

CM2-905A

How CM2 Achieves the Requirements of the EIA-649 Standard for CM

This white paper describes how the CM2 model fulfills the requirements of the EIA-649 standard and why CM2 is the most robust solution.

IpX

Evolve

True North for Ecosystem Excellence



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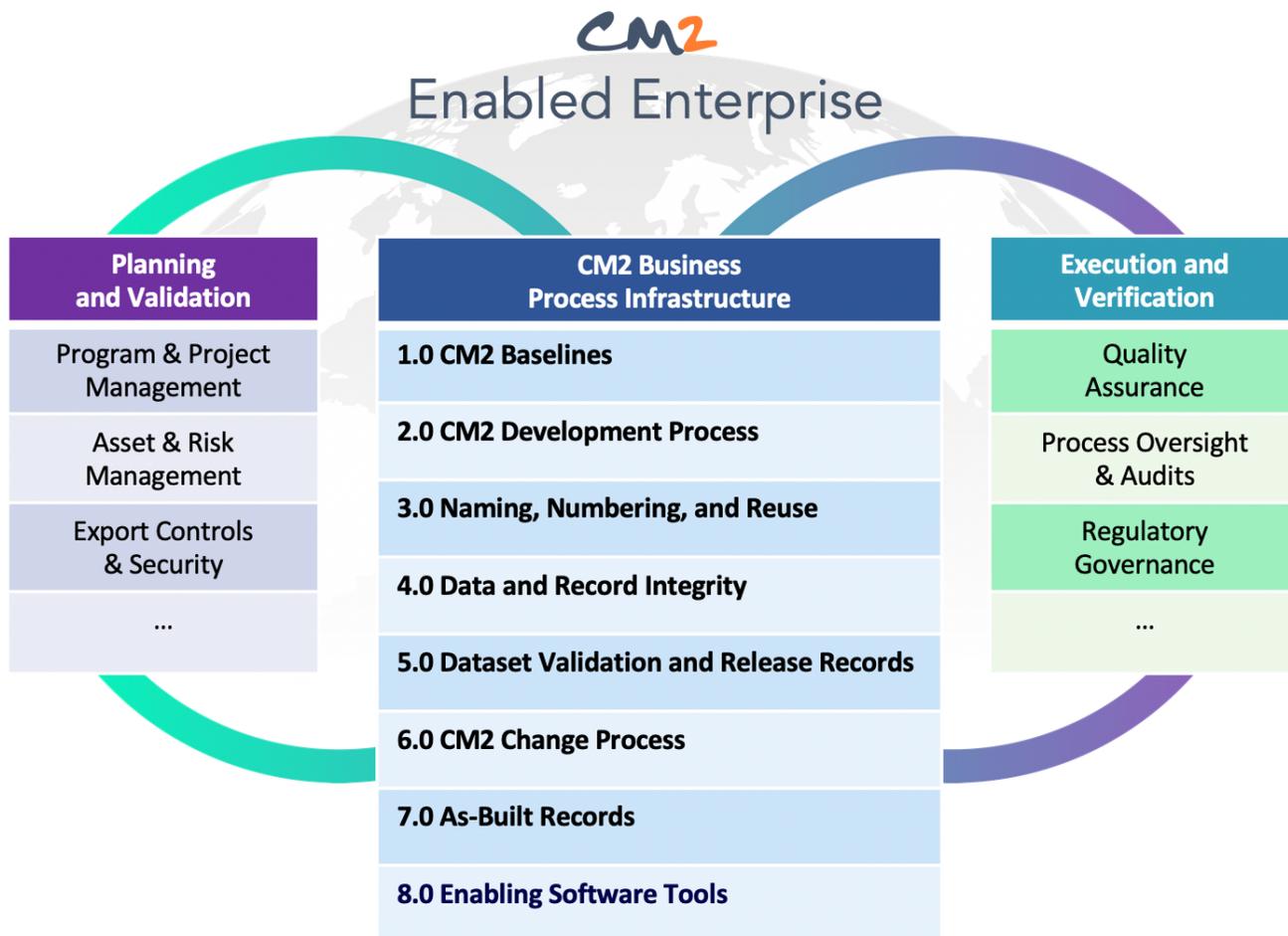
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Standards and Guides for Configuration Management

- EIA-649 Configuration Management Standard
- GEIA-HB-649 Configuration Management Standard Implementation Guide
- MIL-HDBK-61B Configuration Management Guidance
- ISO 10007 Quality Management - Guidance for Configuration Management
- CM2-500 Standard for Enterprise Configuration Management

This white paper describes how the CM2 model fulfills the requirements of the EIA-649 Configuration Management Standard (revision C at the time of this writing) and why CM2 is the most robust solution. The missing link with the siloed approach to CM is the Business Process Infrastructure provided by the CM2 Model.

The operation of every core business process will be positively influenced by the application of CM2 at the enterprise level. Planning and execution activities will be improved at the project, program, and core business process levels. Validation of all requirements and verification of conforming results for all work accomplished will be byproducts of the processes. The application of the business process infrastructure is a prerequisite for achieving enterprise operational excellence.



EIA-649: Configuration Management Standard

SAE EIA-649 provides a flexible and comprehensive methodology for defense contractors to manage and control product configuration. It consists of five interrelated functions which, when collectively applied, maintain consistency between product configuration information and the product throughout conception, development, production, delivery, and support. Configuration management implementation requires a balanced and continuous application of CM functions and their underlying principles throughout the product lifecycle.

The 5 Functions of CM per EIA-649

The CM process is comprised of five functions: 1) CM Planning and Management, 2) Configuration Identification, 3) Configuration Change Management, 4) Configuration Status Accounting, and 5) Configuration Verification and Audit.

This standard is not written as a requirements document, per se, but as the foundation document upon which requirements may be structured and/or tailored.

GEIA-HB-649, MIL-HDBK-61, and ISO 10007 provide additional "how-to" guidance for planning, managing, and implementing CM, as described herein.



40 PRINCIPLES THAT SUPPORT THE 5 CM FUNCTIONS PER EIA-649



CM Planning and Management

1. To apply CM, a thorough understand of the product's context and environment is necessary foundation.
2. The plan for applying CM throughout the lifecycle of a product must be documented to provide consistency between the physical product and its defining information (requirements and documentation).
3. Adequate resources must be applied and responsibilities must be assigned to implement CM.
4. Key performance indicators (metrics) are necessary to measure compliance with the CM plan.
5. CM procedures describe how to achieve the intent of the CM plan.
6. CM training is required to perform the CM tasks properly.
7. The CM process must be assessed periodically to maintain its effectiveness.
8. CM is responsible for the CM performance of suppliers and contractors.
9. CM is responsible for how information is collected, processed, controlled, and preserved.

Configuration Identification

10. Identification is the basis for how products are defined, labeled, and changed.
11. Configuration information serves as the basis for all product lifecycle phases.
12. Enterprise identifiers are used to define the designer or manufacturer, thereby creating a unique ID.
13. Product identifiers identify products, their sources, and their documentation.
14. Products are serialized when it is necessary to distinguish one from the other.
15. When a product is modified, it retains its original serial number.
16. Group numbers are used to identify like-families of end-item products.
17. Product information is identified and linked to associated physical items.
18. A product structure is used to illustrate and organize the parent-child relationships of parts and their supporting information.
19. The act of releasing a product is to validate the product meets its requirements.
- 20.
21. A baseline represents the attributes of a product at a point in time.
22. The current baseline of a product configuration consists of its documentation plus approved changes.
23. Interfaces between products are documented and included in their baselines.
24. Products that require special CM attention are referred to as configuration items.

Configuration Change Management

25. Product changes are made using a systematic, measurable change process.
26. Changes must be justified to warrant the implementation resources, if approved.
27. A unique identifier is assigned to each change request to enable tracking.
28. Change requests are classified to identify the proper level of review.
29. Change requests must be clear in terms of technical, cost, and schedule content.
30. Change request evaluations must include consideration of all potential impacts and risks.
31. Change requests must be approved by the proper authority.
32. The authority that approves a change also assigns its implementation priority.
33. A variance form is used to define and accept a temporary nonconforming condition.

Configuration Status Accounting

34. CSA provides a way to maintain the status of a product and its information throughout its lifecycle.
35. Information about the product is captured as CM tasks are performed.
36. Metrics derived from CSA are used to improve CM process effectiveness.

Configuration Verification and Audit

37. CM processes are verified for consistency.
38. Products are audited to verify that they conform to their documented requirements.
39. Changes are verified to ensure consistency between products and supporting information.
40. Audits are a means to establish baselines at key points in the product lifecycle.

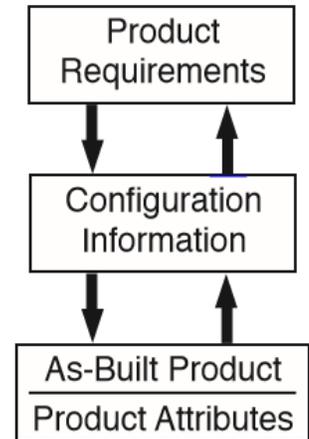
PRODUCT STRUCTURE AND ITEM-TO-DOCUMENT LINKAGES

Relationships and Linkages per EIA-649

The CM process serves to maintain consistency between product requirements, configuration information, and product attributes.

#20 *The current baseline of a product is its documentation plus approved changes*

#34 *Products are audited to verify that they conform to their documented requirements*



Product Structure and Linkages per CM2

The end-item (deliverable) application requirements reside at level 0.

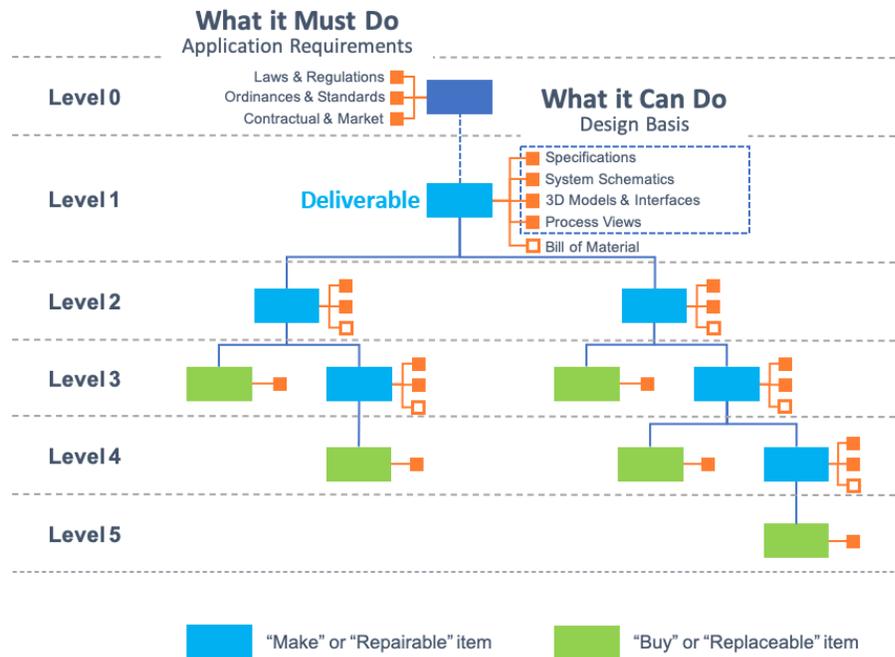
The end-item and its design basis views reside at level 1.

The application requirements represent what the end-item must do.

The design basis represents what the end-item can do.

Each item at each level of the hierarchy is linked to its own unique combination of released datasets.

Every dataset linked to an item can be revised and released independently from other information sets linked to the same item.

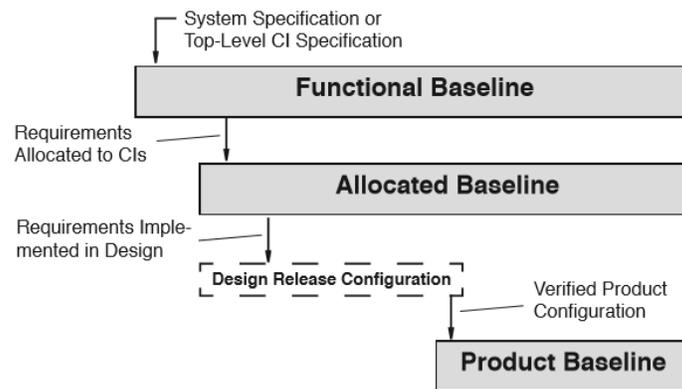


EVOLUTION SEQUENCE OF CONFIGURATION BASELINES

Evolving Configuration Baselines per EIA-649

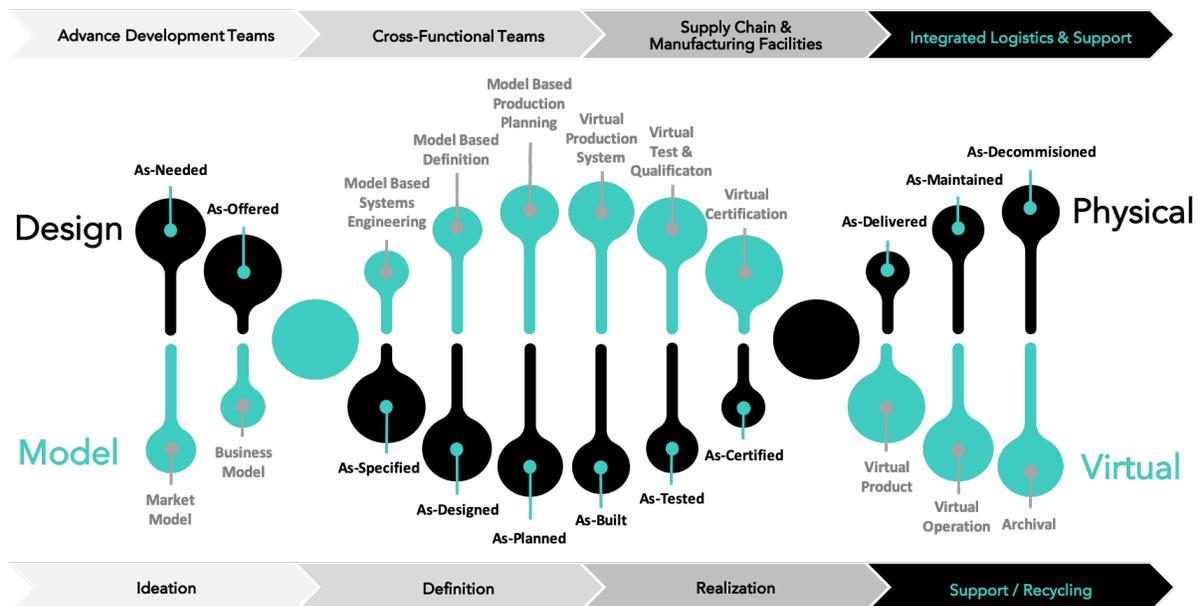
EIA-649 has three formal baselines that align with the product lifecycle phase.

- The Functional Baseline defines the original set of performance requirements.
- An Allocated Baseline is comprised of separately developed modules or configuration items.
- A Product Baseline details the final tested and approved configuration that achieves all performance requirements.



Evolving Configuration Baselines per CM2

The CM2 Baseline is comprised of all design basis views which include functional specifications, system schematics, a 3-D model, and multiple process views.



CONFIGURATION BASELINE CONTENT AND FORMAT

Baseline Hierarchy and Content per GEIA-HB-649

The product baseline shown in the shaded area was excluded from this -649 example.

General Configuration Baseline Hierarchy

Baseline Name	Baseline Definition	Baseline Content	When Created
Functional Baseline	Top-Level Performance Umbrella requirements providing basis for development of systems, lower level products, assessing top-level performance and interface impacts of changes.	<ul style="list-style-type: none"> Overall product purpose Major product capabilities Major interfaces Support and user skill constraints Regulatory constraints 	Conception Phase
Allocated Baseline	Component-Level Performance Basis for development, test and audit of individual products, assessing component-level performance and impact of proposed changes on interfaces.	<ul style="list-style-type: none"> Detailed performance Required interfaces Safety and mandatory verifications Functionality description Test specification 	Definition Phase
Design Baseline	Component-Level Design Basis for building and accepting manufactured units and assessing design impacts of changes.	<ul style="list-style-type: none"> Detailed design information <ul style="list-style-type: none"> - drawings - digital graphics files - acceptance criteria 	Design Phase
Product Baseline	Production Ready	<ul style="list-style-type: none"> Manufacturing processes 	Design & Build Phase

Baseline Content and Format per CM2

CM2 Baselines are provided in an as-planned/as-released format which fully define the current configuration and include visibility of planned changes and their effectivities. Each development team member needs to know the status of each design basis dataset (latest version plus planned changes).

Appropriate visibility can be provided by a CM2 Baseline.

Development personnel are also reluctant to release a dataset that could be misused by the supply chain.

With CM2, potential misuse is not an issue since the application of design basis datasets is controlled by the cross-functional team.

CM2 Baseline											
ID No.		1122		Date		06/Nov/yy					
Items				Datasets					Changes		
Hierarchy & Quantity	Number	Name	TYPE	Num.	Rev	Rel. Date	Eff. Date	CN	A/D	Effectivity	CN
0	1122	WT22 Model	LR	1122	A	01/Nov/yy	05/Nov/yy	3200			
			CM	1122	A	01/Nov/yy	05/Nov/yy	3200	D	01/Dec/yy	4100
			CM	1122	B	20/Nov/yy	01/Dec/yy		A	01/Dec/yy	4100
1	9012	Wind Turbine	FS	9012	A	02/Nov/yy	05/Nov/yy	3200	D	10/Nov/yy	3300
			FS	9012	B	07/Nov/yy	10/Nov/yy		A	10/Nov/yy	3300
			FS	9012	C	25/Nov/yy	01/Dec/yy		A	01/Dec/yy	4100
			SS	9012	A	03/Nov/yy	05/Nov/yy	3200	D	10/Nov/yy	3300
			SS	9012	B	08/Nov/yy	10/Nov/yy		A	10/Nov/yy	3300
			SS	9012	C	30/Nov/yy	01/Dec/yy		A	01/Dec/yy	4100
			3D	9012	A	04/Nov/yy	05/Nov/yy	3200	D	10/Nov/yy	3300
			3D	9012	B	09/Nov/yy	10/Nov/yy		A	10/Nov/yy	3300
			PV	9012	A	05/Nov/yy	05/Nov/yy	3200	D	10/Nov/yy	3300
PV	9012	B	10/Nov/yy	10/Nov/yy		A	10/Nov/yy	3300			

LR = Laws & Regulations FS = Functional Specification SS = System Schematics
 CM = Contractual & Market 3D = 3D Model PV = Process Views

THE MISSING LINK: BILLS OF MATERIAL

From the 1960s to about 1998, military standards were the only source for CM requirements and implementation "how-to's." Product structures were defined with specification trees, drawing trees, parts lists, and/or work breakdown structures, but not bills of material.

Scheduling tools such as MRP/ERP, introduced in the 1970s, have a very robust bill of material module. PLM tools, as introduced in 2000, also have a robust BOM module. Manufacturing engineers are very proficient at using bills of material to create product structures/physical item hierarchies. Such hierarchies are used in the CM2 model as the framework for product baselines.

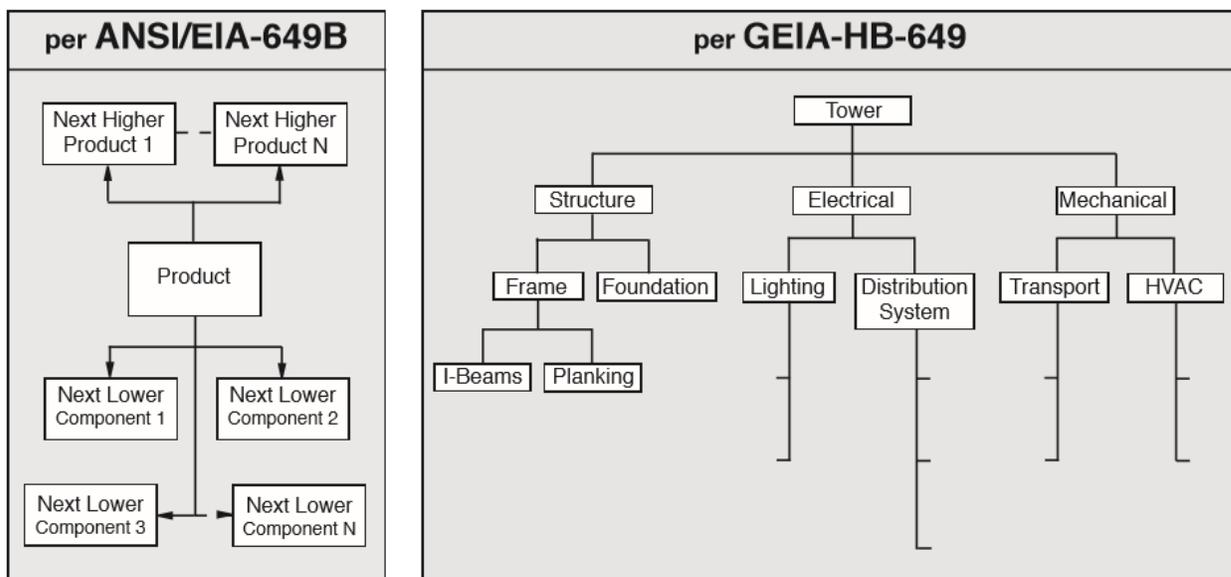
Bills of Material in the CM Standard and Implementation Guides

The "bill of material" term appears in ANSI/EIA-649B as an alias for product structure on page 9 and appears again under Product Structure on page 25 in Section 5.2.3. It includes the diagram shown below on the left. The term is not used in ISO 10007.

The "bill of material" term appears only once in GEIA-HB-649 and once in MIL-HDBK-61B, but there is no accompanying information. GEIA-HB-649 uses "product structure" as the title for Section 5.2.2 and includes the diagram shown below on the right.

These examples are not compliant with the CM2 model. They do not provide the appropriate framework for a product baseline. They are not appropriate for driving the supply chain. A properly structured bill of material, as used in the CM2 model, is shown on page 14.

Examples of Product Structure



CM2-500 STANDARD

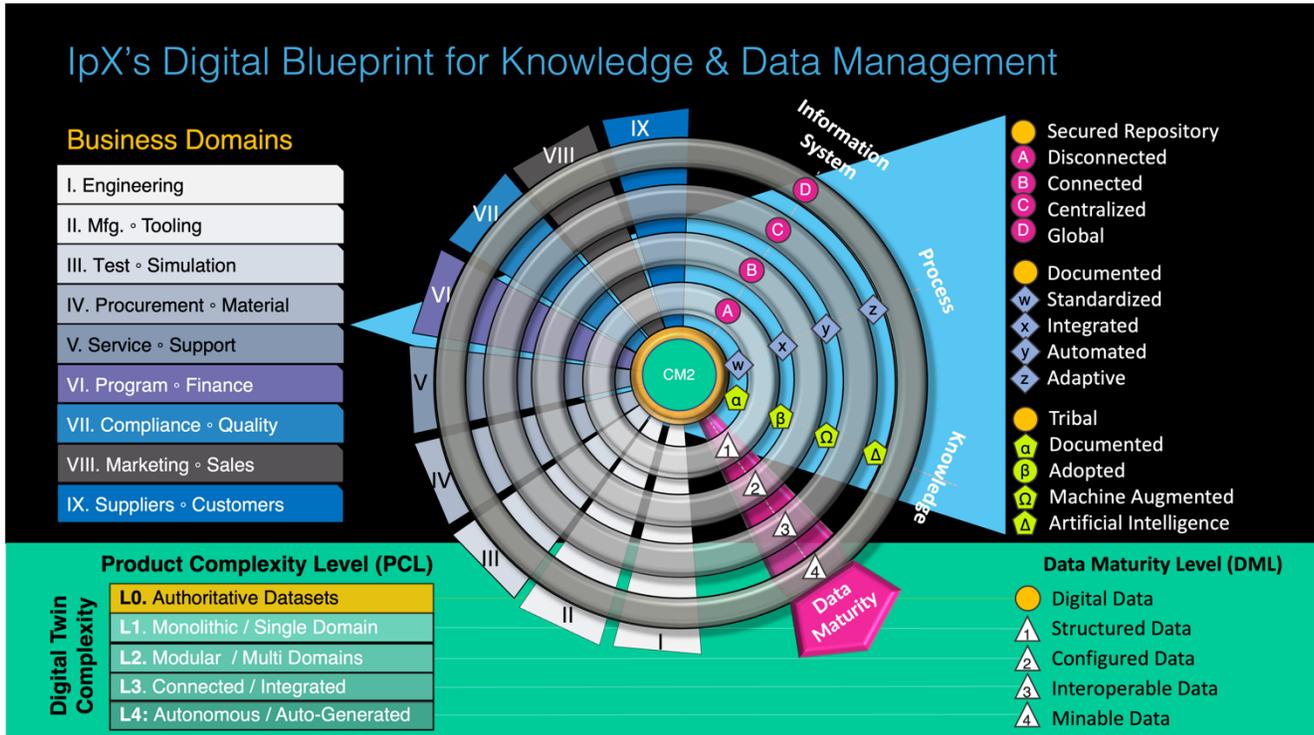
The CM2 Model is comprised of 19 core business process categories. The power of the CM2 Model comes from its business process infrastructure which includes the Strategic Business Plan and process categories 1.0 through 8.0. Categories 1.0 through 7.0 reside in the domain of CM and provide the ability to accommodate change and keep requirements clear, concise, and valid.

Categories 1.0 through 8.0 also provide the infrastructure for categories 9.0 through 19.0. The core business process owners are a cross-functional team that is responsible for continuous process improvement.

Business Process Infrastructure and Other Core Business Processes			Process Owner
Business Process Infrastructure	1.0	CM2 Baselines	CM per CM2
	2.0	CM2 Development Process (4 Tier, 8 Step)	
	3.0	Naming, Numbering and Reuse	
	4.0	Data and Record Integrity	
	5.0	Dataset Validation and Release Record	
	6.0	CM2 Change Process	
	7.0	As-Built Records	
	8.0	Enabling Software Tools	
Other Core Business Processes	9.0	Facilities and Asset Management	
	10.0	Security, Safety and Environmental	
	11.0	Program Management	
	12.0	Engineering Research and Development	
	13.0	Marketing, Sales and Contracts	
	14.0	Supply Chain Management	
	15.0	Order Fulfillment and Verification	
	16.0	Integrated Logistics Support (ILS)	
	17.0	Human Resources and Workforce Development	
	18.0	Financial Accounting and Reporting	
	19.0	Process Oversight and Internal Audit	

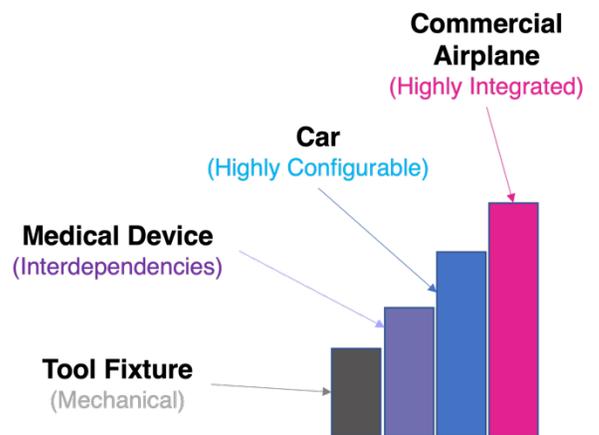
Assessing Your CM Process, Its Effectiveness, and Its Value

This white paper has highlighted areas in the CM standard and implementation guides that are cumbersome and inefficient. Significant improvements are readily available. It is simply a matter of replacing the CM implementation guides with the CM2 model. The organizational alignment in a growing business eventually evolves into a matrix of core business processes and business programs. A core business process is a functional activity which supports all business programs. Core business process members may be fully allocated to specific business segments or support multiple segments.



The Level of Configuration and Data Management (CMDM) Rigor and Formality Increases with the Product Complexity Level (PCL). Product Complexity is dependent upon the following key elements:

- Level of Integration across Domains (Increases with the number of Cross Systems Dependencies)
- Level of Configuration and Customization (Increases with number of possible variations)
- The Impact of Malfunctions on Public Safety or the Environment (Increases with Severity of Impacts) An organization must decide what its core processes are and how they should be aligned to most efficiently achieve overall objectives.



CMDM Rigor Requirements
Configuration and Data Management Processes must Support Product Complexity

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