모델기반 엔터프라이즈와 PLM 혁신, 디지털 융합

Model Based Enterprise and PLM Innovation, Digital Tapestry

PLM지식 연구소 조형식 대표

PLMBOK
Product Lifecycle Management Body of Knowledge

1. 서론

2. 모델기반 엔터프라이즈

3. MBE와 3D PDF

4. 디지털 테페스트리

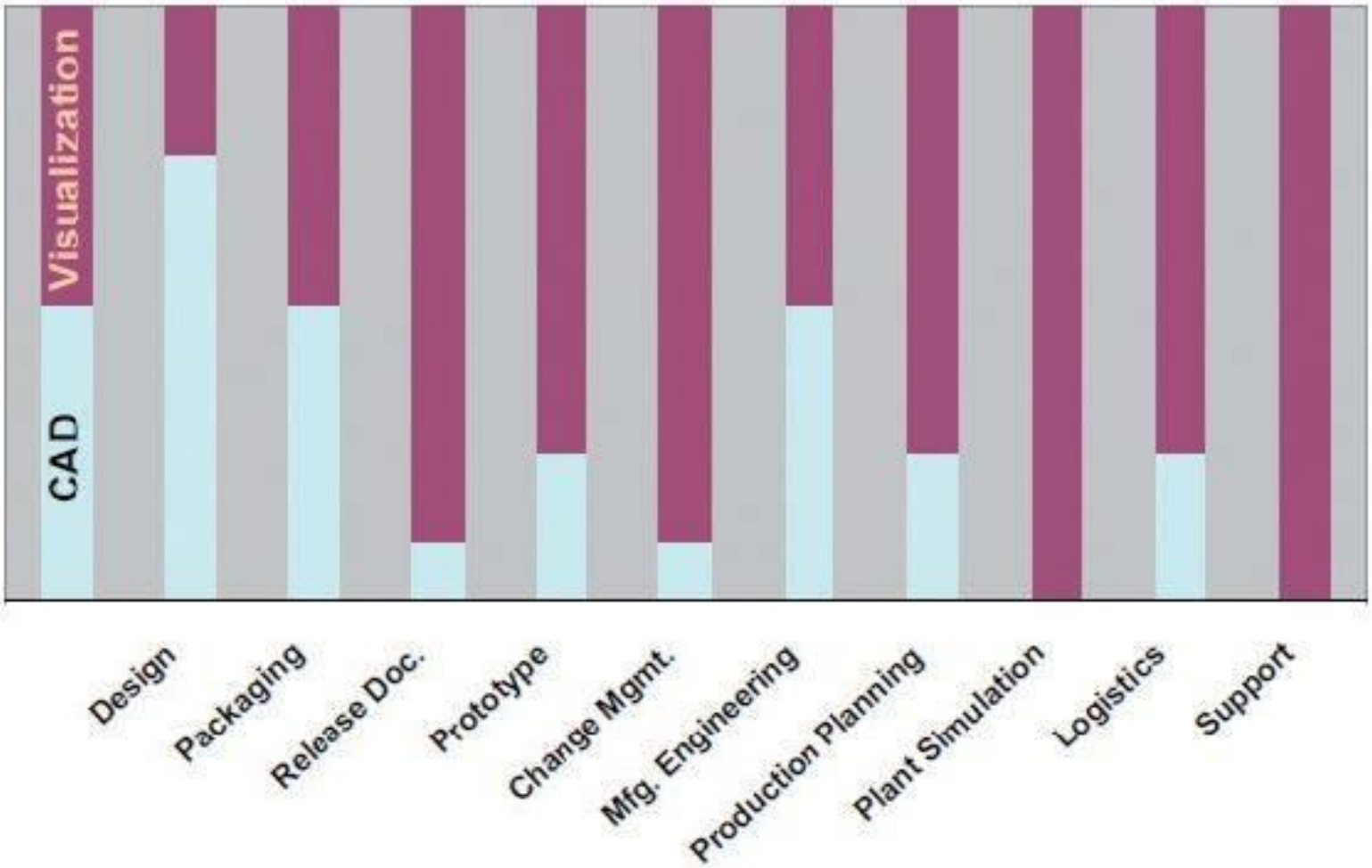
5. 결론

6. 질의 응답

1. 서론

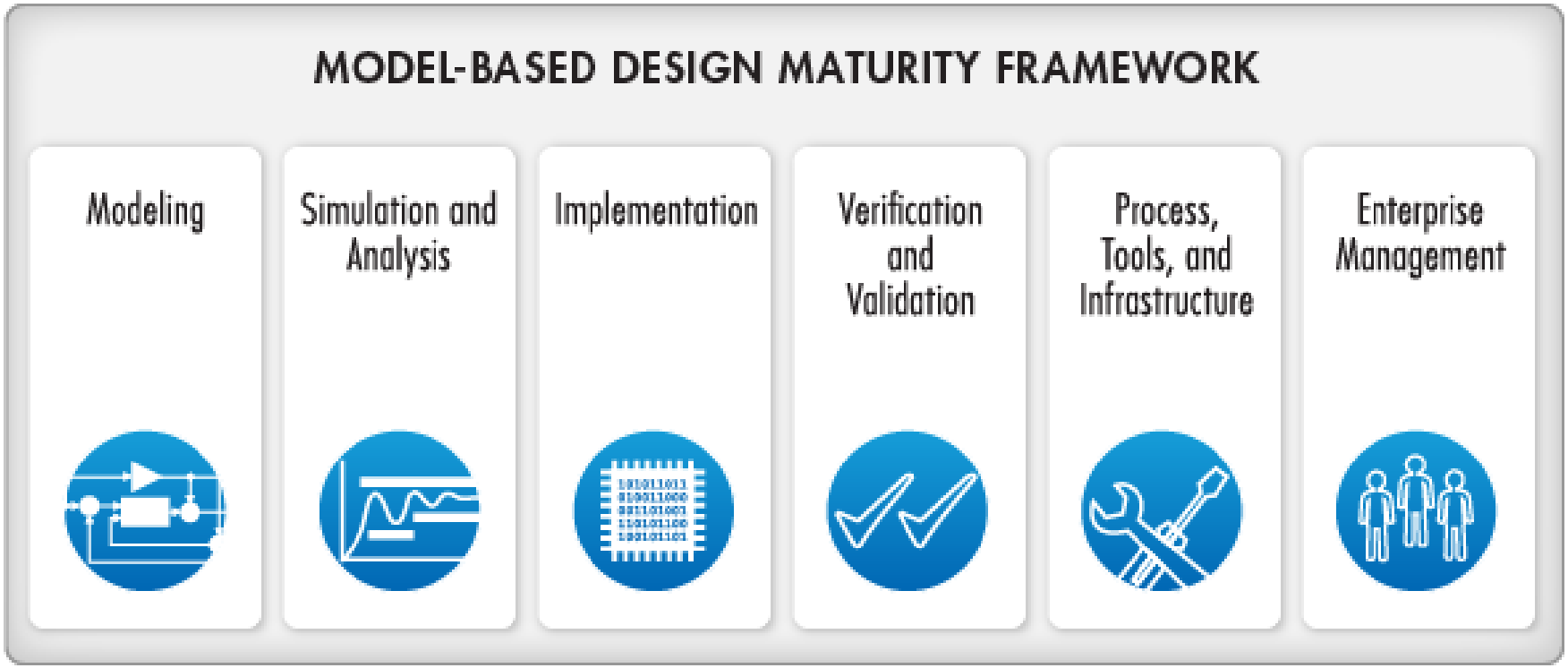
요즘 최대의 화두는 인더스트리 4.0 또는 4차 산업혁명이다. 인더스트리 4.0은 제품의 개발보다는 제조업이나 생산 공장 중심의 사상이다. 제조업도 중요하지만 혁신제품의 개발 역량 없이는 스마트 공장도 소용이 없다. 혁신 제품 개발에서의 최대의 이슈는 모델기반설계(MBD: Model Based Design)와 모델기반정의(MBD: Model Based Definition)이다. 이런 제품 3D 형상을 제품수명주기 전체에서 사용하는 것이 모델기반 엔터프라이즈(MBE: Model Based Enterprise)라고 할 수 있다.

모델 기반 엔터프라이즈(Model-Based Enterprise)는 모델 기반의 자료(Model-Based Definition), 모델 기반의 설계(Model-Based Design), 모델 기반의 개발 프로세스(MBSE)를 전사적 수명주기 관점에서 구현하는 것이다. 3D 모델을 생성하는 인원은 3% 정도이다. 나머지 97%는 사용자이다. 3D 스마트 문서가 중요하다.

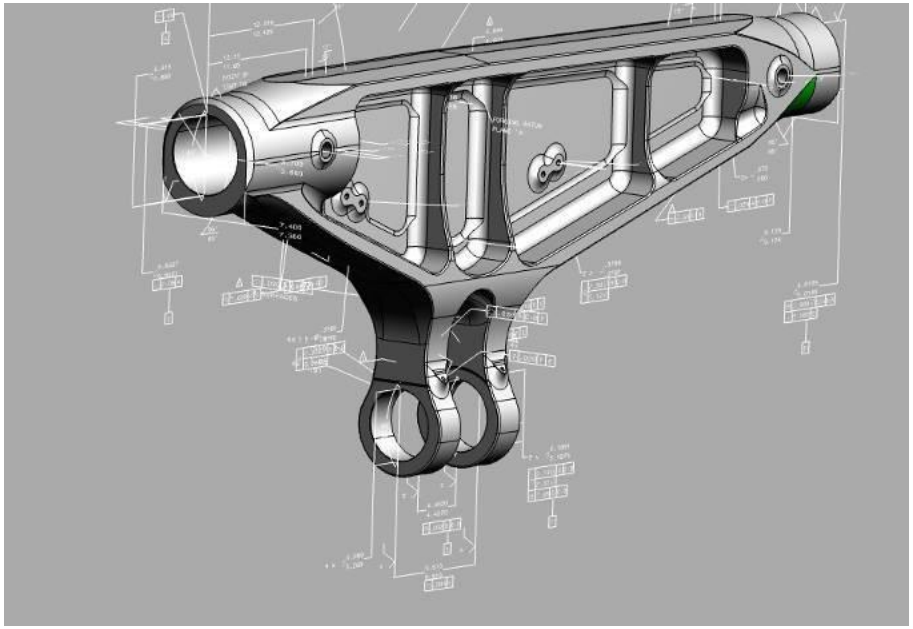

Visualization
CAD
Design
Packaging
Release Doc.
Prototype
Change Mgmt.
Mfg. Engineering
Production Planning
Plant Simulation
Logistics
Support

2. MBD Framework

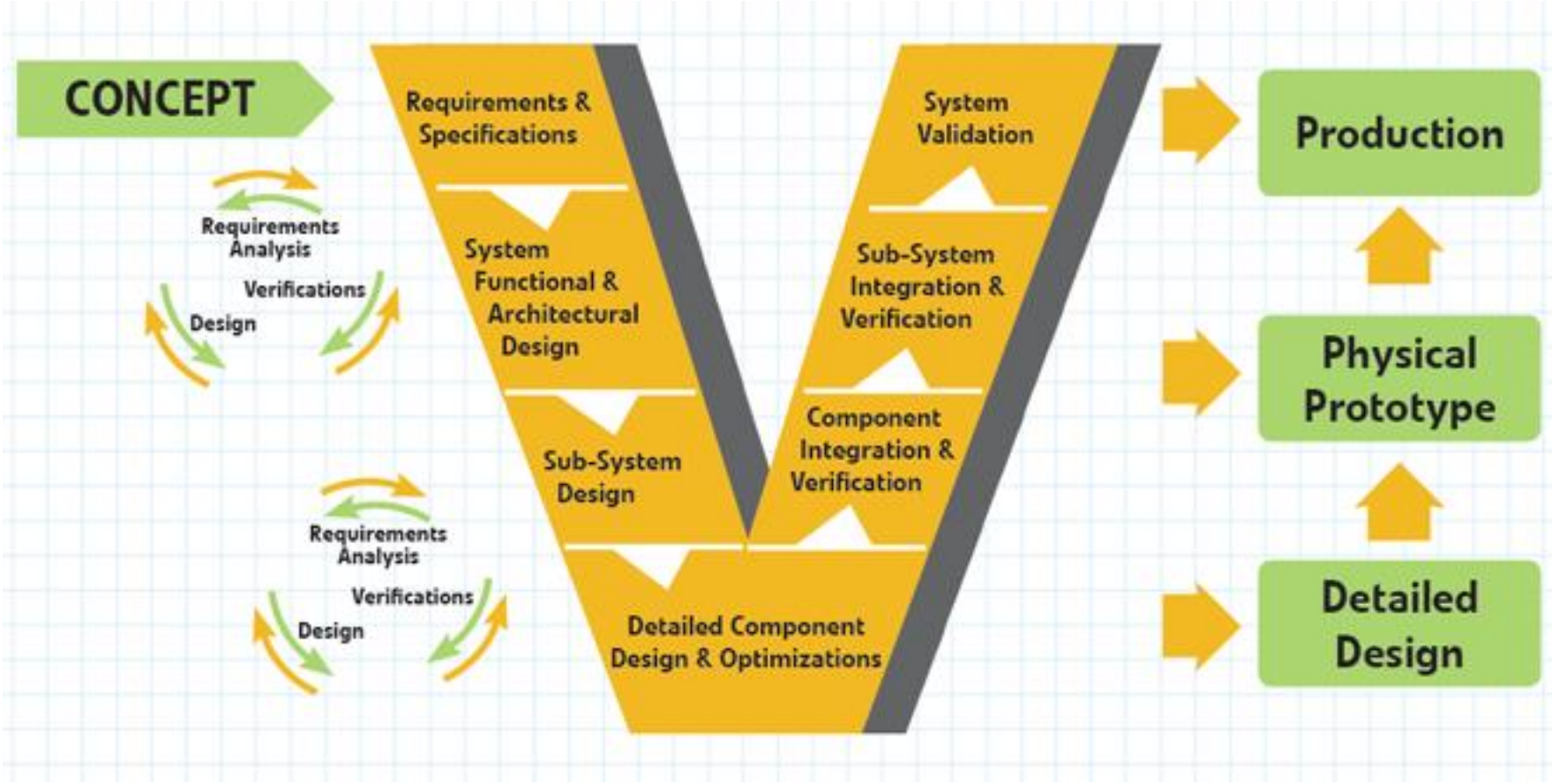
모델기반 설계 (Model Based Design)

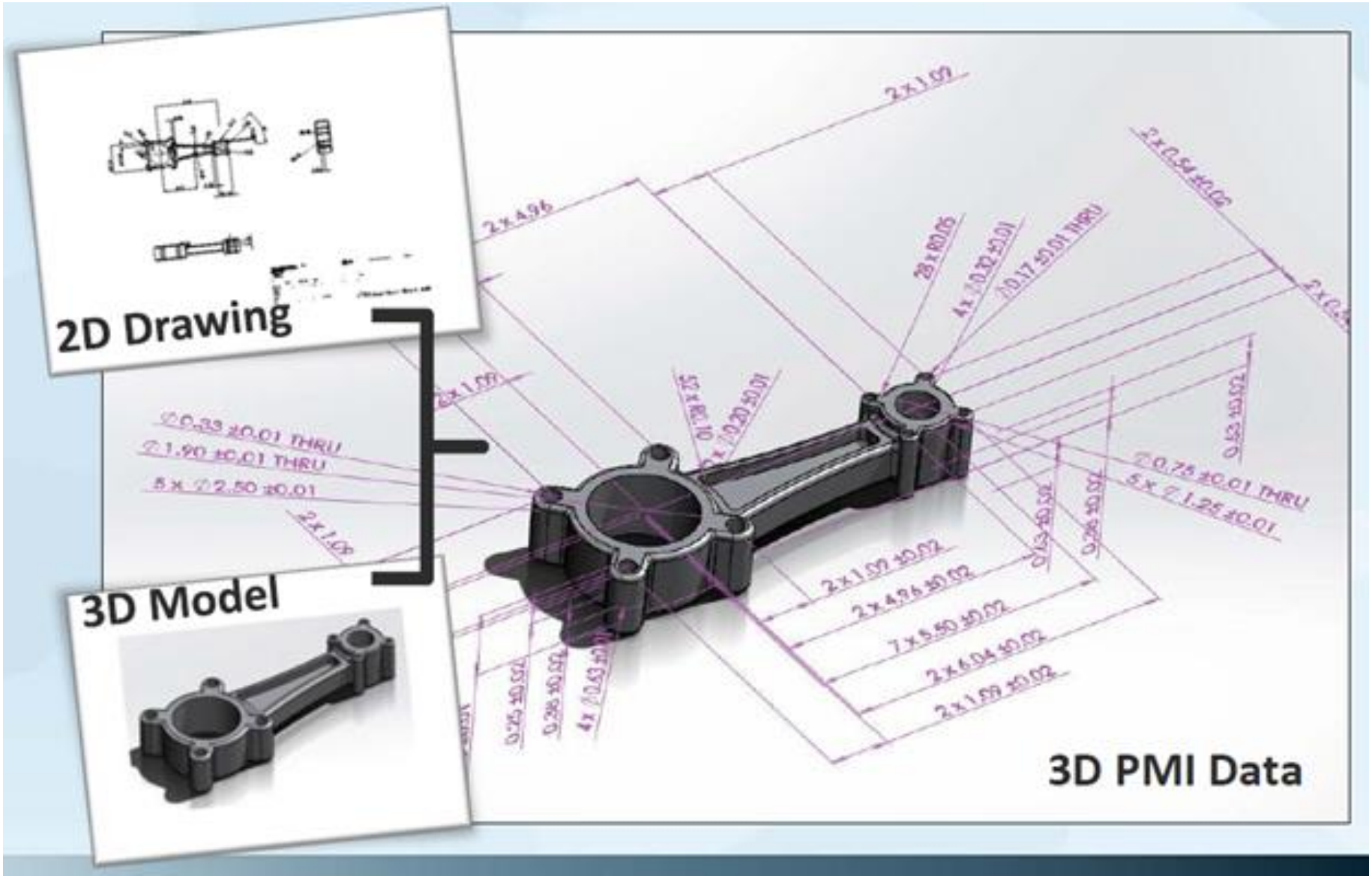


모델기반 엔터프라이즈는 “Model Based Enterprise (MBE) is a digital tapestry which has been optimized around a core set of annotated product models enabling rapid, seamless, and affordable deployment of products from concept to disposal.”



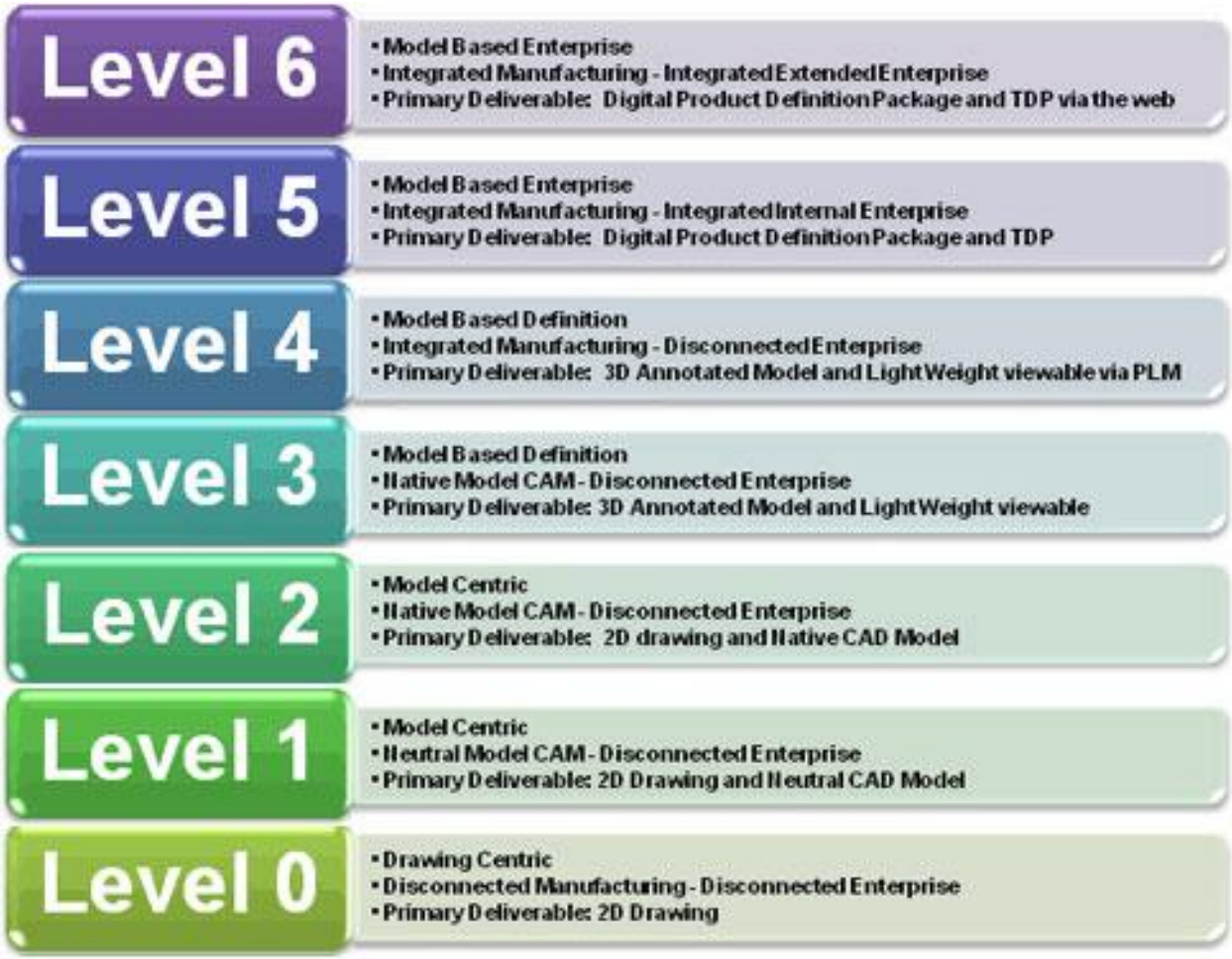
MBD과 MBSE


CONCEPT
Requirements Analysis
Verifications
Design
Requirements & Specifications
System Functional & Architectural Design
Sub-System Design
Detailed Component Design & Optimizations
Component Integration & Verification
Sub-System Integration & Verification
System Validation
Requirements Analysis
Verifications
Design
Production
Physical Prototype
Detailed Design


2D Drawing
3D Model
3D PMI Data


Engineering
Manufacturing
Procurement
3D
Quality
Sales
Service

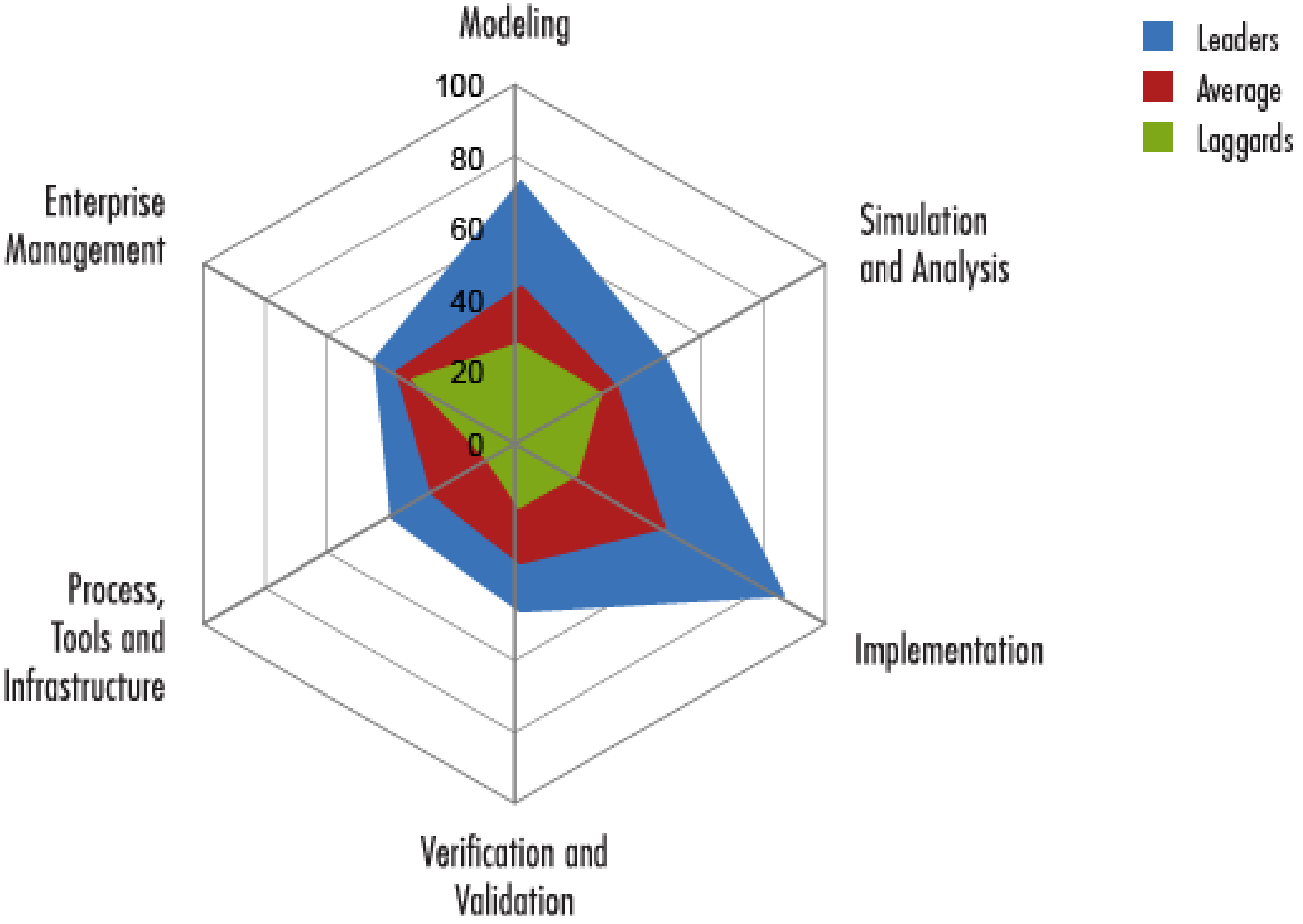
MBE 수준


Level 6
• Model Based Enterprise
• Integrated Manufacturing - Integrated Extended Enterprise
• Primary Deliverable: Digital Product Definition Package and TDP via the web
Level 5
• Model Based Enterprise
• Integrated Manufacturing - Integrated Internal Enterprise
• Primary Deliverable: Digital Product Definition Package and TDP
Level 4
• Model Based Definition
• Integrated Manufacturing - Disconnected Enterprise
• Primary Deliverable: 3D Annotated Model and Light Weight viewable via PLM
Level 3
• Model Based Definition
• Native Model CAM - Disconnected Enterprise
• Primary Deliverable: 3D Annotated Model and Light Weight viewable
Level 2
• Model Centric
• Native Model CAM - Disconnected Enterprise
• Primary Deliverable: 2D drawing and Native CAD Model
Level 1
• Model Centric
• Neutral Model CAM - Disconnected Enterprise
• Primary Deliverable: 2D Drawing and Neutral CAD Model
Level 0
• Drawing Centric
• Disconnected Manufacturing - Disconnected Enterprise
• Primary Deliverable: 2D Drawing

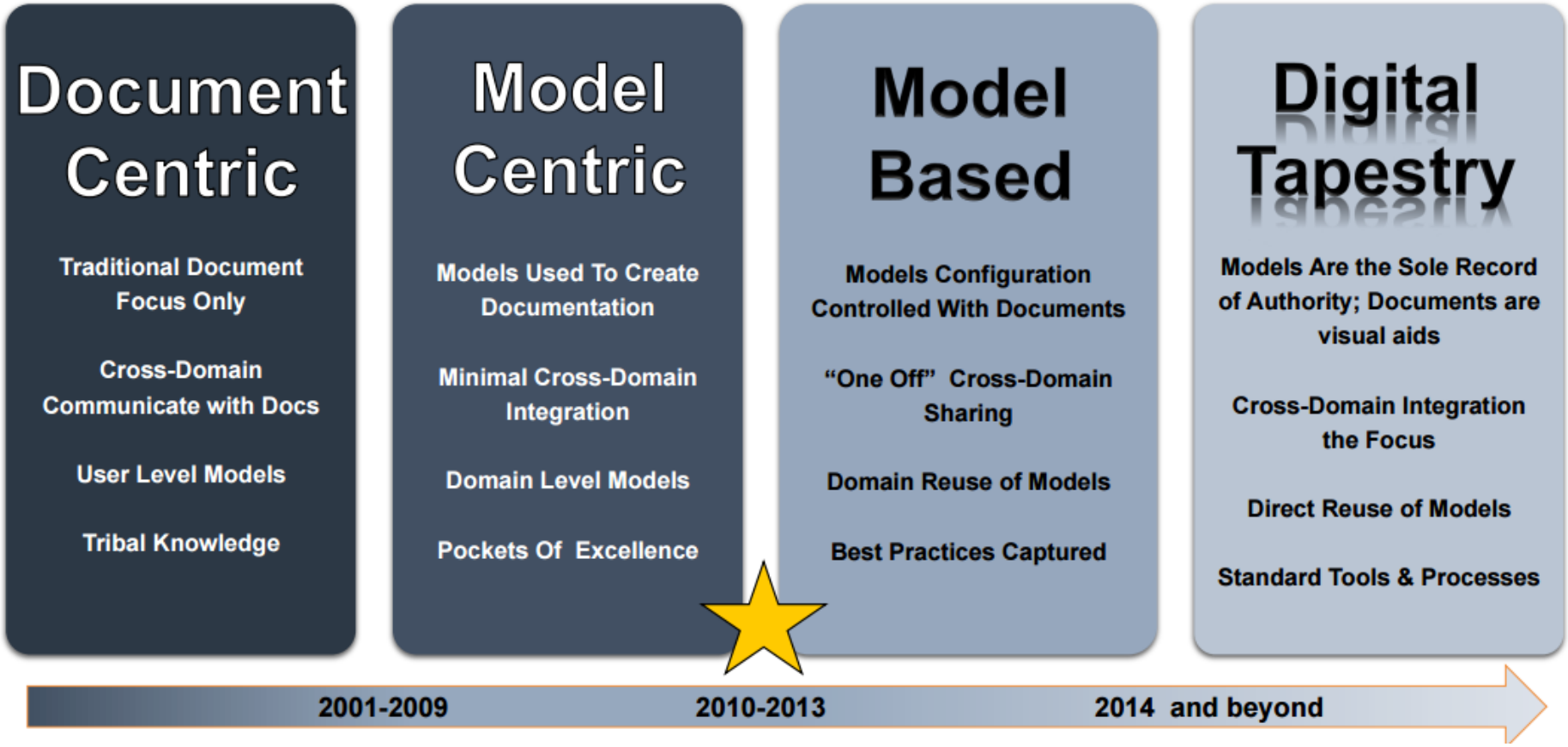
MBE의 수준

0. Drawing Centric
1. Model Centric (Neutral Model CAM)
2. Model Centric(Native Model CAM)
3. Model Based Definition
4. Model Based Definition (via PLM)
5. Model Based Enterprise
6. Model Based Enterprise (via the web)

MBE 환경분석

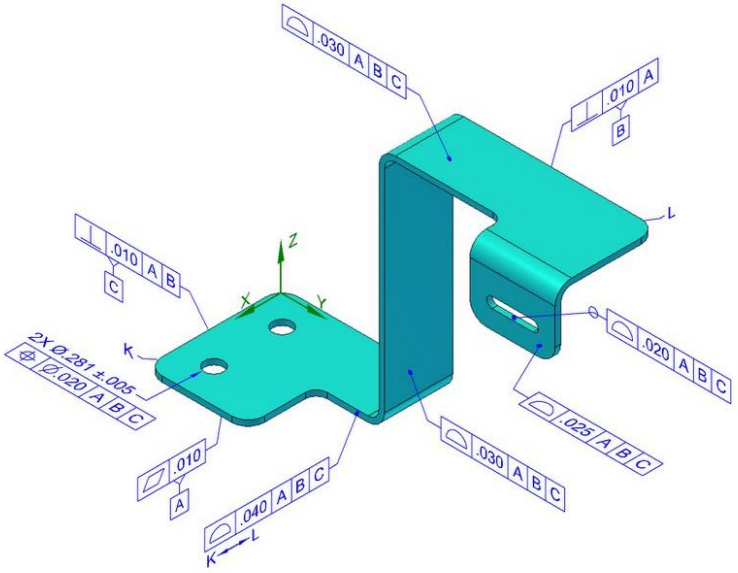

Modeling
100
80
60
40
20
0
Simulation and Analysis
Implementation
Verification and Validation
Process, Tools and Infrastructure
Enterprise Management
Leaders
Average
Laggards

MBE 과거 현재 미래


Document Centric
Traditional Document Focus Only
Cross-Domain Communicate with Docs
User Level Models
Tribal Knowledge
Model Centric
Models Used To Create Documentation
Minimal Cross-Domain Integration
Domain Level Models
Pockets Of Excellence
Model Based
Models Configuration Controlled With Documents
"One Off" Cross-Domain Sharing
Domain Reuse of Models
Best Practices Captured
Digital Tapestry
Models Are the Sole Record of Authority; Documents are visual aids
Cross-Domain Integration the Focus
Direct Reuse of Models
Standard Tools & Processes
2001-2009
2010-2013
2014 and beyond

3D 스마트 문서의 대표적인 주자는 3D PDF 형태이다. 거의 모든 PC에 PDF 리더가 설치 되어있다. 3D PDF는 현재 MBD 핵심인 PMI 정보도 포함 되고 있다. 그러므로 MBE와 3D PDF의 결합은 중요하다. MBE 확장은 영업, 공급망 관리, 유지보수, 지원, 마케팅, 구매, 치공구 등 모든 기업 활동을 포함 되어야 한다. .

3D PDF는 MBD, MB설계, MBSE, MBE 환경을 구성하는 데 가장 유리하다. 3D Model 주석 (Annotated) 환경에서 PMI 와 GD & T 환경을 저 비용으로 지원할 수 있다.

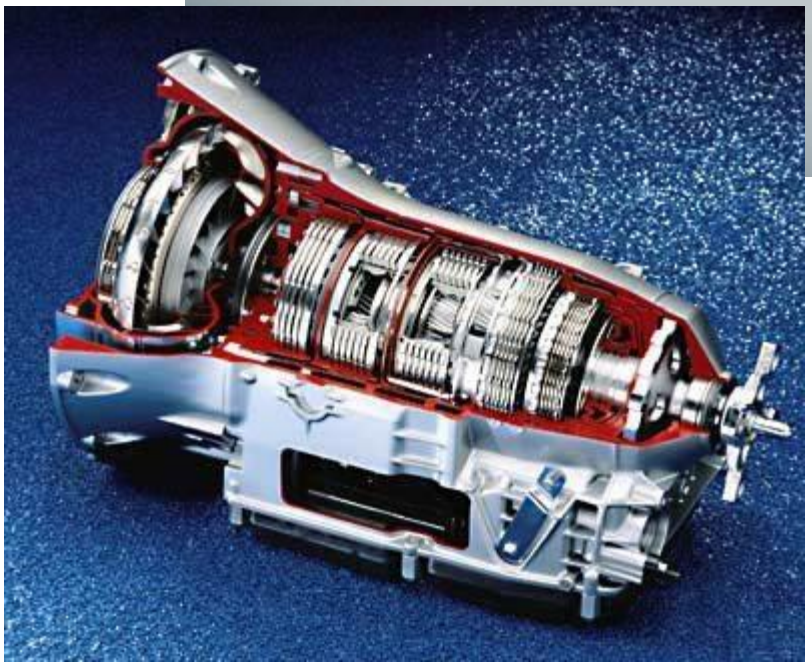


3D-MBD & 3D GD&T™ - Annotated Axonometric View

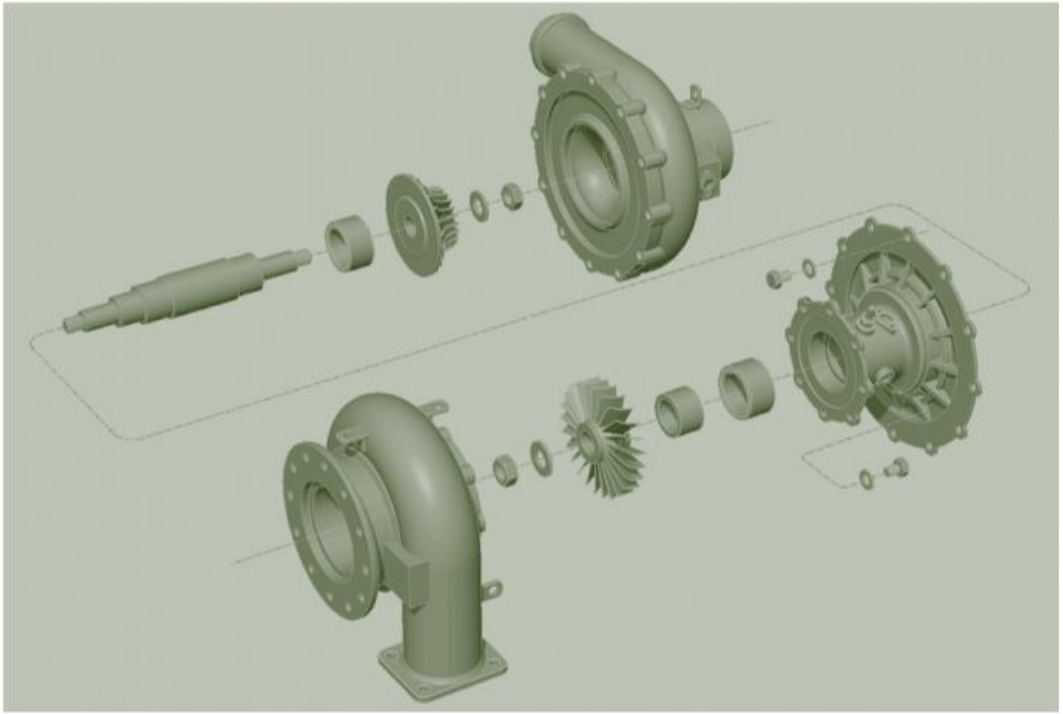
MBD, MBSE, Simulation

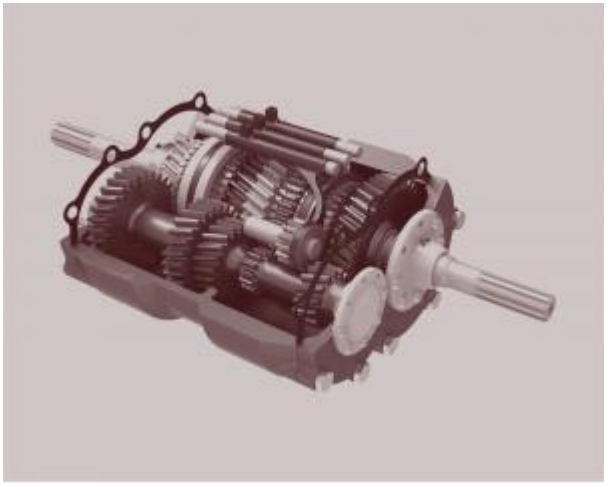
광의 전산기술(CAE) 분야를 4 V로 정리해 보았다. 제품 모형(Model)정보의 시각화 (Visualization), 제품의 모형정보 가상화 (Virtualization), 제품 모형정보의 검증 (Verification), 제품 모형정보의 유효화 (Validation) 라고 할 수 있다. 이것을 통합적으로 관리 하는 것이 모델기반의 체계공학(MBSE)이다.

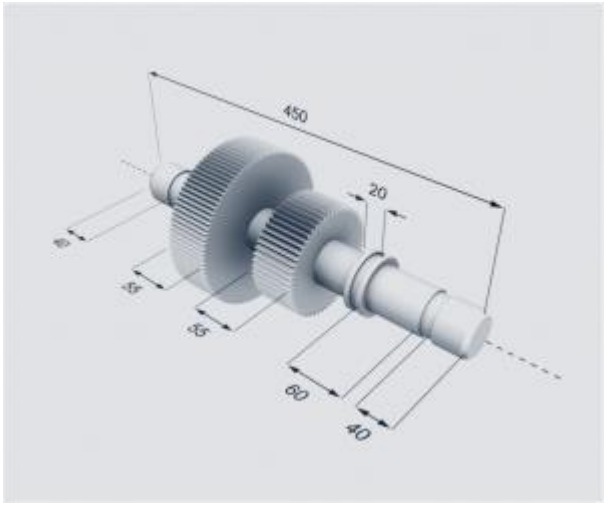
3D PDF와 Model Based



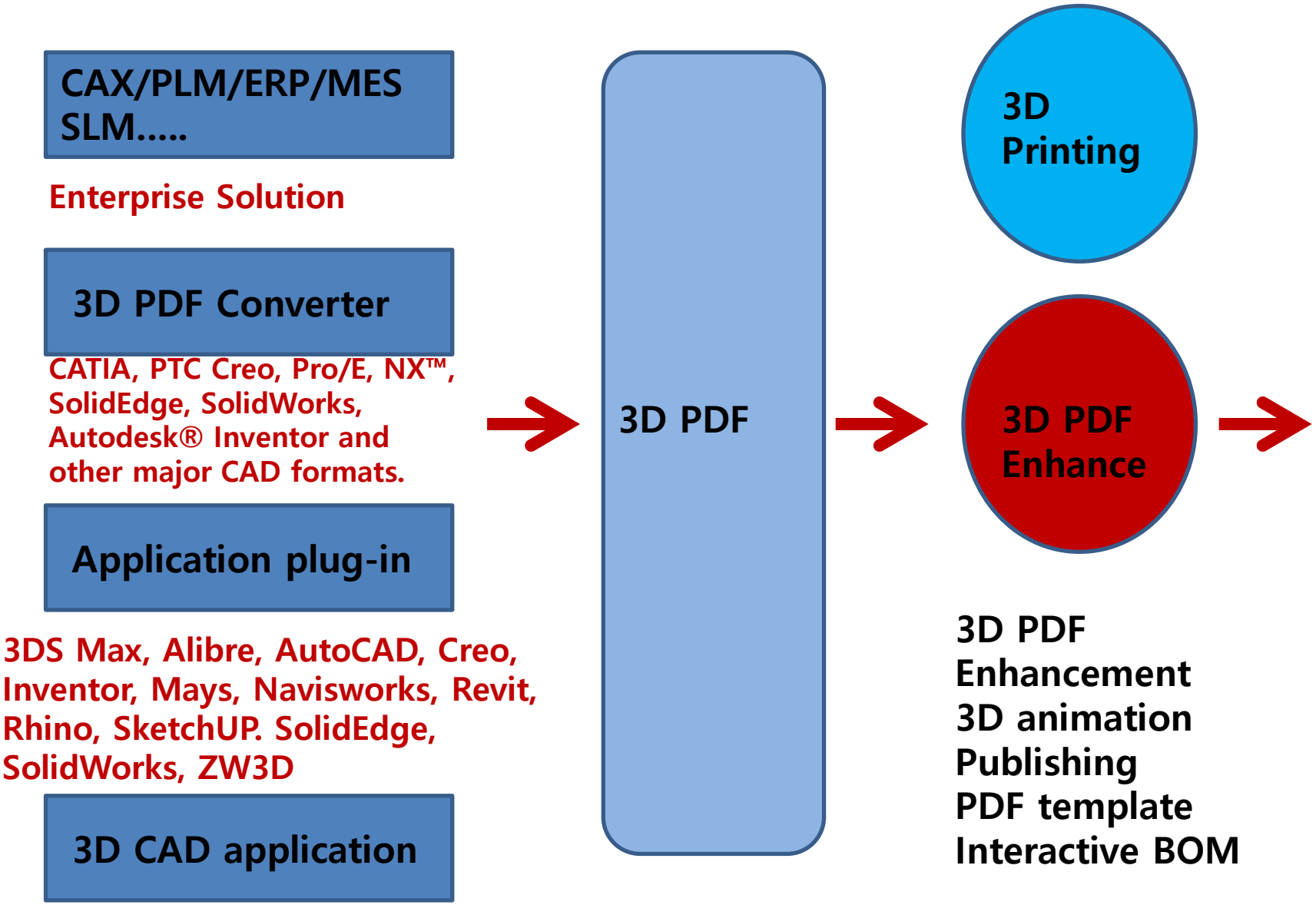
3D Model 과 Model Based



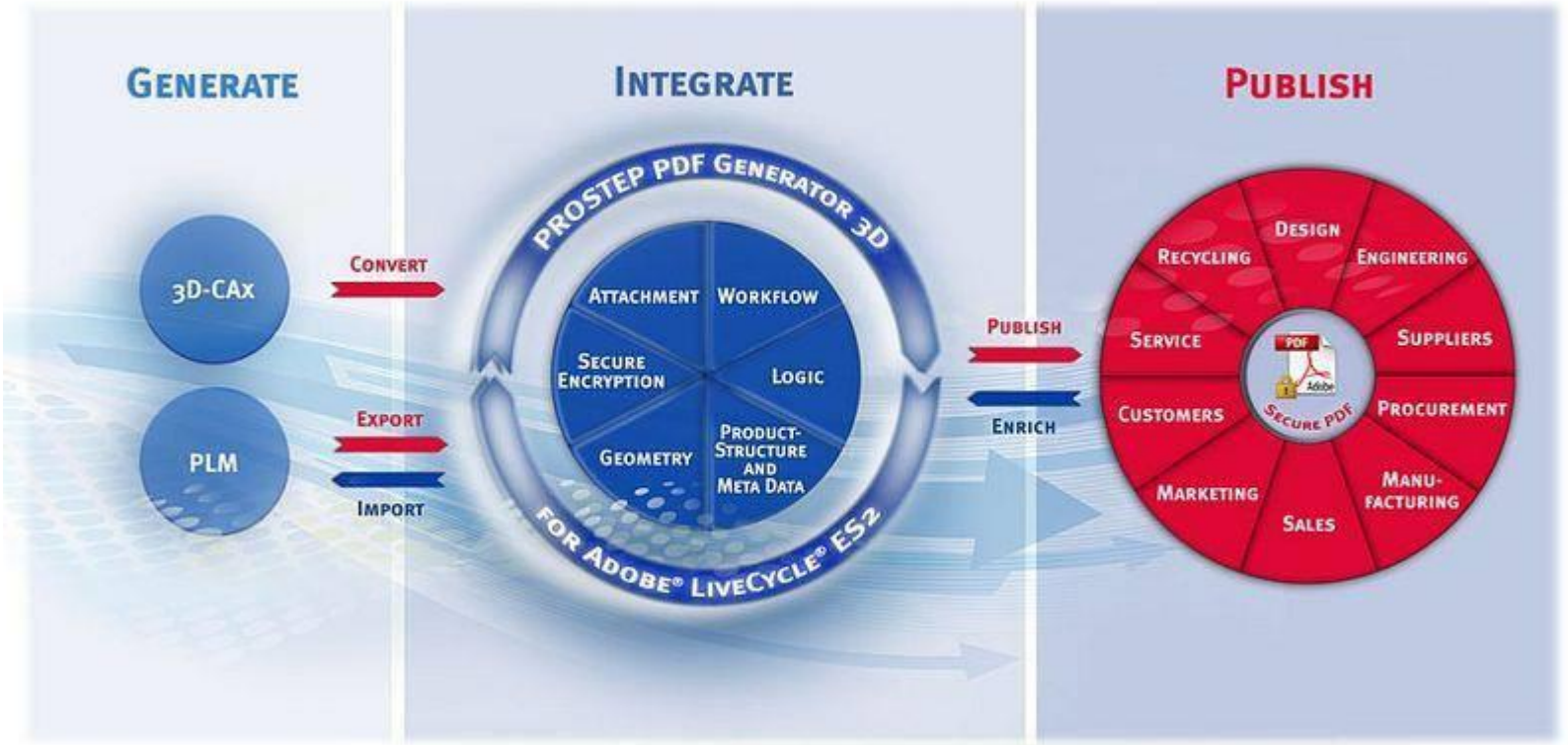


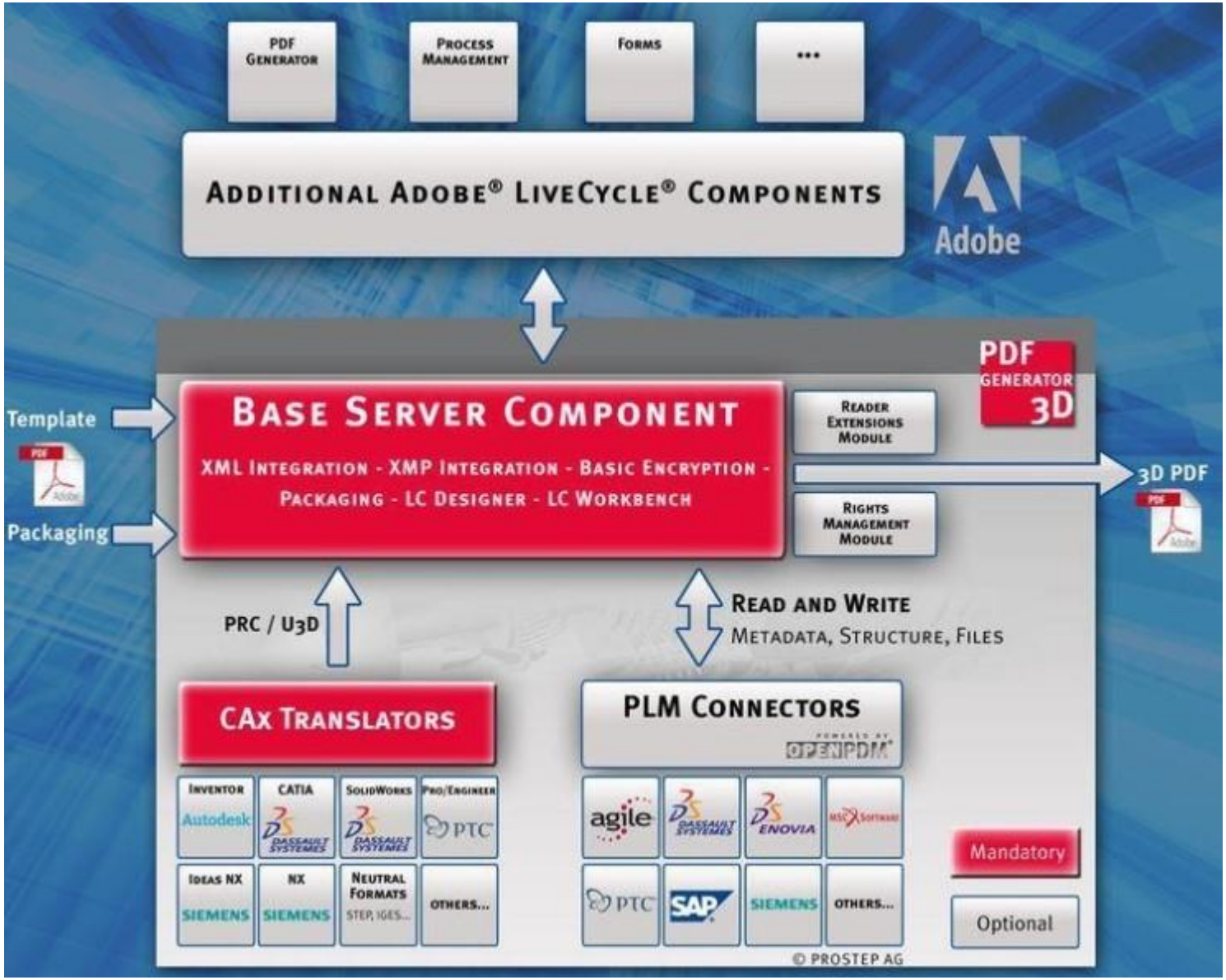


3D PDF 다양한 환경과 MBE



3D PDF 생성 – 통합 – 배포 – 부가 가치




PDF Generator
Process Management
Forms
...
Additional Adobe® LiveCycle® Components
Adobe
PDF Generator 3D
Base Server Component
XML Integration - XMP Integration - Basic Encryption - Packaging - LC Designer - LC Workbench
Reader Extensions Module
Rights Management Module
Template
Packaging
3D PDF
PRC / U3D
Read and Write
Metadata, Structure, Files
CAx Translators
Inventor
CATIA
SolidWorks
Pro/Engineer
Ideas NX
NX
Neutral Formats
STEP, IGES...
Others...
PLM Connectors
powered by OPENPDM
agile
ENOVIA
PTC
SAP
SIEMENS
Others...
Mandatory
Optional
© PROSTEP AG

OpenPDM® - The integration platform
Connectors and Interfaces

PROSTEP

3D 스마트 문서 환경 구축

Test Order and Report

PROSTEP integrate the future

Test Info

ID:	EMS007-TQC-001	Test Type:	Low µ-Test
Status:	rejected	Date:	09.10.2010
Project Mgr:	Sandy Schmitt	Phone:	+49-6151-9287-0
eMail:	Sandy.Schmitt@prostep.com		

Test Engineer

Tester:	Toby Muller	Phone:	+49-6151-9287-392
e-Mail:	Toby.Muller@prostep.com		

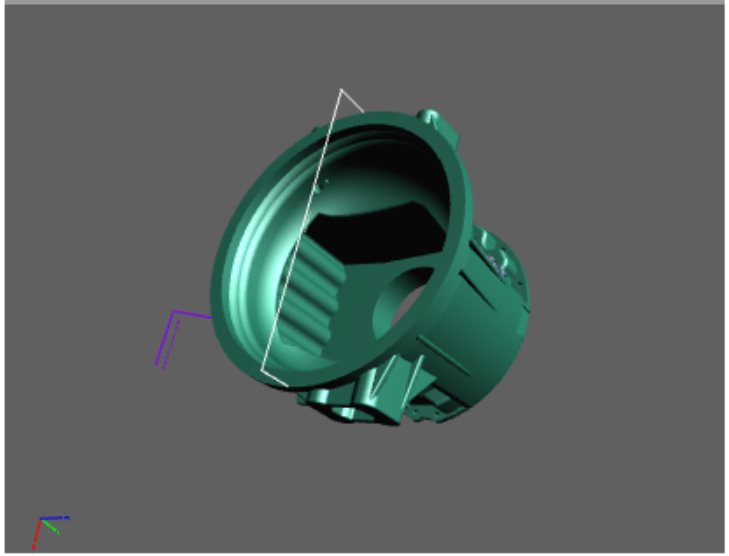
Test OK			Urgency	Add File	Send Form
☒ yes	☐ hold	☐ no	high		

Test Description: 001 - 223 - 1	Signatur
Test succeeded! Everything worked great!	

System Parameter

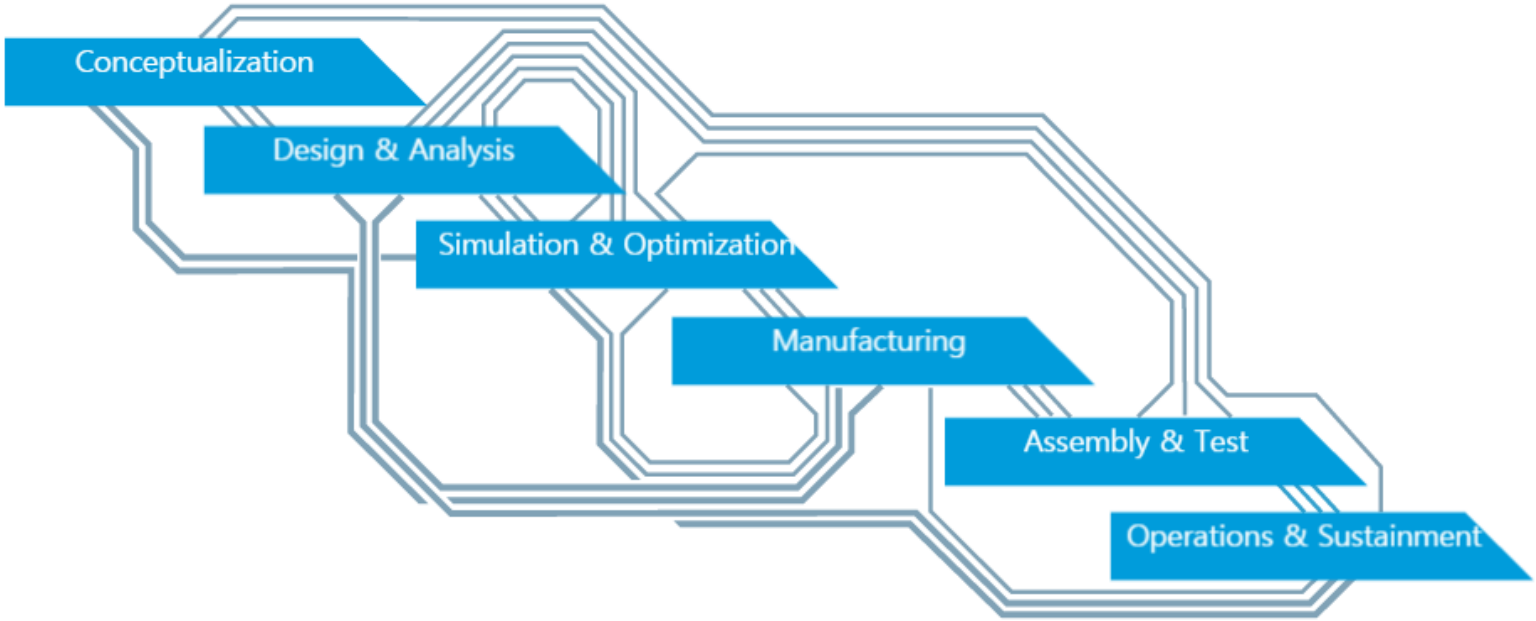
Mass:	2245kg
Barycenter:	1,84m; 0,92m; 0,46m
Bench testing:	Ok
Stall testing:	Ok
Multiplication ratio	2.1:1
Moment of Inertia:	12,7kg*m^2

Assembly Structure



Digital Tapestry

"Model Based Enterprise (MBE) is a digital tapestry which has been optimized around a core set of annotated product models enabling rapid, seamless, and affordable deployment of products from concept to disposal."



At Lockheed Martin, we're rethinking our digital world so we can quickly innovate, deliver faster and improve our ideas well into their service lives.

We are pushing the frontiers of digital technology by linking all stages of a product's life cycle.

The Digital Tapestry seamlessly connects conceptualization, design, verification, manufacturing and sustainment to better understand and improve the ideas that we bring to life.

Advanced 3D Tools
Enable Rapid Design Iterations

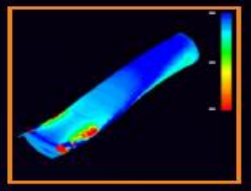
Design Process

Rapid Iteration (Associatively)


Configuration Design


Subsystem Integration

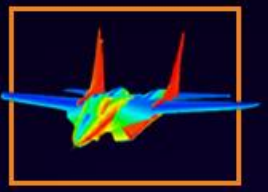

Structural Design

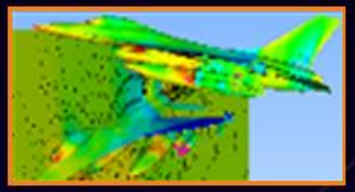

Propulsion Design

Analysis Process

Custom Integration and Interfaces


Aerodynamics


Signature


Computational Fluid Dynamics

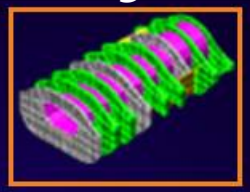

Carrier Suitability

Virtual Modeling

Rapid Solid & Structural Modeling


2D to 3D


Subsystem Models


Finite Element


Reducibility


Stereo lithography

Virtual Simulation

Interactive Virtual Walk-Thrus

Rapid Design Cycles

Complex CAD System

MDE Case Study
Digital Tapestry

Everyone Plays a Part

ENGINEERING

A product's life begins with the digital tools that help create ideas in virtual worlds and see them for the first time in 3-D printed models.

PRODUCTION

For the first time, assemblers are using the same models as those who created it, allowing for accurate, efficient production with 3-D printing and more.

QUALITY

Virtual inspection in 3-D models, and even inspection through advanced sensors, allows us to verify as we build, instead of just waiting for a finished product.

IT

The digital life of a product depends on the system that nourishes it. Easy-to-use systems that speed ideas help engineers and assemblers alike realize their vision.

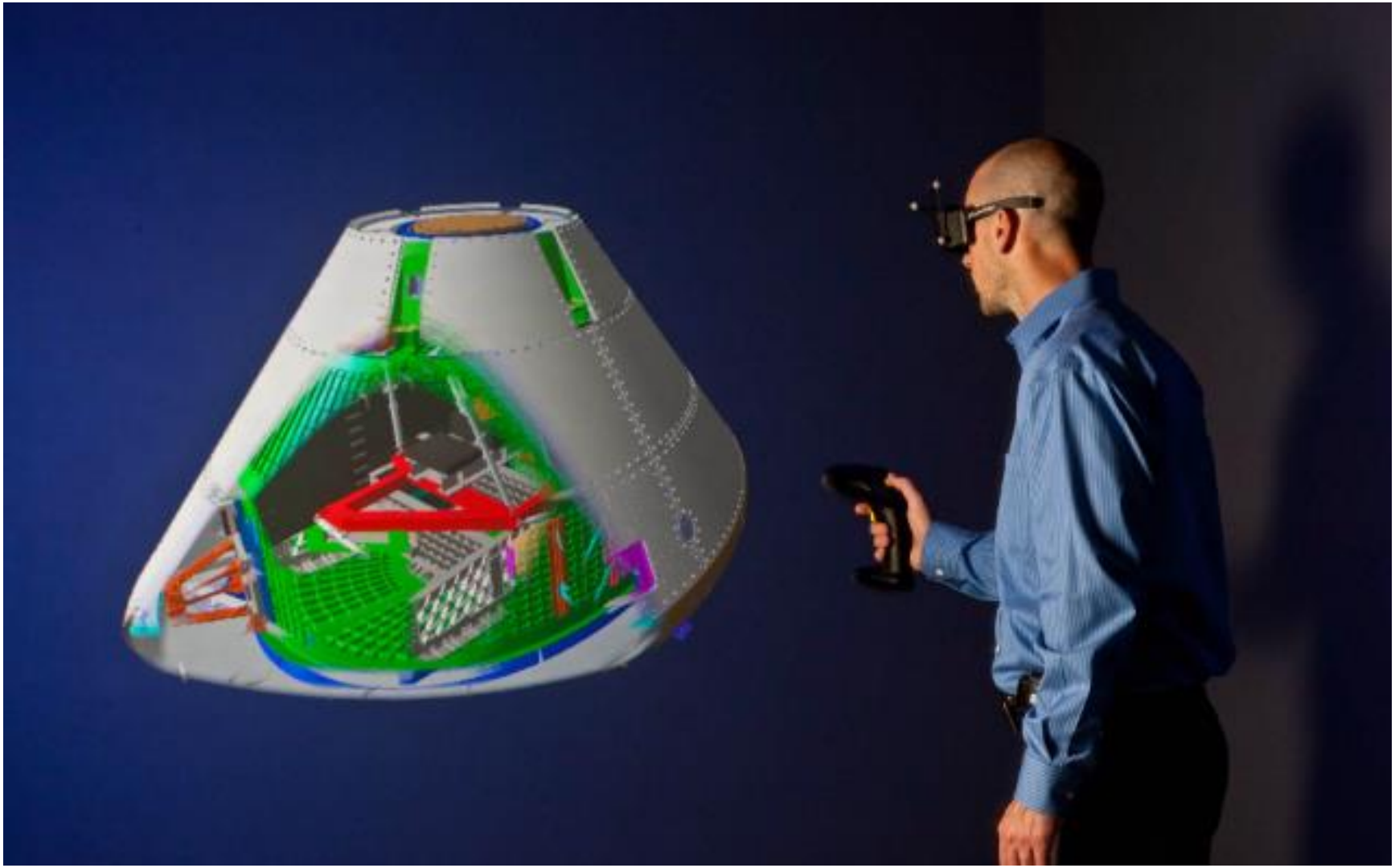
SUPPLY CHAIN

We can't do this alone. We connect our suppliers into this digital vision to build a better supply chain. Common products and 3-D designs are just the beginning.

CUSTOMERS

Users connect to the development process in ways never before possible. Everything from real-time model construction, realistic simulations or easily accessing operational data.

MDE Case Study Digital Tapestry



MDE Case Study Digital Tapestry

3D PLM시스템이 제품정보의 중앙집중화(Centralization)이라면 디지털 태피스트리는 제품정보의 분산화(Decentralization)이라고 할 수 있다. 제품의 전체 수명주기인 개념단계, 설계, 확인, 생산과 유지보수 단계를 중간에 끊어짐이 없이 연결해서 제품의 아이디어에서 실제 제품의 출시까지 개발자들이 제품에 대한 개념을 최대한으로 이해하고 개선하는데 그 목적이 있다.

결론

1. MBE 핵심 MB 3D 데이터관리와 MBD, MBSE 프로세스이다.

2. 3D 시뮬레이션 /해석/시험/검증/3D 프린팅 기술이 기업의 핵심 경쟁력

3. MBE- 저비용 MBE

3D Data / 3D PDF Document (P&A) / 3D Printing / 3D Simulation

4. 최첨단 미래형 MBE- Digital Tapestry