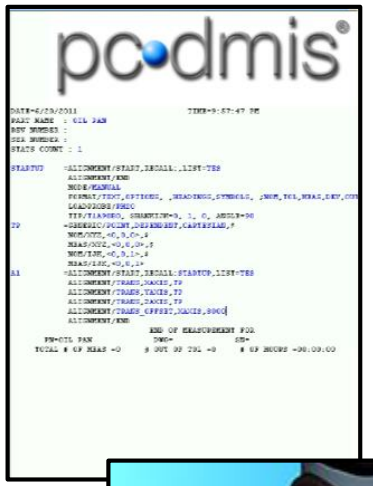
Create PC-DMIS model

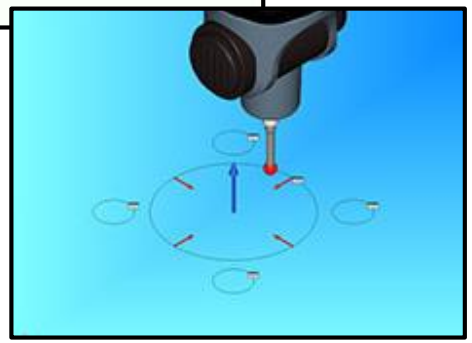
Execute Inspection

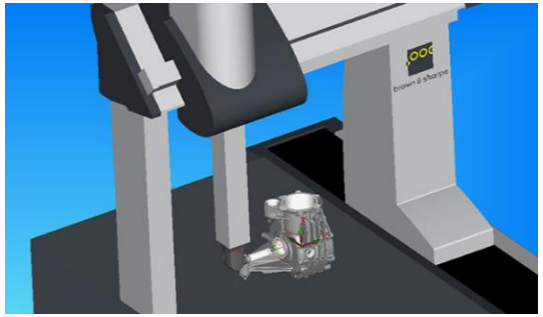


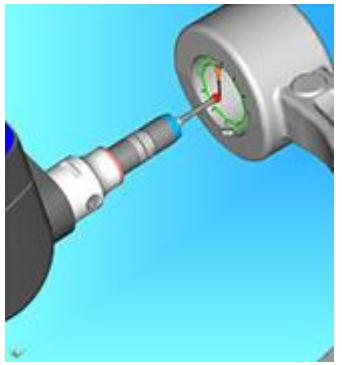












Comments,

thoughts?

Thank You