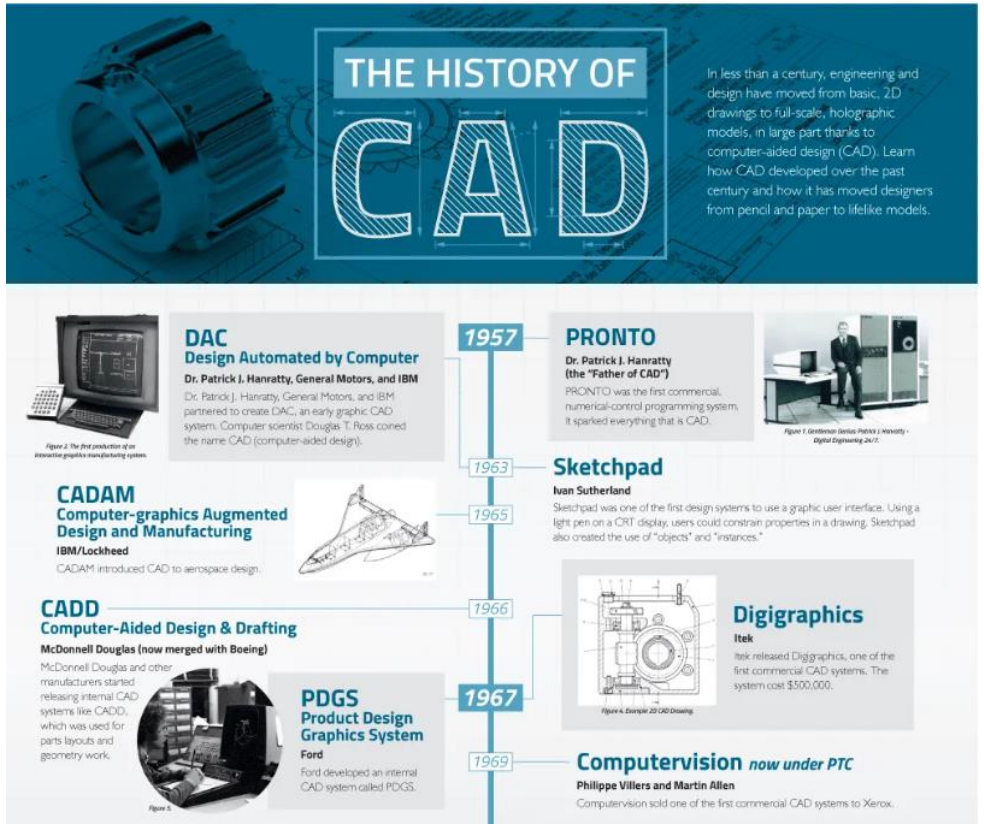
Model Based Definition(MBD)을 활용한 설계 및 제조 프로세스의 통합

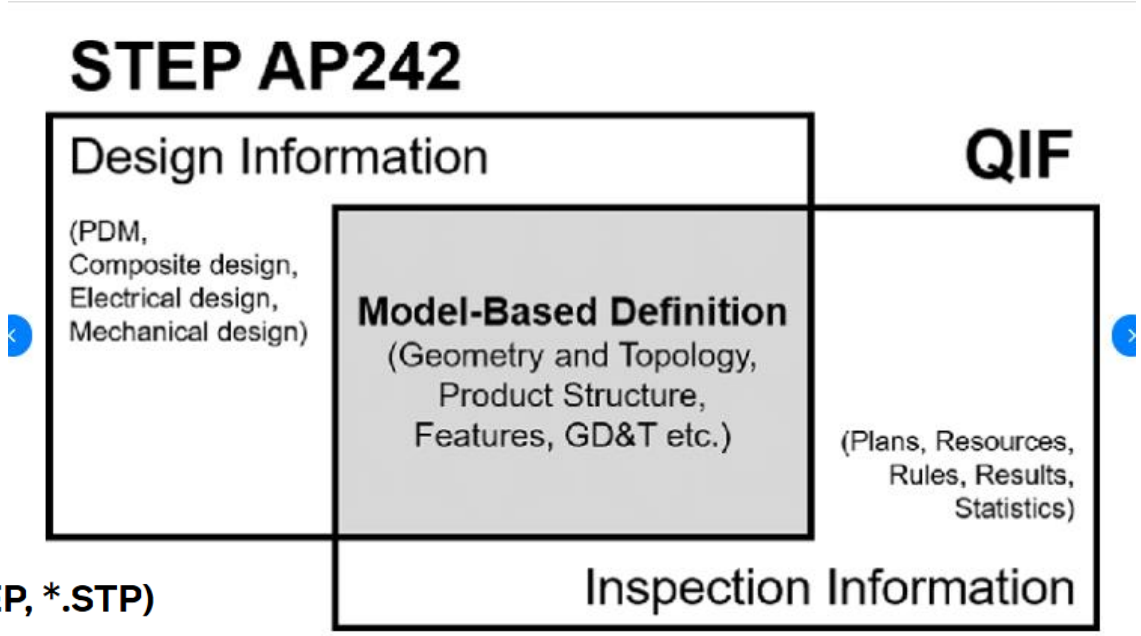
2025. 10. 23

(주) 솔루션랩

Computer Aided Design (CAD)



New Standard



of the intersection between STEP AP242 and QIF.

1. STEP (File Extension: *.STEP, *.STP)

- Year Introduced: 1994, Last Update: 2022.
- Standard: ISO 10303-242:2022
- Representation: B-rep (precise) & Vis-rep (approximation)
- Organization: International Organization for Standardization and PDES Inc.

STEP files are the most widely used & accepted neutral CAD format today, making it a standard across multiple industries.

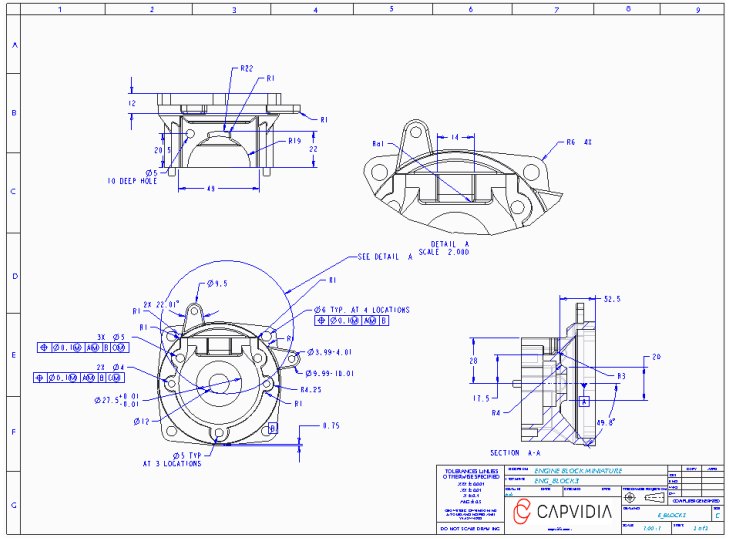
Most CAD software supports importing & exporting STEP files, allowing it to be interoperable between different systems, including CAM (computer-aided manufacturing), CAI (computer-aided inspection), and CAE (computer-aided engineering).

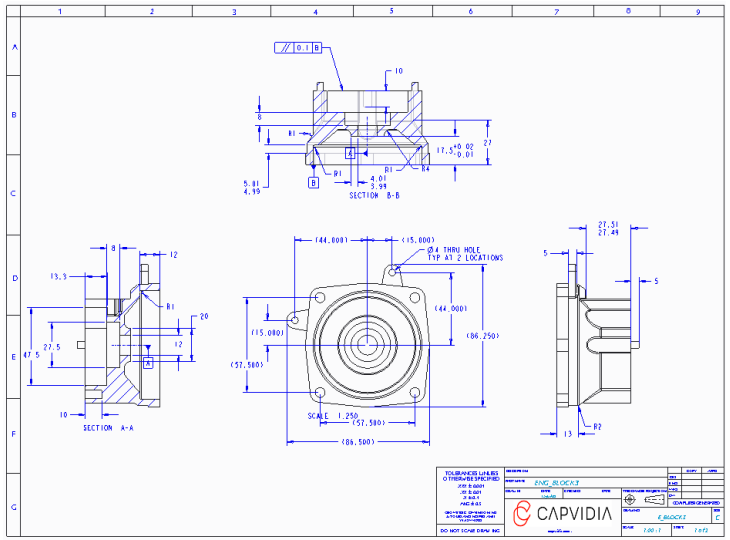
2. QIF (File Extension: *.QIF)

- Year Introduced: 2013, Last Updated: 2020
- Standard: ISO 23952:2020
- Representation: B-rep (precise) & Vis-rep (approximation)
- Organization: DMSC (Digital Metrology Standards Consortium)

QIF (Quality Information Framework) files are made for digital manufacturing in the 21st century. It optimizes for semantic PMI, which allows for human & machine-readable CAD leading to two main things: interoperability & traceability downstream.

3D MBD Models Based on 2D Drawing





Challenge

- 2D Drawing is the master document and contains all annotations
- Over 90% of 3D models have no annotations
- Manual conversion is expensive and error prone

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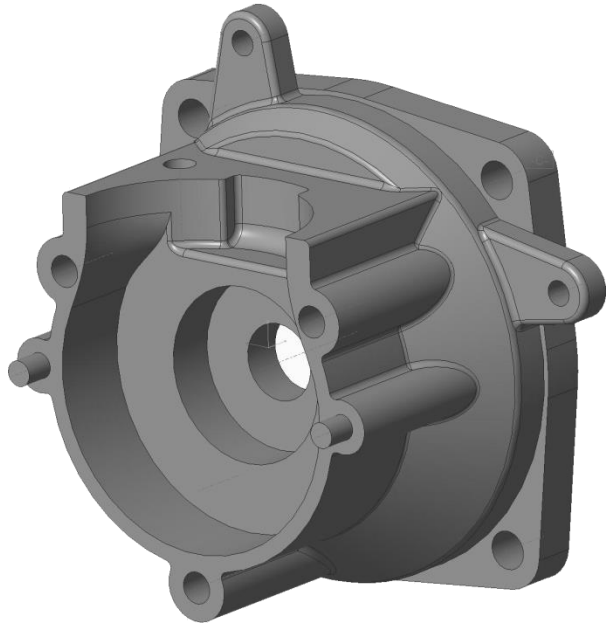
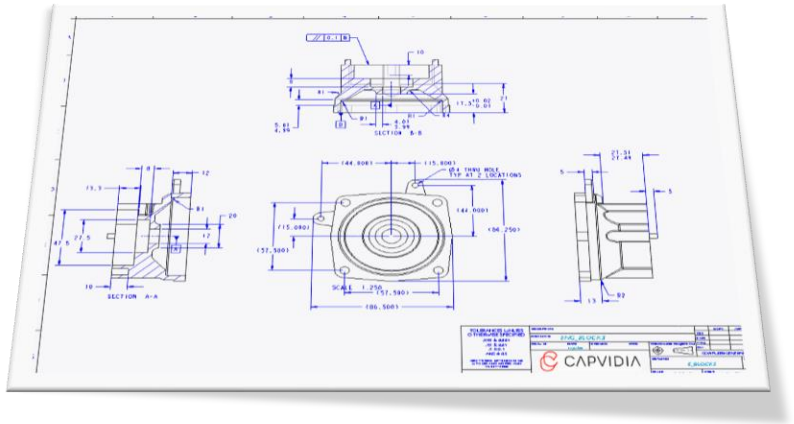
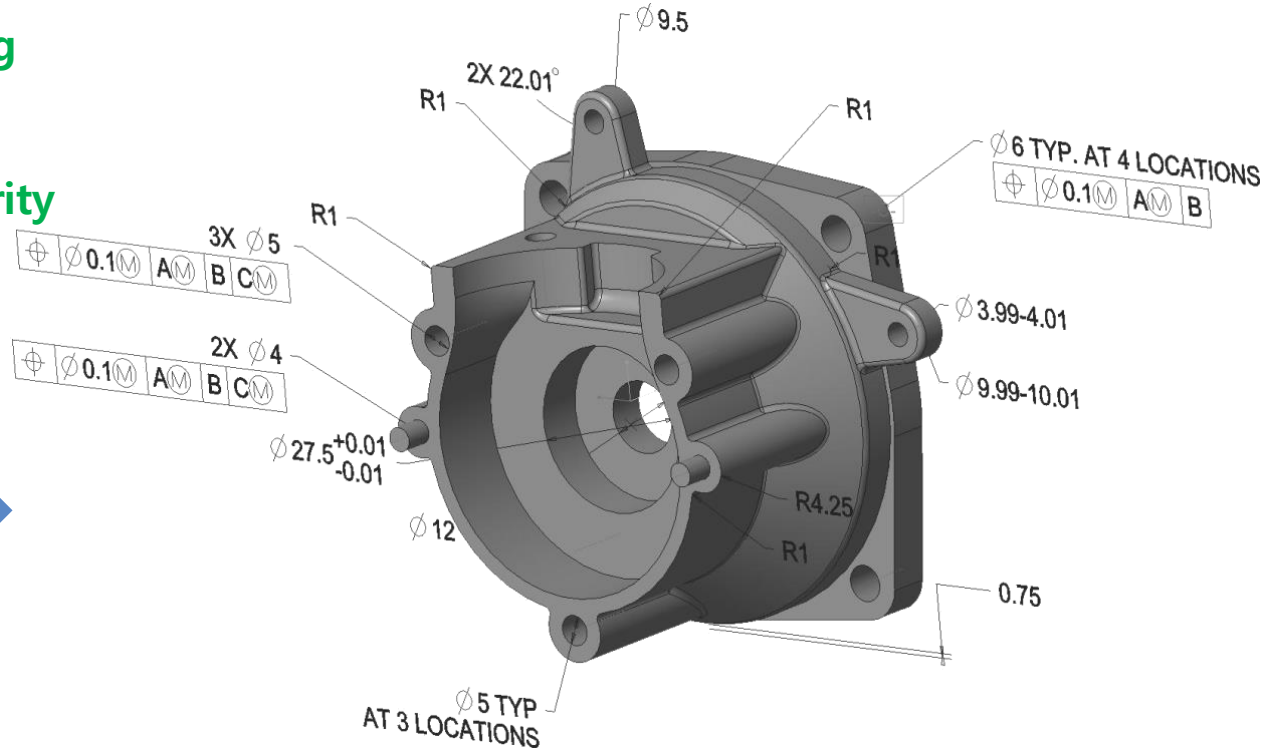


Annotated 3D MBD models

Model-based definition is an approach to creating 3D models so that they effectively contain all the data needed to define a product.
With MBD, the model becomes the source authority that drives all engineering activities.





2D drawing

- 2D Drawing is the master document and contains all annotations
- Over 90% of 3D models have no annotations
- Manual conversion is expensive and error prone

3D MBD annotated model

- Fully semantic, machine-readable PMI
- Complete MBD definition (MBD ready data)
- Validated model quality

Industry 4.0 – digital transformation in engineering

Automation

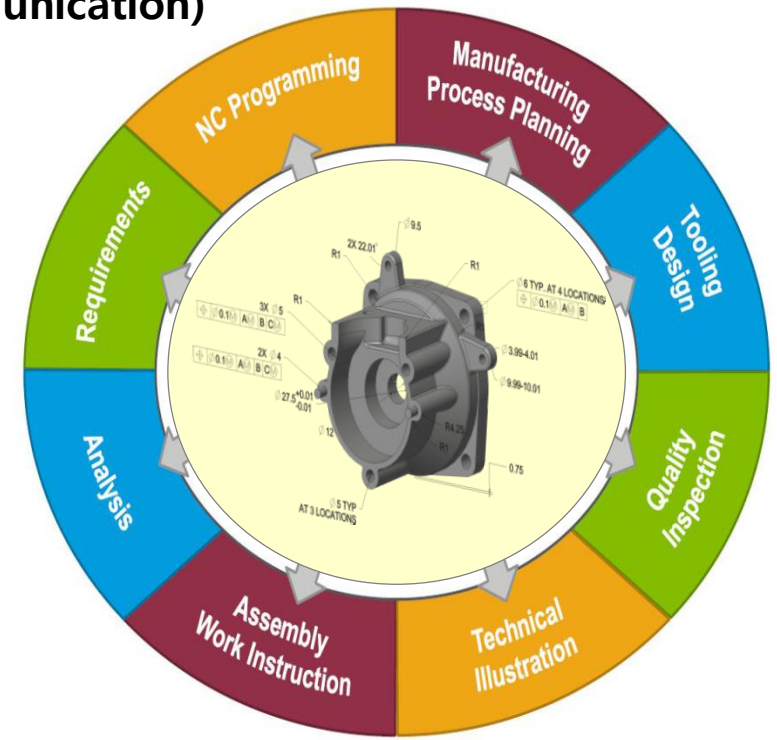
- Lower costs (more competitive)
- Better products (quality demanded by the market)

Requirements

- Engineering information must be Machine Readable (M2M communication)
- Replace traditional 2D drawings with Annotated 3D MBD models
- Reuse of existing information through product life-cycle

Benefits

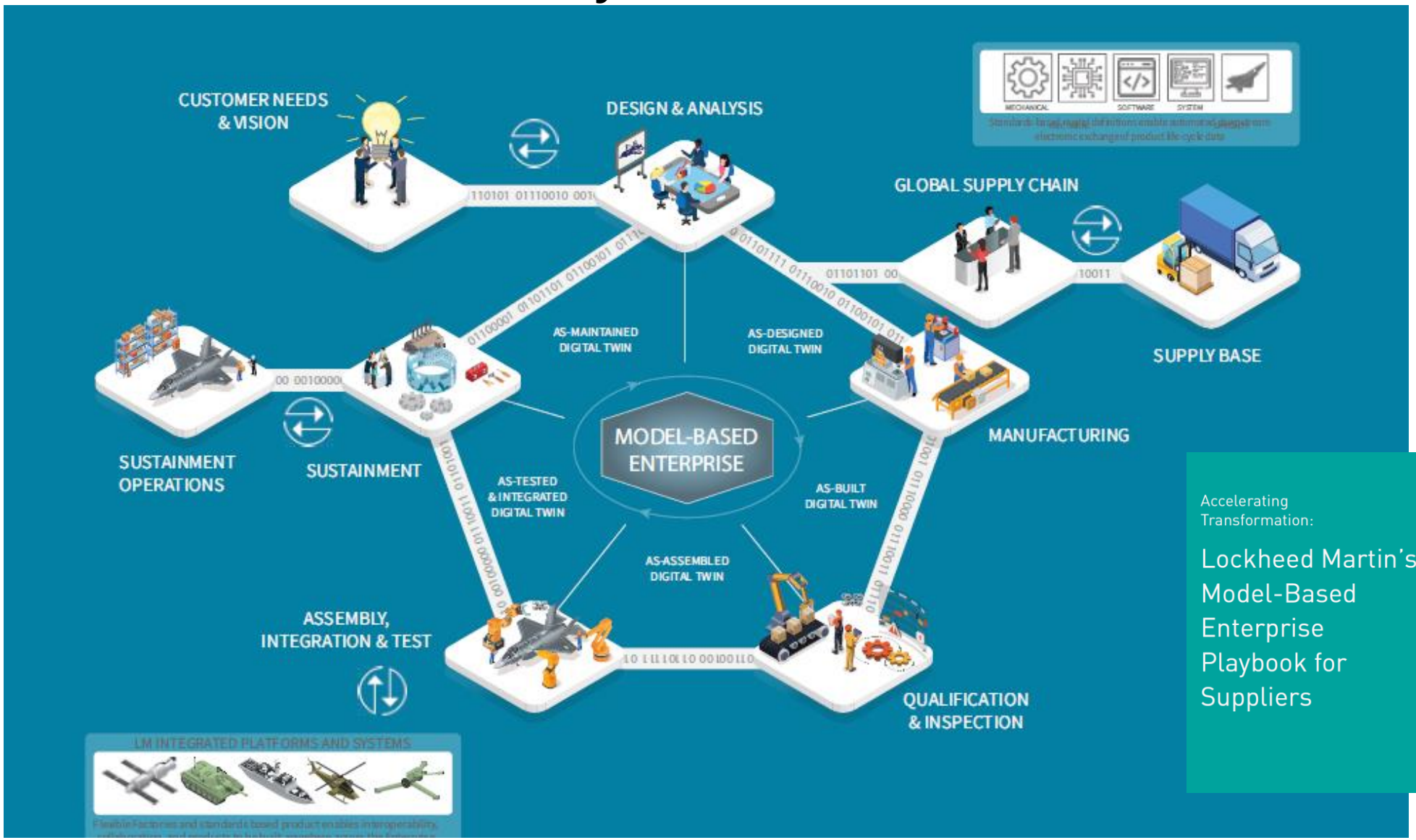
- Elimination of human interaction (source of errors/expertise)
- Better process control
- Reuse of existing information (3D MBD)
- Lower cost
- Better products



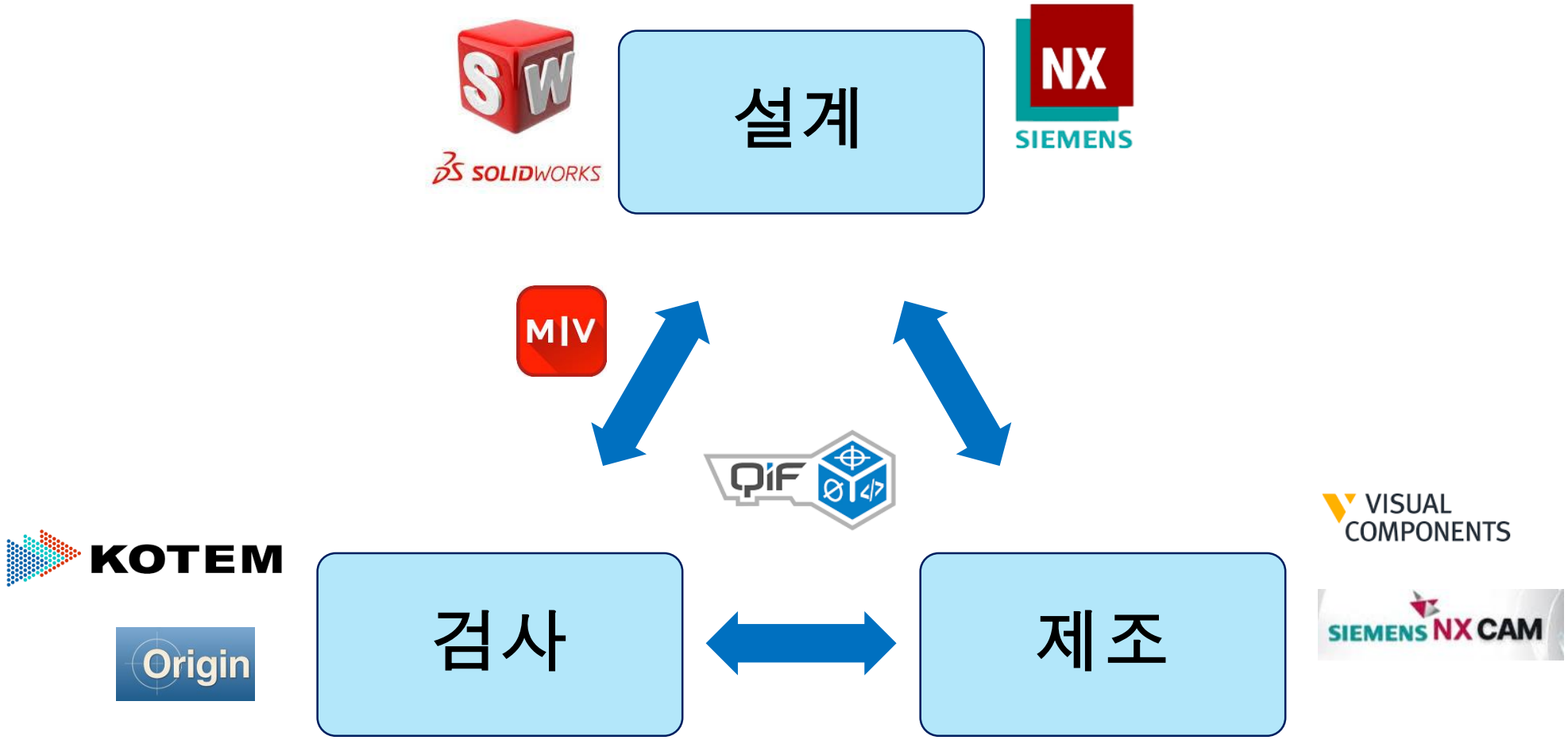
MBD 적용 사례: GPT-4o

- **보잉(Boeing)**
  - 보잉은 항공기 설계 및 제조에 MBD를 도입하여 설계와 제조 간의 일관성을 높였습니다. MBD를 통해 3D 모델에 모든 제품 및 제조 정보를 포함시켜, 도면 없이도 제조 및 조립이 가능하도록 했습니다. 이를 통해 오류를 줄이고, 설계 변경 시의 반영 속도를 높였습니다.
- **록히드 마틴(Lockheed Martin)**
  - 록히드 마틴은 F-35 전투기 프로그램에서 MBD를 활용했습니다. MBD를 통해 설계 데이터를 디지털 방식으로 관리하고, 제조 및 조립 과정에서의 정확성을 높였습니다. 이로 인해 생산 효율성이 향상되고, 비용 절감 효과를 얻었습니다.
- **제너럴 일렉트릭(GE)**
  - GE는 항공 엔진 부문에서 MBD를 도입하여 설계와 제조 프로세스를 통합했습니다. MBD를 통해 엔진 부품의 설계 정보를 3D 모델에 포함시켜, 제조 과정에서의 오류를 줄이고 품질을 향상시켰습니다.
- **포드(Ford)**
  - 포드는 자동차 설계 및 제조에 MBD를 적용하여, 설계 변경 시의 반영 속도를 높이고, 부품 간의 간섭 문제를 사전에 해결할 수 있었습니다. 이를 통해 제품 개발 주기를 단축하고, 생산 비용을 절감했습니다.
- **애플(Apple)**
  - 애플은 제품 설계와 제조에 MBD를 활용하여, 제품 개발 주기를 단축하고 품질을 향상시켰습니다. MBD를 통해 설계 데이터를 통합 관리하고, 제조 파트너와의 협업을 강화하여 생산 효율성을 높였습니다.
- **인텔(Intel)**
  - 인텔은 반도체 설계 및 제조에 MBD를 도입하여, 설계와 제조 간의 데이터 일관성을 유지하고, 오류를 줄였습니다. MBD를 통해 복잡한 반도체 설계의 정확성을 높이고, 생산 공정의 최적화를 이루었습니다.
- **지멘스(Siemens)**
  - 지멘스는 산업 자동화 및 디지털화 솔루션에 MBD를 적용하여, 설계와 제조 프로세스를 통합했습니다. 이를 통해 제품 개발의 효율성을 높이고, 고객 맞춤형 솔루션을 제공할 수 있었습니다.
- **소니(Sony)**
  - 소니는 전자제품 설계에 MBD를 활용하여, 제품의 복잡성을 관리하고, 설계 변경 시의 반영 속도를 높였습니다. MBD를 통해 설계와 제조 간의 협업을 강화하고, 제품 품질을 향상시켰습니다.

Lockheed Martine MBE Playbook



MBD 작업 흐름도


SOLIDWORKS
설계
NX
SIEMENS
MV
QIF
KOTEM
Origin
검사
제조
VISUAL COMPONENTS
SIEMENS NX CAM

MBDVidia

Access, explore, share, and organize your MBD data

Model Based Definition: Current Challenges

Typical Problems with MBD Workflows

Access to MBD

- Requires costly CAD seat
- Bad data means loss of design intent
- MBD requires access to real data

Inspection Planning

- Characteristic ballooning and generation of FAI & inspection reporting forms is a time-consuming process
- Paper-based formats are antiquated

Scattered Results

- Measurement results in various formats
- Lack of result format interoperability prohibits all-encompassing analytics
- Results are not traceable to the authority MBD model

Access MBD (Direct Interface)

creo®

NX

SOLIDWORKS

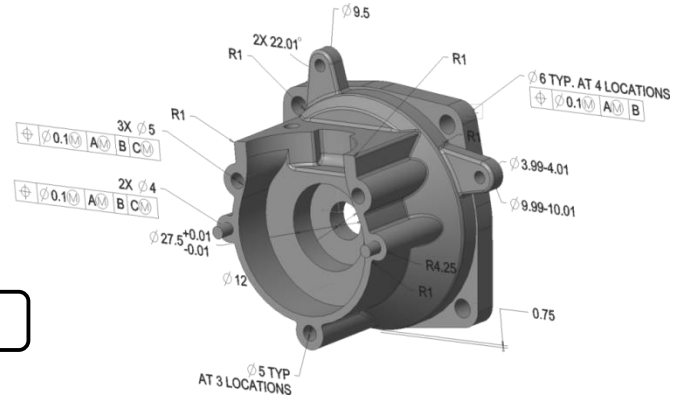
Direct Interface

Direct Interface

Direct Interface

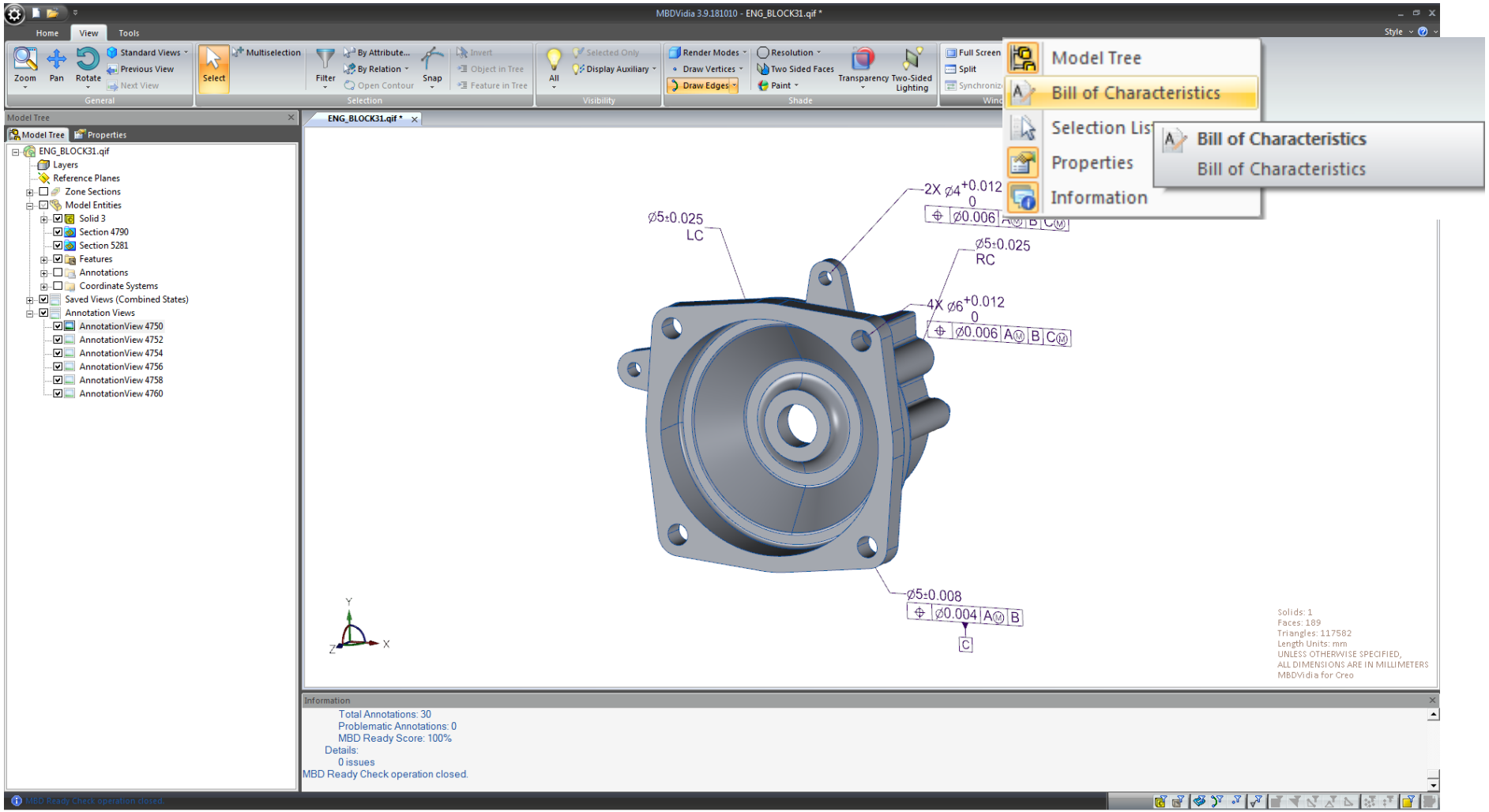
MBDVidia

Direct CAD Interface

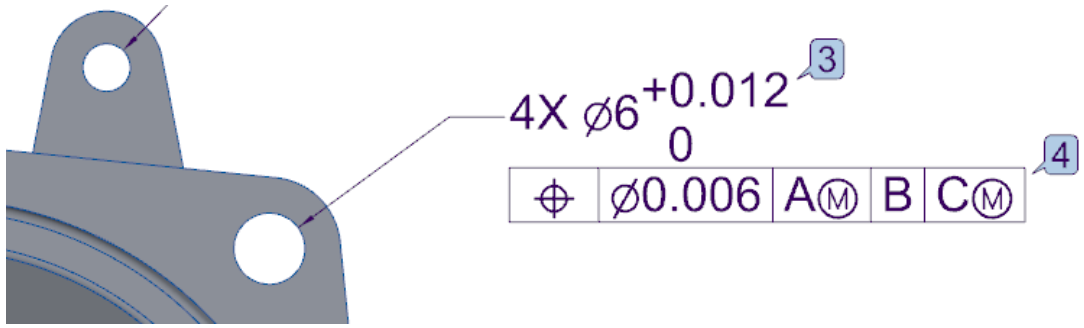


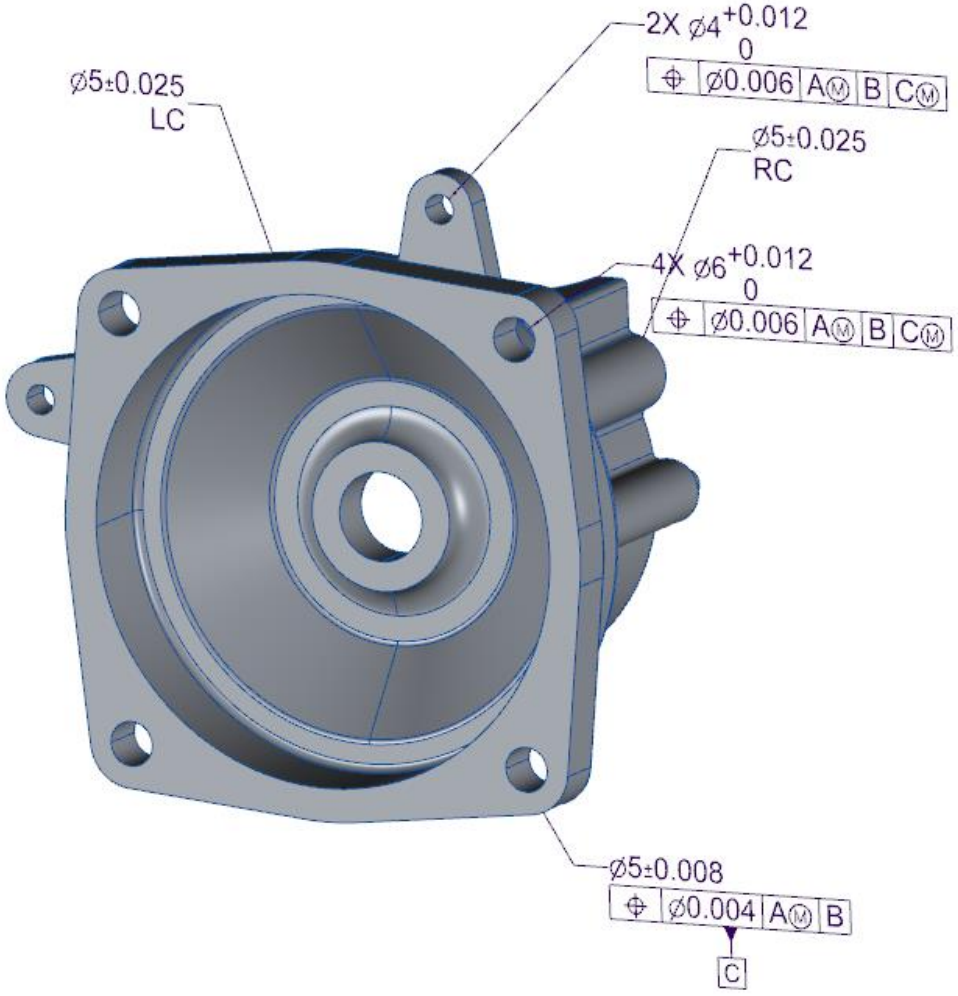
First Article Inspection (FAI) Preparation

FAI Data Preparation



Ballooning


4X ⌀6 +0.012 0
⌖ ⌀0.006 A Ⓜ B C Ⓜ
3
4


2X ⌀4 +0.012 0
⌖ ⌀0.006 A Ⓜ B C Ⓜ
⌀5±0.025 LC
⌀5±0.025 RC
4X ⌀6 +0.012 0
⌖ ⌀0.006 A Ⓜ B C Ⓜ
⌀5±0.008
⌖ ⌀0.004 A Ⓜ B
C

HTML Export

CAPVIDIA

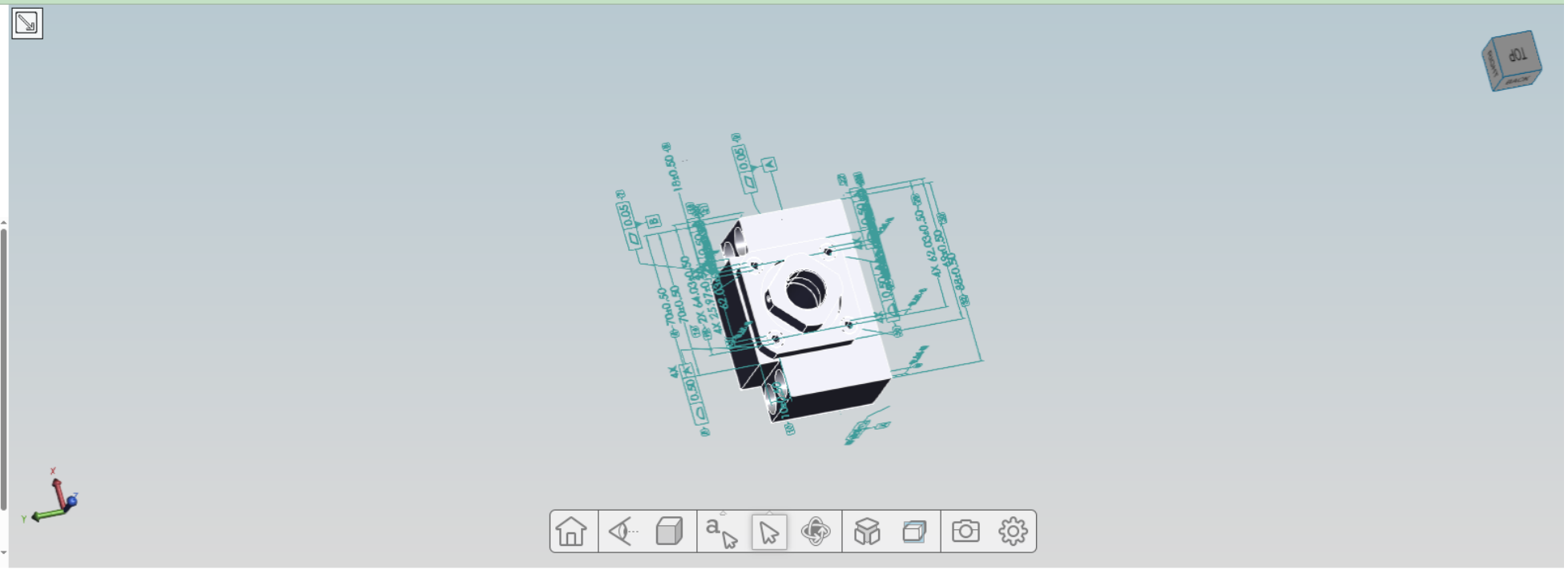
Bill of Characteristics

MBDVidia 2024.4.2412.27

CAD_modelDefault.qif

General Information

QPID	da88cdb8-43d5-4439-92ef-lef0748d6212
Modification Date	07.03.2025
Source System	
Part Number	
Revision	
Description	
Units	mm



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1	*우측면	Plane 5097 [3304] - Plane 5132 [3304]	TXD4	⌖ ⌀0.50	-0.50	⌀	0.50	-
2	*우측면	Plane 5087 [3304] - Plane 5124 [3304]	TXD3	⌖ ⌀0.50	-0.50	⌀	0.50	-
3	*우측면	Plane 5067 [3304] - Plane 5108 [3304]	TXD1	⌖ ⌀0.50	-0.50	⌀	0.50	-
4	*우측면	Plane 5077 [3304] - Plane 5116 [3304]	TXD2	⌖ ⌀0.50	-0.50	⌀	0.50	-
5.1	*정면	Plane 5068 [3304]	도면화 항목3	⏥ 0.50 A	-	-	0.50	A
5.2	*정면	Plane 5065 [3304]	도면화 항목3	⏥ 0.50 A	-	-	0.50	A
5.3	*정면	Plane 5067 [3304]	도면화 항목3	⏥ 0.50 A	-	-	0.50	A

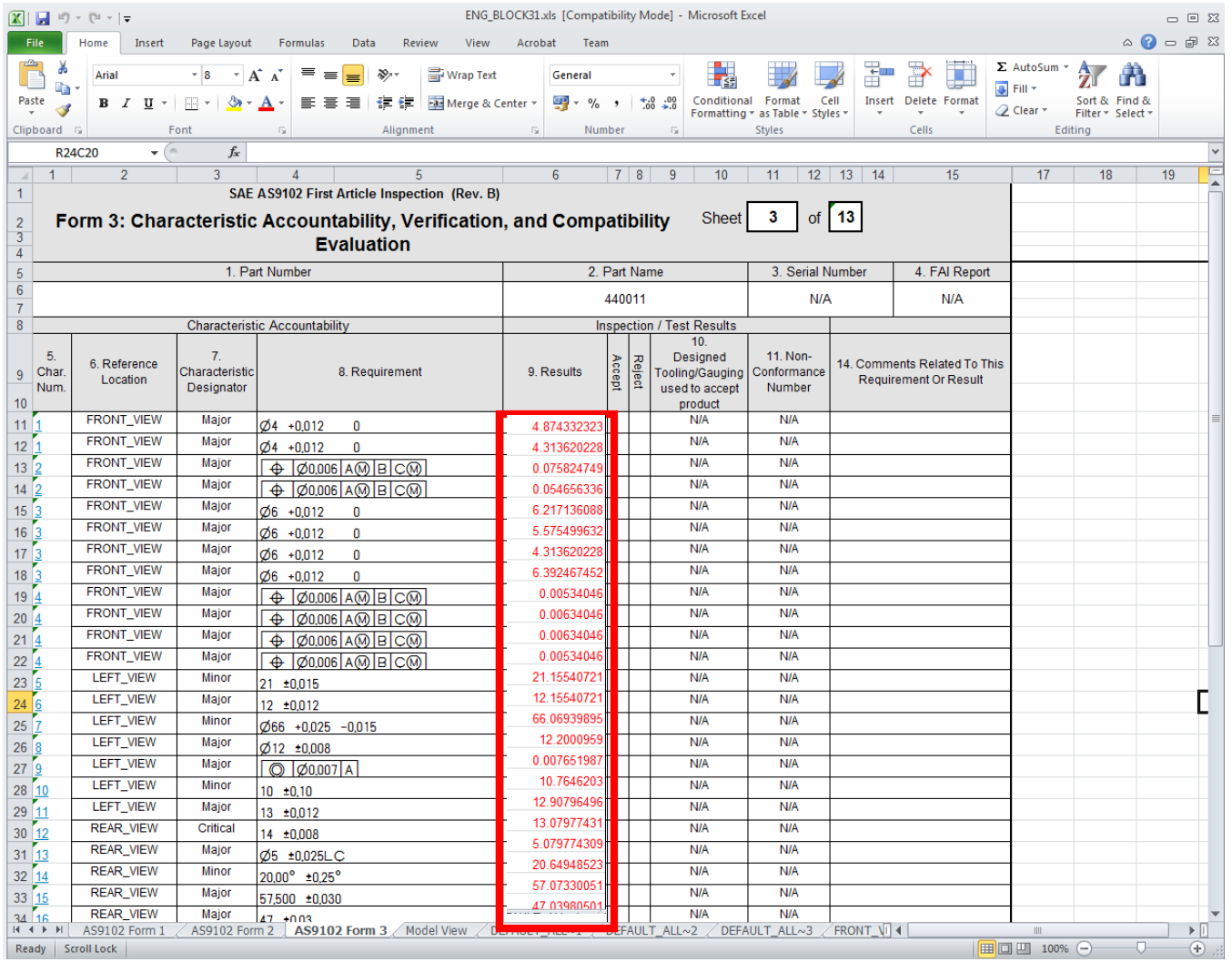
Measurement Results Management

Traceability (Binding with CAD Data)

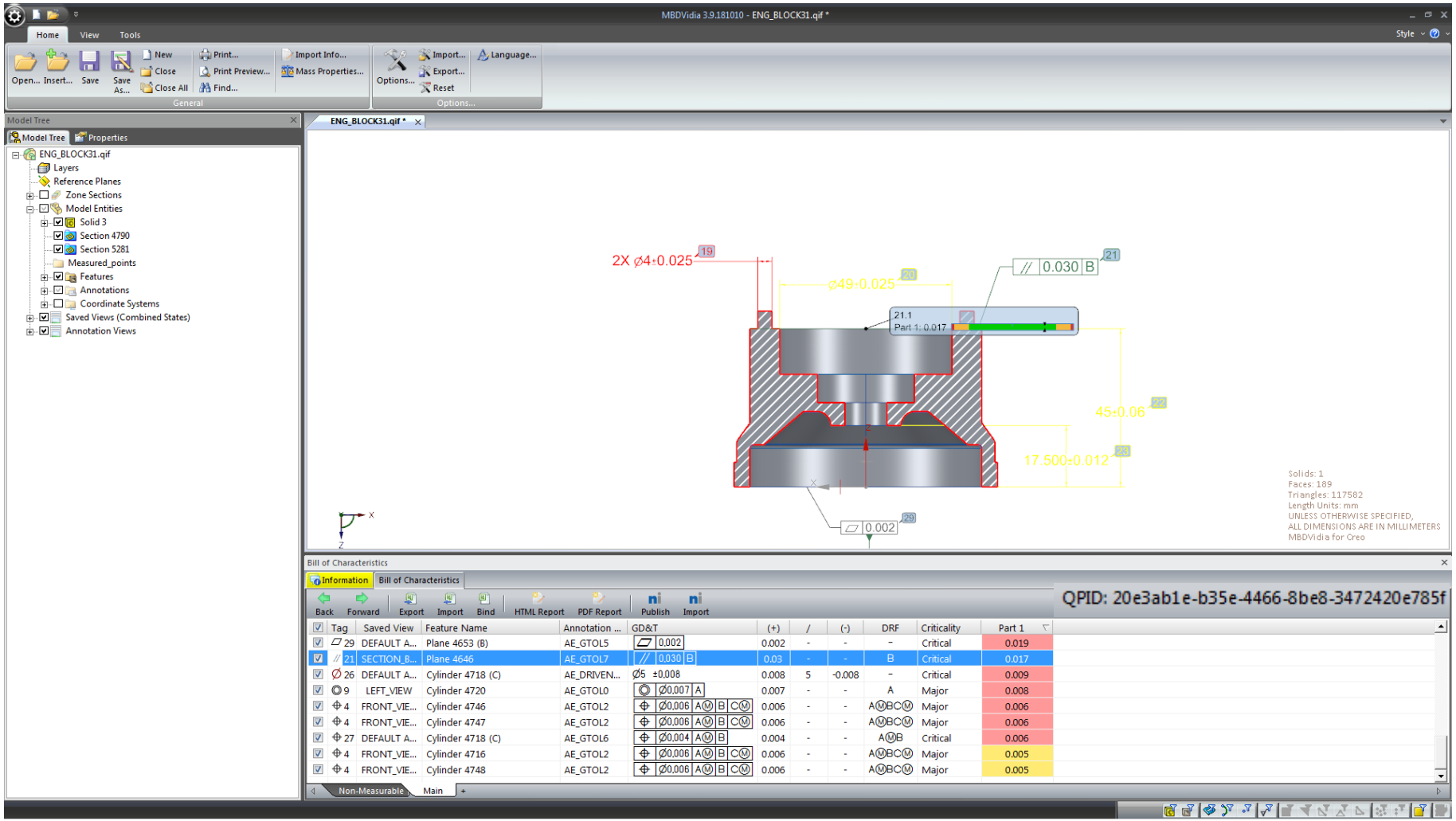
Measurement Results Management

First Article Inspection Report

- Imput Measurement Results
  - Manually fill in measurement results
  - Import from CSVExcel File



Traceability

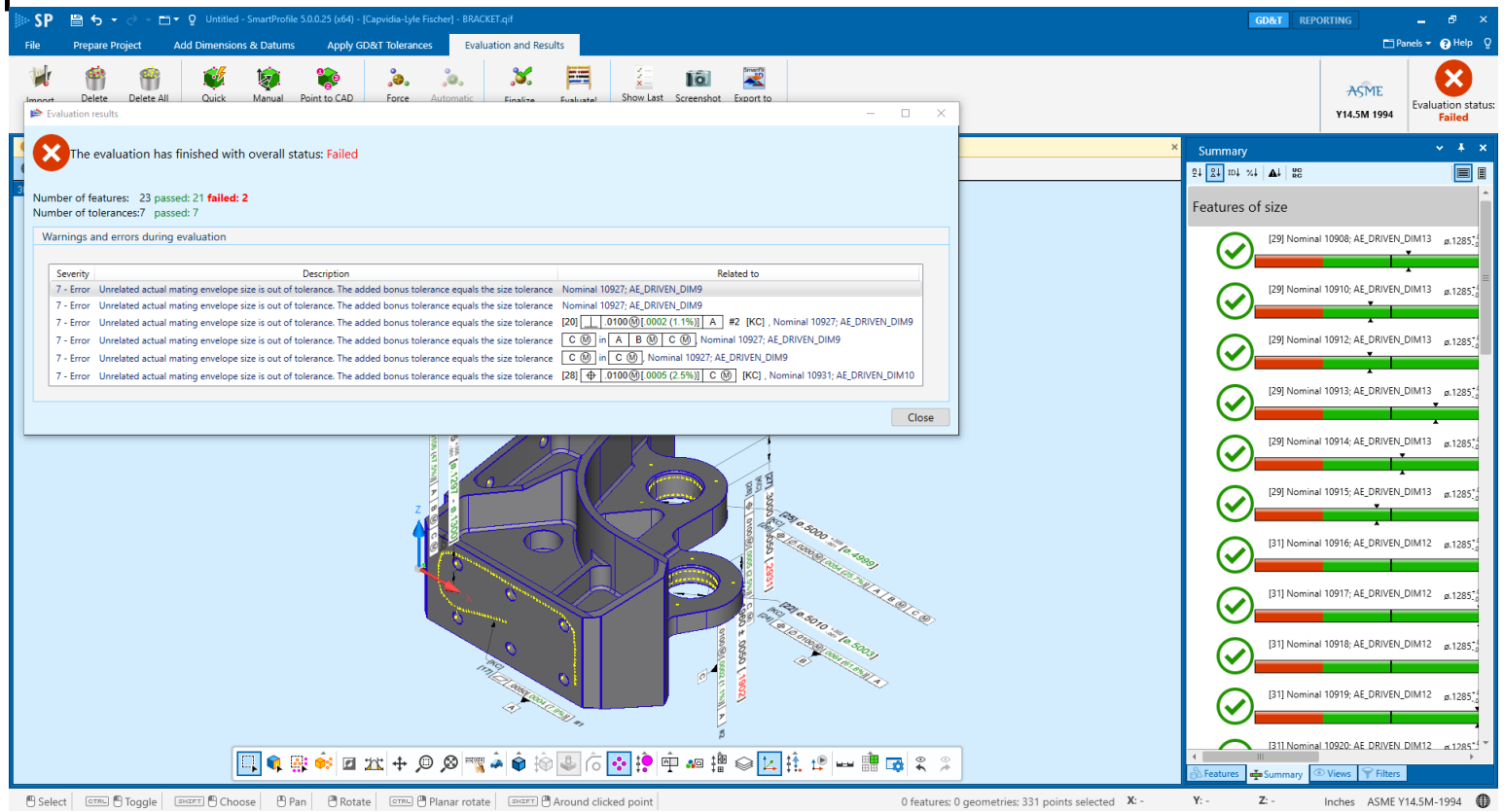


QIF Based Workflow with CMM Programs

Inspection Results Analysis with Smart Profile

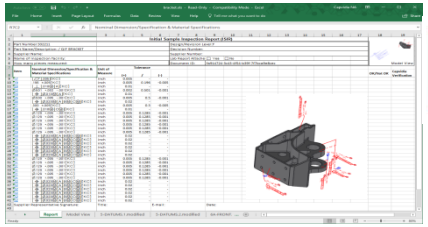
- QIF (3D +PMI) import into Kotem Smart Profile
- Import measurement points
- Evaluate
- Get Results

KOTEM



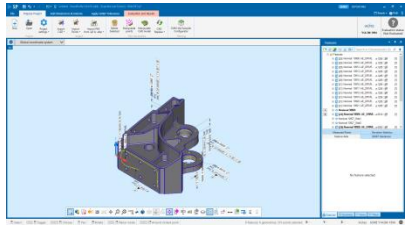
Gather Measurement Results

- Standard Format
- Traceable to MBD
- Enables Data Mining & Analytics



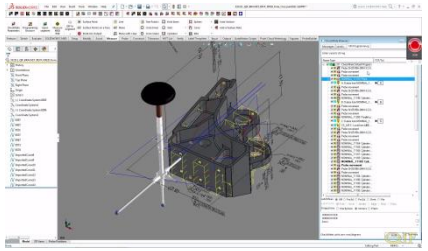
Excel

Results



KOTEM

Results



Origin

Results