

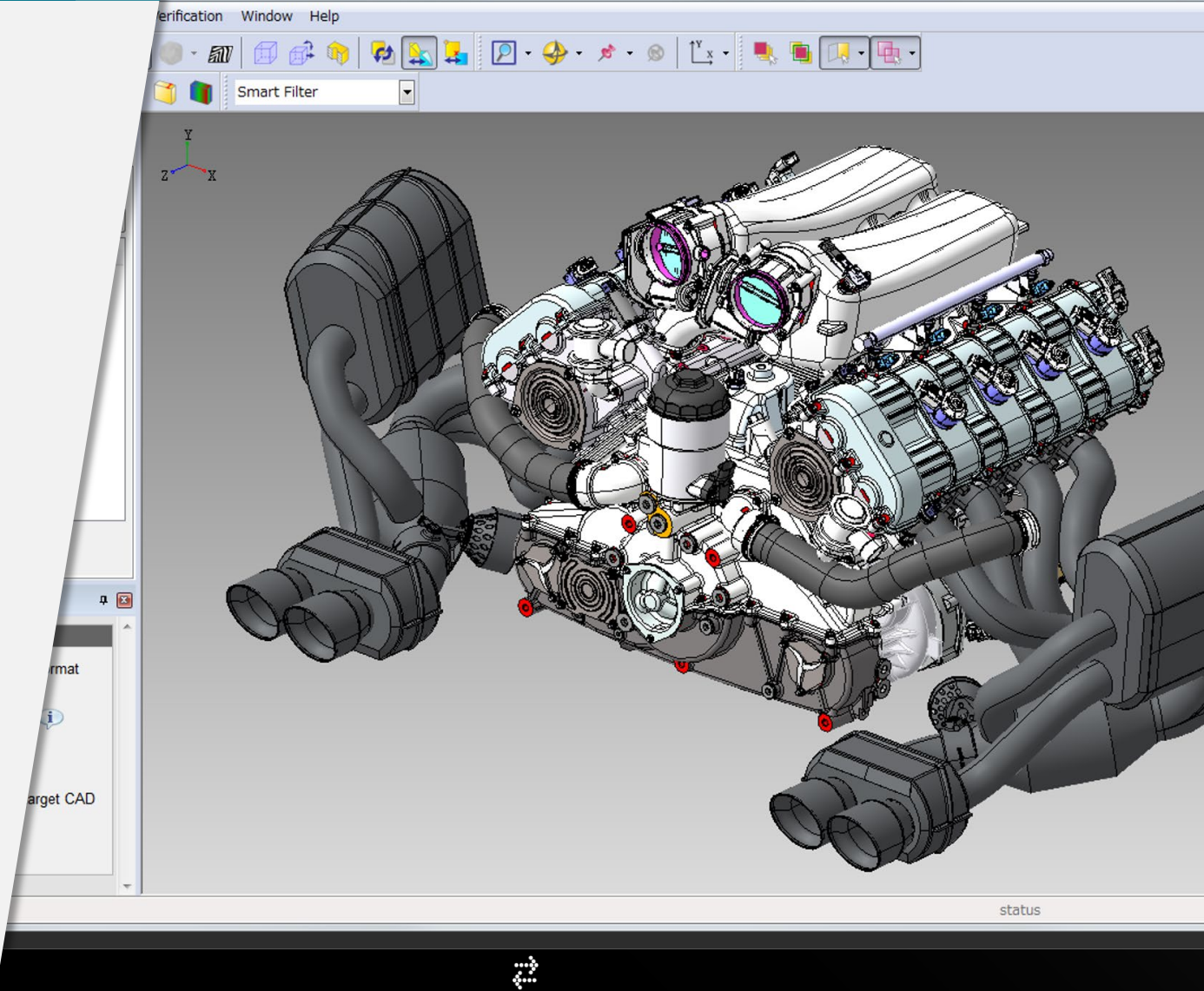


MBE Workshop

# MBE CAPABILITY INDEX

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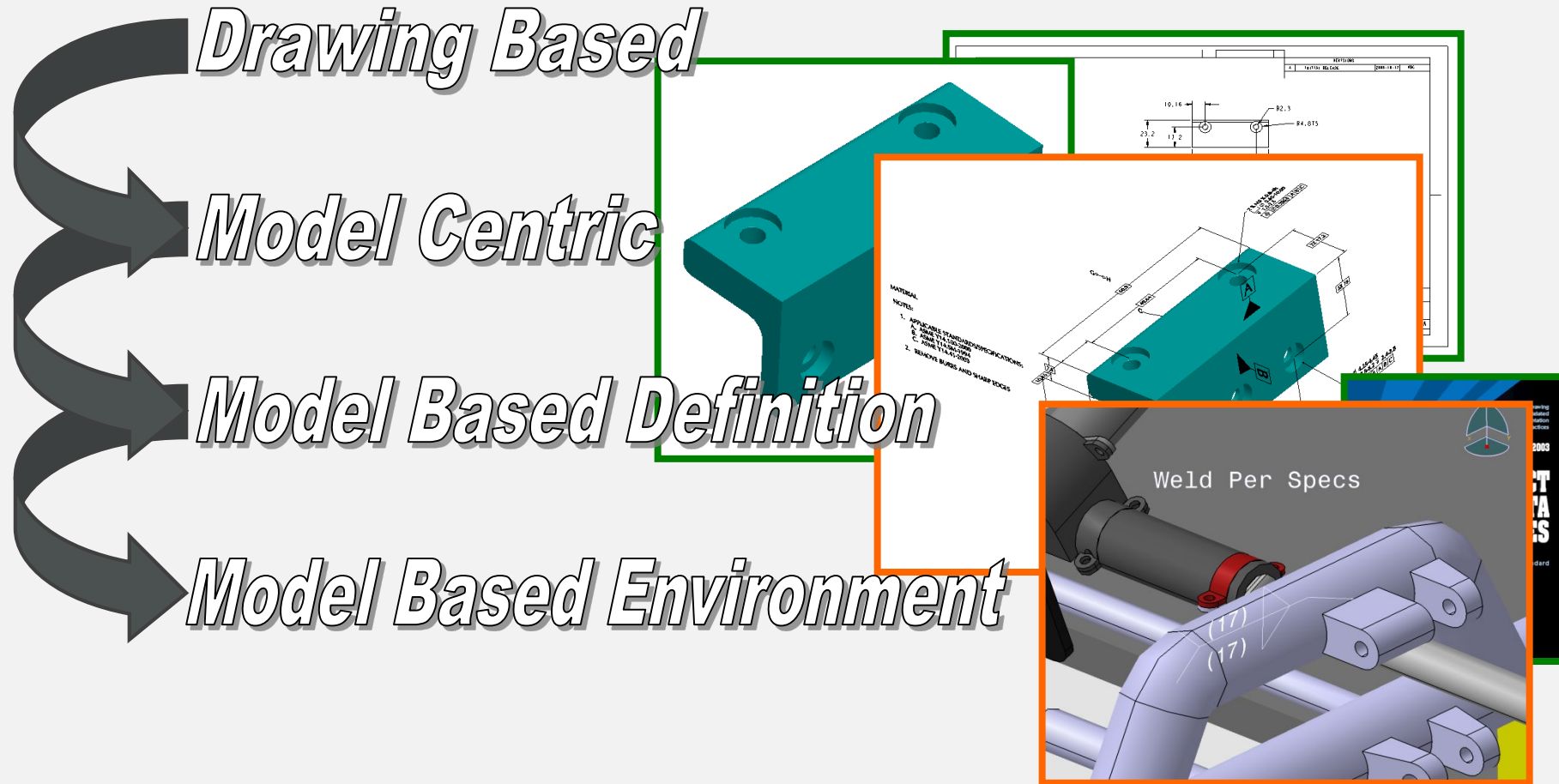
## CAPABILITY INDEX

The MBE Capability Index is a self assessment tool used to determine where your organization is on the MBE journey.

It has the ability to let you score yourself based on your enterprise as well as departments within the enterprise. Within each department are specific tasks, these tasks are scored to determine the department score as well as enterprise score.

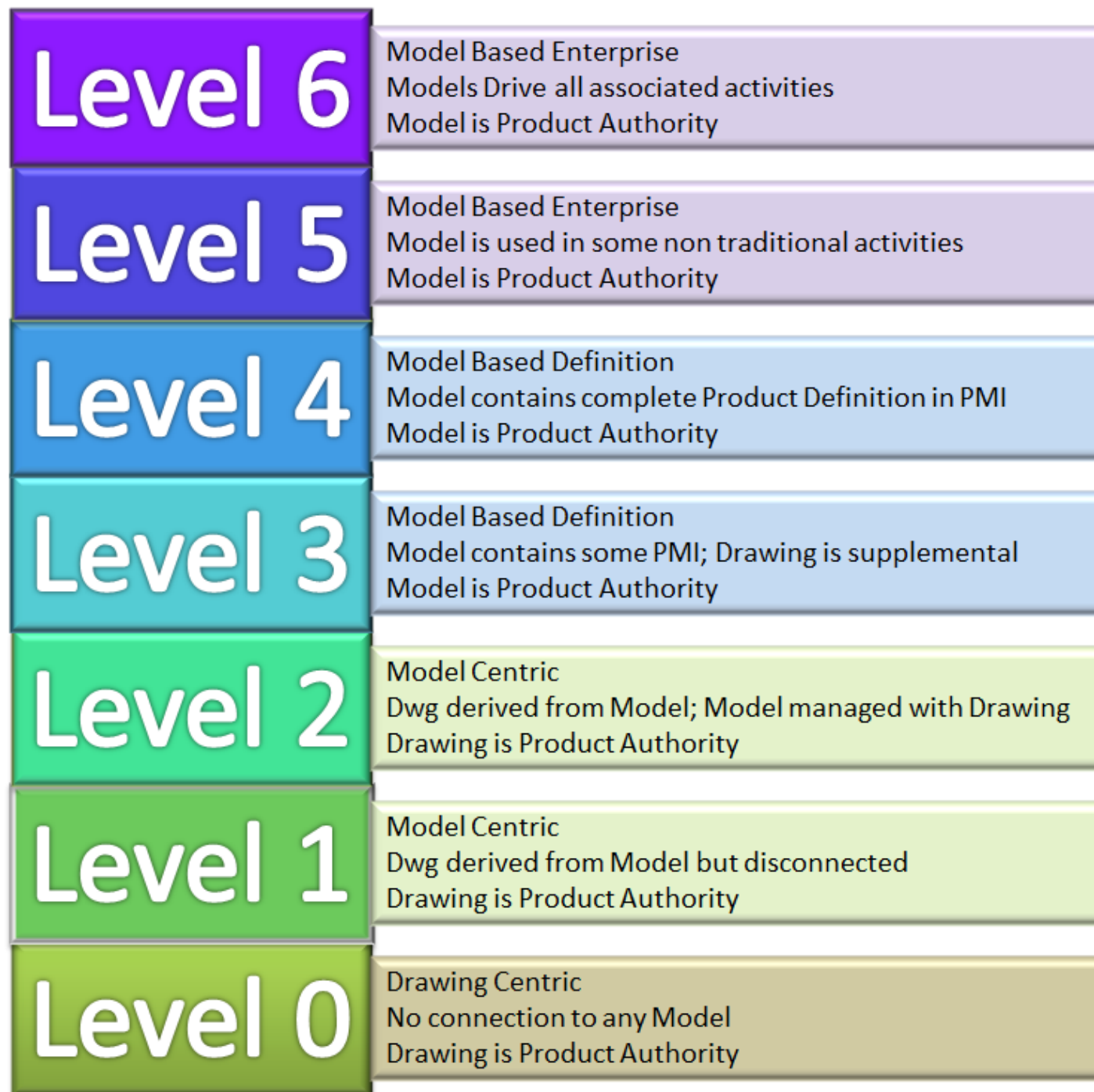


# MODEL BASED DEFINITION IS A JOURNEY



## LEVELS OF MBD

In a general sense the levels are described as seven levels in this graphic





# LEVELS OF MBD

- In a more specific sense scores are developed based on activities within specific departments.
- Scores are awarded for each activity within departments and averaged for the department score.
- If your organization does not have a specific department or activity it can be eliminated from the scoring.
- Sometimes there is only design and document management at one site. That site can be scored on its own CI level.
- The CI Index is a document you can grow to suit your needs.
- If you have activities not listed they can be added.
- If you do not have an activity listed it can be deleted (be careful on this one not to delete just for a better score).
- Remember this is a self assessment only you can be hurt by trying to win the game instead of understanding it.

SCORE EQUALS BASE REQUIREMENT PLUS ACTIVITY LINE ITEM REQUIREMENT								MBE Level Assessment Worksheet	
MBE Maturity Level	Level 0	Level 1	Level 2	Level 3	Level 4	Level 5	Level 6	As-Is Score	Goal
MBE Maturity Classification	Drawing Centric	Model Centric		Model Based Definition		Model Based Enterprise			
Base Requirement	No connection to any Model	Dwg derived from Model but disconnected	Dwg derived from Model; Model managed with Drawing	Model contains some PMI; Drawing is supplemental	Model contains complete Product Definition in PMI	Model is used in some non traditional activities	Models Drive all associated activities		
Product Authority	Drawing	Drawing	Drawing	Model	Model	Model	Model		
Design Activities								0.00	3
Product Definition	Drawings only; No connection to any Models	Dwg derived from Model but disconnected	Model managed with Drawing	Model contains some PMI Drawing is supplemental	Model contains complete Product Definition in PMI	Model is used in some non traditional activities	Models Drive all associated activities	0	3
EBOM	EBOM manually defined in ERP/appropriate database.	EBOM manually defined in ERP/appropriate database. EBOM not linked to the CAD models.	Some or all of EBOM is extracted from CAD product structure	Same requirement as level 4 -->	EBOM managed in PLM/ERP tool. EBOM available for distribution for MBOM/EBOM/other definition.	EBOM managed in PLM. MBOM/other BOM definition is defined using CAD based tools.	Automation software develops other BOMs automatically	0	3
Analysis	Calculations based on manual methods/spreadsheets	New models created to support analytic activities	Same requirement as level 4 -->	Same requirement as level 4 -->	Native CAD Model is reused as analytic model, some modifications required	Native CAD Model is reused as analytic model without model modifications	Automatic analysis as design progresses.	0	3
Checking & Model Quality	2D drawing contents validated Manually.	2D drawing validated. 3D model NOT validated.	2D drawing validated. 3D model geometry validated.	3D model validated. 2D drawing validated.	3D model geometry and part annotations validated.	3D model validated - Semi automation using PLM based tools.	3D Product definition validated during model creation. Derivatives validated at creation, Automatically	0	3
CM / DM Activities (PLM)								2.00	3
Manufacturing Planning Activities								1.86	3
Quality Requirements, Planning Activities								1.40	3
Enterprise Activities								4.00	3
Overall Enterprise score									
Weighted MBE Level								1.9	



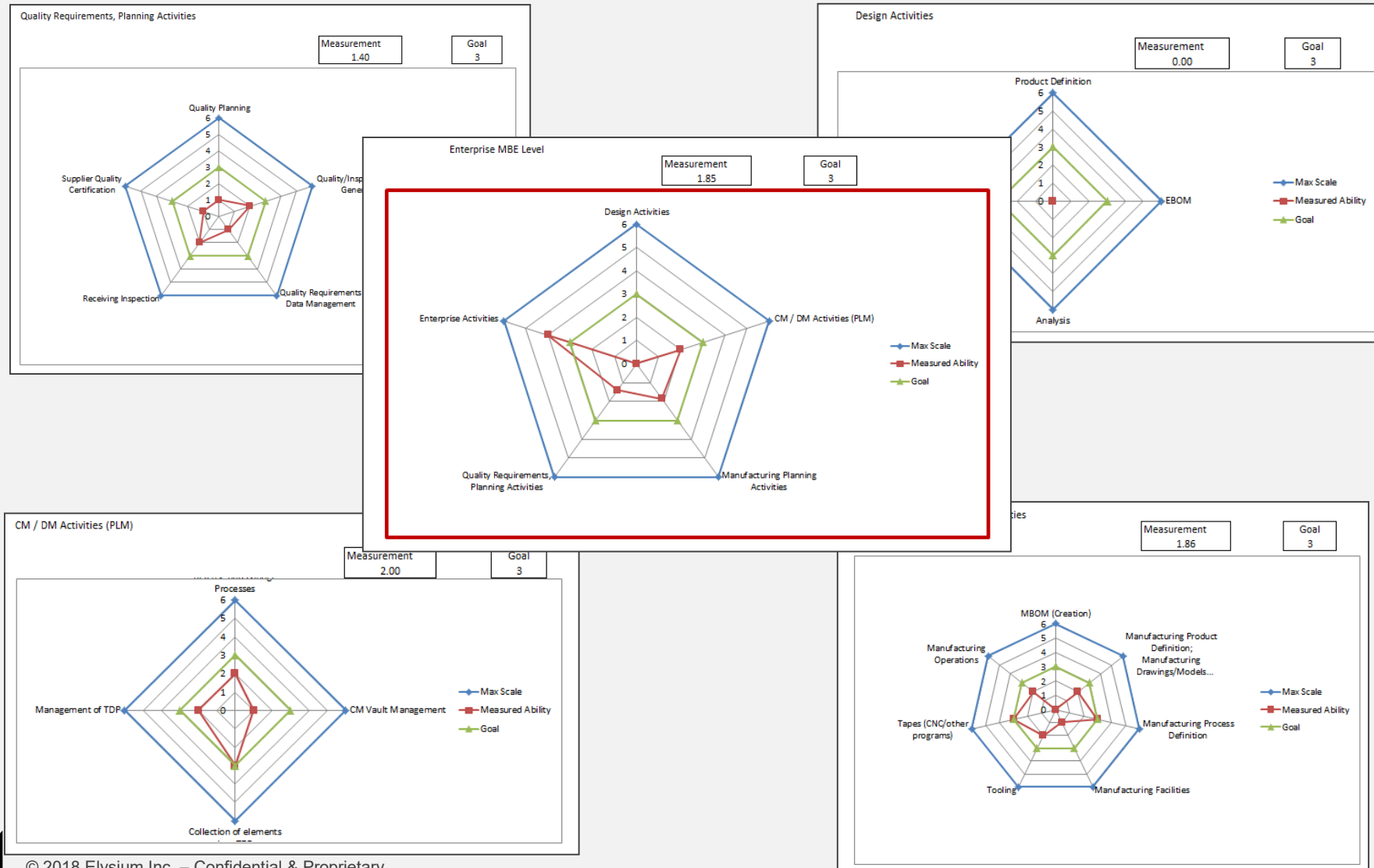


# LEVELS OF MBD

CM / DM Activities (PLM)								2.00	3
Release and Change Processes	<i>Same requirement as level 2 --&gt;</i>	<i>Same requirement as level 2 --&gt;</i>	Drawing Based, Manual CM and DM processes.	Model Based, Manual CM and DM processes.	Model Based, Manual CM and DM processes. (Some CM process controlled)	Model Based, all CM processes from PLM	Model Based, all CM processes from PLM (Support Automation)	2	3
CM Vault Management	<i>Same requirement as level 1 --&gt;</i>	2D drawing and supplementary data are managed in a manual vault and database	2D, 3D and supplemental data managed in separate database outside of PLM (25% in PLM)	2D, 3D and supplementary data are managed in a manual vault and database (50% - 75% in PLM)	2D, 3D managed in PLM. Some supplemental in PLM. CM might be manual.	Fully managed by PLM System	Fully PLM managed with automated supporting routines.	1	3
Collection of elements into TDP	<i>Same requirement as level 2 --&gt;</i>	<i>Same requirement as level 2 --&gt;</i>	Ad-hoc, manual collection of 3D TDP data (digital and physical data)	Structured manual collection of digital 3D TDP data	Semi-automated collection of digital 3D TDP data by PLM	Same requirement as level 6 -->	Automated collection of digital 3D TDP data by PLM	3	3
Management of TDP	Does not manage/deliver 3D TDP data	<i>Same requirement as level 2 --&gt;</i>	Ad-hoc manual digital or physical delivery of 3D TDP data	<i>Same requirement as level 4 --&gt;</i>	Structured digital delivery of full 3D TDP data	Same requirement as level 6 -->	Automated digital delivery of full 3D TDP by PLM.	2	3
Manufacturing Planning Activities								1.86	3
MBOM (Creation)	Manual drawing based lists compiled	<i>Same requirement as level 2 --&gt;</i>	Manual drawing based lists compiled	CAD Product Tree Plus manual MBOM components (Raw/Misc. material)	CAD Product tree contains Raw/Misc. Material	Smart BOM extraction routines used	Automation drives EBOM - MBOM definition MRP needs (By product type factory type)	0	3
Manufacturing Product Definition; Manufacturing Drawings/Models when required	Mfg. Drawings created as required	Mfg. drawings created based on models, no CM on models	Mfg. drawings and models managed by CM	Mfg. models are master with supplemental drawings	Mfg. models are complete definition	Smart model recognition routines provide initial automation	Automation drives Mfg. product definition	2	3
Manufacturing Process Definition	Text and photograph based work instruction document	<i>Same requirement as level 2 --&gt;</i>	Text and photograph based work instruction document some pictures of models	Model based work instructions, pictures and text	3D Model based work instructions including PMI usage	Smart model recognition routines provide initial automation of WI creation.	Automation drives process definition based on product type, facility, available processes	3	3
Manufacturing Facilities	Defined; based on processes that are derived from drawings	<i>Same requirement as level 2 --&gt;</i>	Defined; based on processes derived from drawings. (Some model visual analysis)	Defined; based on visual model analysis	Defined; based on combination of visual and parametric analysis	Defined based on parametric analysis with visual double check	Facilities plans are automatically derived from product definition	1	3
Tooling	Defined; based on processes that are derived from drawings	<i>Same requirement as level 2 --&gt;</i>	Defined; based on processes derived from drawings. (Some model visual analysis)	<i>Same requirement as level 5 --&gt;</i>	<i>Same requirement as level 5 --&gt;</i>	Defined; based on model analysis	Tooling is automatically defined based on product definition	2	3
Tapes (CNC) other programs	CNC/ other manually created or new models created to support	CNC/ new models created to support	CNC /other based on existing model, checked to drawing	CNC /other based on existing model, checked to model and supplemental drawing	CNC /other based on existing model, checked to model. Updates possible with model modification	Some automation based on Model Features and PMI	CNC/other programs automatically defined based on product design and mfg. facility	3	3
Manufacturing Operations	2D Drawings and hard copy routings used on shop floor	<i>Same requirement as level 2 --&gt;</i>	2D Drawings and routings accessed from workstation computer	Models, 2D Drawings and routings accessed from workstation computer	<i>Same requirement as level 5 --&gt;</i>	Models, product and process definition accessed from workstation computer	Factory completely automated to create Product definition	2	3
Quality Requirements, Planning Activities								1.40	3
Quality Planning	<i>Same requirement as level 2 --&gt;</i>	<i>Same requirement as level 2 --&gt;</i>	Drawing used to define inspection processes	Drawing and Model used to define inspection process	Model used to define inspection processes Some automated extraction of PMI	Complete extraction of Semantic PMI used in inspection process software	Automated QA plans, including CMM programs and processes.	1	3
Quality/Inspection Code Generation	<i>Same requirement as level 2 --&gt;</i>	<i>Same requirement as level 2 --&gt;</i>	Drawing used to define manually created CMM routines	Model and Drawing used to define manually created CMM routines	Models used to define CMM programs interactively	Complete extraction of Semantic PMI used in inspection CMM software	Automated CMM programs and processes.	2	3
Quality Requirements Data Management	<i>Same requirement as level 1 --&gt;</i>	File Folders (manual or computer based database)	Managed in separate database outside of PLM/ERP	Managed in separate database outside of PLM (50% in PLM)	Managed in separate database outside of PLM (75% in PLM)	<i>Same requirement as level 6 --&gt;</i>	Fully managed in PLM	1	3
Receiving Inspection	<i>Same requirement as level 2 --&gt;</i>	<i>Same requirement as level 2 --&gt;</i>	2D drawings used to Inspect/Verify incoming material.	<i>Same requirement as level 4 --&gt;</i>	3D models/derivatives used to manually Inspect/Verify incoming material.	3D Models/Derivatives systematically compared to models with human assist.	Incoming material Inspected/Verified automatically (compared to Model).	2	3
Supplier Quality Certification	<i>Same requirement as level 2 --&gt;</i>	<i>Same requirement as level 2 --&gt;</i>	Drawing used to define inspection processes	Drawing and Model used to define inspection process	Model used to define inspection processes Some automated extraction of PMI	Complete extraction of Semantic PMI used in inspection process software	Automated QA plans, including CMM programs and processes.	1	3



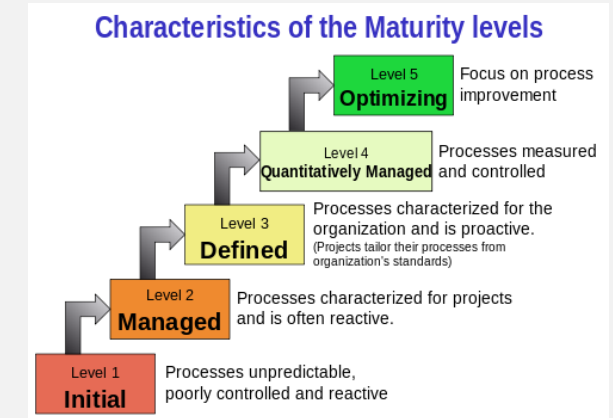
# LEVELS OF MBD





# SEVEN LEVELS

- It looks kind of like the CMMI 5 level Maturity Index. We looked at that and decided on 7 levels.
- The 7 levels are more indicative of the journey you need to travel in the MBE world.
- Level 0 is no models, drawing boards used to create 2D Drawings.
- Level 6 is such a high level of automation that for the most part it does not exist yet.
- Each process task is measured individually then averaged with its department peers to provide department score.
- The sum of department scores are averaged for the enterprise score.



Level 6	Model Based Enterprise Models Drive all associated activities Model is Product Authority
Level 5	Model Based Enterprise Model is used in some non traditional activities Model is Product Authority
Level 4	Model Based Definition Model contains complete Product Definition in PMI Model is Product Authority
Level 3	Model Based Definition Model contains some PMI; Drawing is supplemental Model is Product Authority
Level 2	Model Centric Dwg derived from Model; Model managed with Drawing Drawing is Product Authority
Level 1	Model Centric Dwg derived from Model but disconnected Drawing is Product Authority
Level 0	Drawing Centric No connection to any Model Drawing is Product Authority





## ENTERPRISES, DEPARTMENTS, TASKING

- When you look at enterprise departments, Design Engineering creates the “Base” or “Foundation” of MBD. (Since all other activities access that same product model created by Design Engineering.)
  - It is almost impossible for other departments within the same enterprise to surpass the capability level of this foundation without starting from scratch. Starting from scratch is completely contrary to the principal of “Data Reuse”.
  - It is possible to have departments on the global scale where measurements need to be department by department.
  - If Design happens at two sites each can be scored separately.
  - The same holds true for various manufacturing sites. In this case it is possible for a manufacturing site to score higher than a Design site.
  - In some cases it would be possible for capable downstream suppliers to outperform a design department.
  - Some Companies are using an MBE CI to grade their suppliers.



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# WHAT SHOULD BE YOUR TARGET LEVEL?

It's all about what you want.

- How well will you be able to utilize the data?
  - Automation Level
  - Human Level
- What will your roadmap look like?
  - You need to determine your journey.
  - Is your corporate culture ready?
  - Will you be able to achieve your goals?
  - What will be your ROI at various times during technology transition?
  - When should you invest in the various aspects of MBE?



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