

Multi-view BOM Value Potential

CIMdata 2022 PLM Market & Industry Forum

Multi-view BOM Value Potential
PLM Market & Industry Forum
A CIMdata PLM Leadership Event
6 April 2022

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Strategic management consulting for competitive advantage in global markets

CIMdata is the leading independent global strategic management consulting and research authority focused exclusively on PLM and the digital transformation it enables.

We are dedicated to maximizing our clients' ability to design, deliver, and support innovative products and services through the application of PLM.

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Key Takeaways

Multi-view BOM Value Potential – 2022 CIMdata PLM Market & Industry Forum

- The Multi-view Approach for implementation of eBOM, mBOM and related product lifecycle structures, is core to the concept of Digital Thread
- With recent advances in PLM technology, enablement of the Multi-view Approach has become technically possible, including for industries producing complex products, such as automotive, aerospace and high tech
- Industry implementations are only now starting to roll out and go live, so there is not much available in the way of lessons learned or actual value realized
- This presentation describes several case studies and the expected business value identified by industry leaders making early investments in multiple-view bill of materials solutions

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Agenda

Multi-view BOM Value Potential

- Concepts
- Basis of Value
- Technology Validation – Multi-view BOM Solution Evaluation Benchmarks
- Case Studies
- Business Opportunity
- Conclusion
- To Learn More

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Concepts

Digital Thread = Multiple views of product structure with traceability through the product lifecycle

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Concepts

Connections between the four principal product structure configurations – Thread vs. Web

Product Lifecycle Timeline Sequence (Thread)

Derivative Dependencies (Web)

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Concepts

Lifecycle Product Structures

Product structure is the organizing construct for all information that defines and is associated with the product definition throughout its lifecycle. There are many views by which this structure can be configured:

- Requirements view
- Functional and logical views
- Engineering view (i.e., eBOM)
- Test and validation view
- Purchasing view
- Manufacturing view (i.e., mBOM)
- Service view (i.e., sBOM)
- Sales view

and many others, including simulation and test views, as built and inspected views

On each of these configurations is hung the information needed by the owning business area to perform its role within the overall product program lifecycle



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Basis of Value

Purpose of multiple BOMs is to optimize key product program processes

1. Development and definition of an optimized product design
2. Validation and certification of the product design
3. Development and definition of optimized production, support and other enabling systems
4. Definition of a specific product as ordered and tracking the definition of that product instance as it is built and supported
5. Reconfiguration and reuse of product and enabling systems designs

An eBOM enables #s 1, 2 and 5

An mBOM and sBOM enable #s 3 and 4



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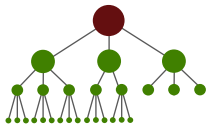
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Basis of Value

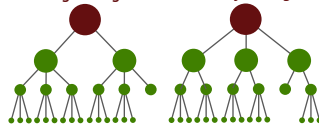
BOM Management Concepts – Three approaches to managing the transition of BOM definition

Single BOM Approach
A common data organization for Engineering and Manufacturing
Engineering = Manufacturing



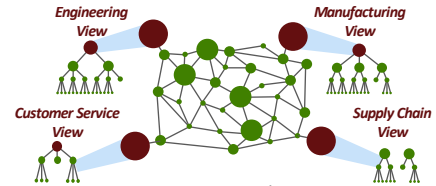
- Engineering content structured in Manufacturing view and augmented with Manufacturing content
- Single authority for release and change
- Unambiguous, single definition (i.e., reconciliation and synchronization are not an issue)
- No Engineering view
- Manufacturing change is slow and costly

Dual BOM Approach
Two separate data organizations for Engineering and Manufacturing
Engineering ≈ Manufacturing



- Engineering content and structure maintained; restructured and augmented for Manufacturing
- Independent authorities for release and change
- Engineering and Manufacturing optimized views
- Manufacturing change is timely and efficient
- Manual reconciliation
- Manual synchronization

Multi-view Approach



- Engineering content and structure maintained; restructured and augmented for Manufacturing
- Independent authorities for release and change
- Engineering and Manufacturing optimized views
- Manufacturing change is timely and efficient
- Automated reconciliation
- Automated synchronization
- Extensible to additional domains

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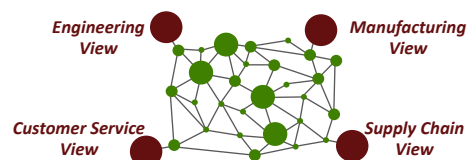
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Basis of Value

Potential benefits of automatic reconciliation and synchronization across lifecycle views are many & substantial

- Elimination of time and effort for reconciliation and synchronization of eBOM, mBOM and sBOM
- Reduction of cost and quality issues due to inaccurate data
- Elimination of time and effort to validate data which is not trusted
- Reduction in lead time and increase in efficiency and quality of supplier collaboration resulting from trusted data
- Increase in efficiency and quality of production resulting from timely processing of manufacturing requested changes

Multi-view Approach



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Multi-view BOM Solution Evaluation Benchmarks

Aerospace & Defense PLM Action Group – Founded in February 2014

Mission

An association of aerospace & defense companies within CIMdata's globally recognized PLM Community Program, which functions as a **PLM advocacy group** to:

- Set the direction for the aerospace & defense industry on PLM-related topics that matter to members
- Promote common industry PLM processes and practices
- Define requirements for common interest PLM-related capabilities
- Communicate with a unified voice to PLM solution providers
- Sponsor collaborative PLM research on member-prioritized industry and technology topics

Website: www.ad-pag.com

Members



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Multi-view BOM Solution Evaluation Benchmarks

Stage four of a multi-year A&D PLM Action Group project workstream

Over several years, project work progressed through defined stages

1. Problem statement
2. Desired state
3. Requirements

Over this same period, commercial PLM solutions had advanced to a level where enablement of the Multi-view BOM Approach might be achievable

The question on the table in the spring of 2019 was whether commercial PLM technologies had matured to a level where implementation of Multi-view BOM management within an aerospace OEM would be a practical possibility

Determining the answer to that question was the goal of the Multi-view BOM Solution Evaluation Benchmarks

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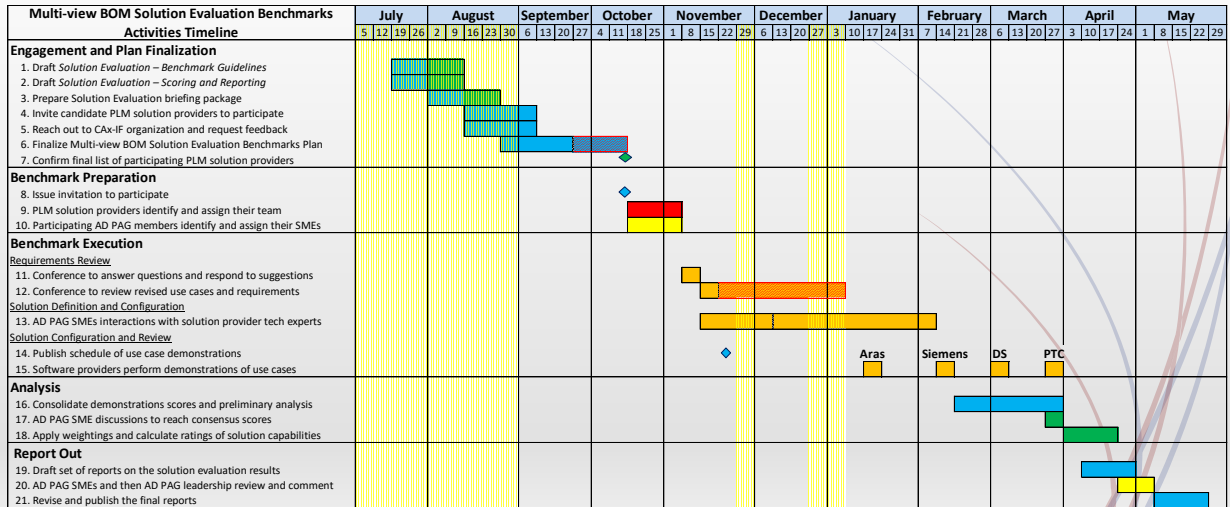
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Multi-view BOM Solution Evaluation Benchmarks

Activities timeline



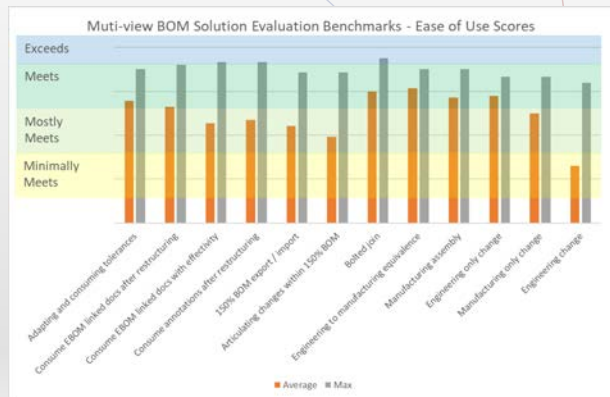
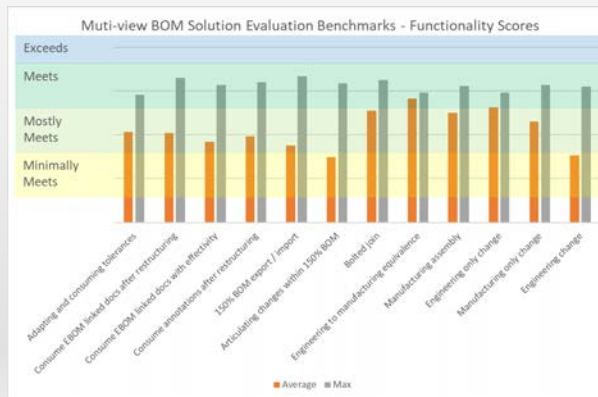
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Multi-view BOM Solution Evaluation Benchmarks

Results - A significant verification of the digital thread capabilities of commercial PLM technology

- A&D OEM Multi-view BOM management requirements were met or mostly met by multiple commercially available PLM software solutions
- Usability of commercially available PLM software solutions' Multi-view BOM management capabilities will not inhibit adoption or efficiency



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Example 1: Heavy Equipment & Support Packages

Business situation

Problem Statement

- The company engineers and manufactures heavy equipment
- An order may be for moderate to large volumes of these items which may be of multiple configurations, and since the equipment is expensive and lasts for a long time, they also sell complex support packages
- Preparing proposals was a major problem – very slow, error prone, high dependence on tribal knowledge
- In addition to expense and risk, they were leaving money on the table

Goal

- Improve speed, efficiency and accuracy of proposal preparation



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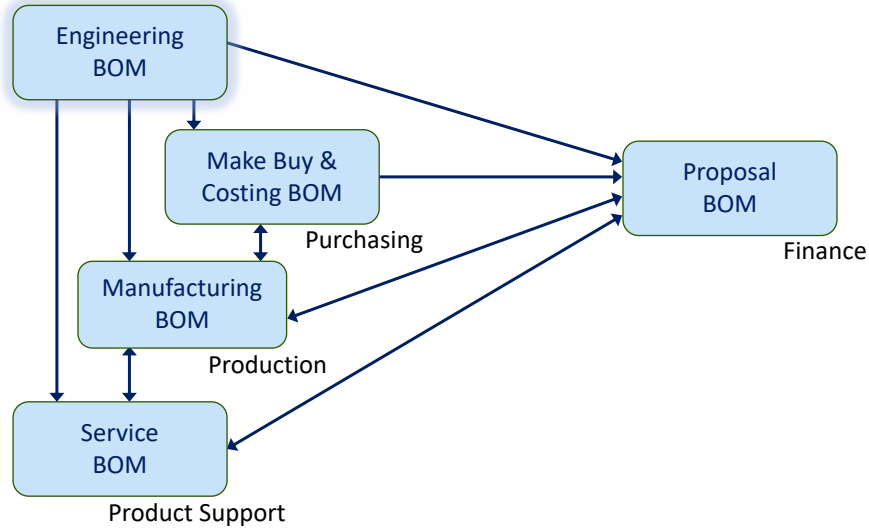
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Example 1: Heavy Equipment & Support Packages

Scope



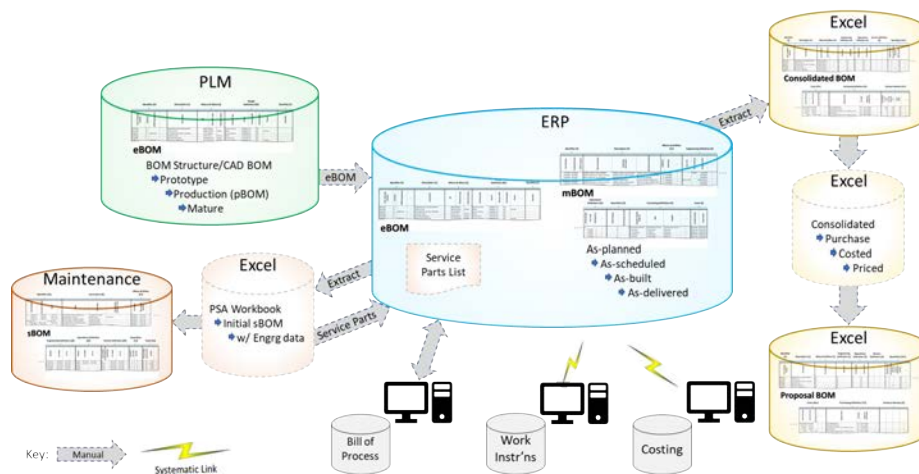
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Example 1: Heavy Equipment & Support Packages

Initial state



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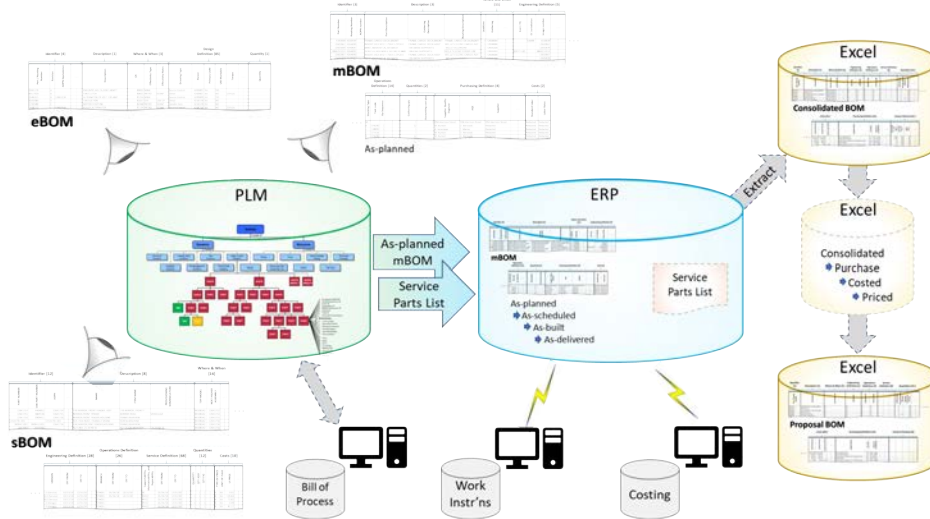
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Example 1: Heavy Equipment & Support Packages

Future state – step 1



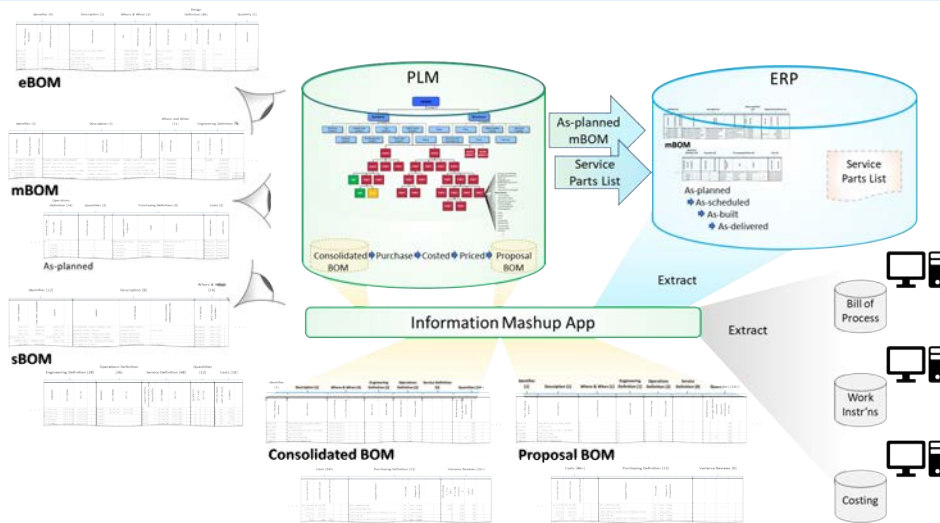
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Example 1: Heavy Equipment & Support Packages

Future state – step 2



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Example 1: Heavy Equipment & Support Packages

Business value – Select benefits

- Reduced turnaround and increased accuracy of proposals for all types of business opportunities
 - Large orders of complex products with variants
 - Orders for products in development
 - Orders for products in production
- Dramatic reduction in level of effort and disruption of normal staff activity to verify product configurations as needed for proposal pricing
- Ability to define service configurations more quickly and accurately
- Improved visibility into as-planned, as-built and as-delivered configurations
- Improved visibility of changes made for production improvements while retaining efficiency and flexibility in processing those changes
- Improved product cost and reliability from closed loop service feedback to product engineering



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Example 2: Specialty High Tech Equipment

Business situation

Problem Statement

- This company is very successful at what they do, but as they looked to the future, they saw limitations with their current practice
- They managed their product configuration with a single bill of materials, a manufacturing BOM

Goal

- They believed – correctly – that if they introduced an engineering BOM they could achieve two goals
 1. Improve efficiency of release to manufacture
 2. Increase design reuse



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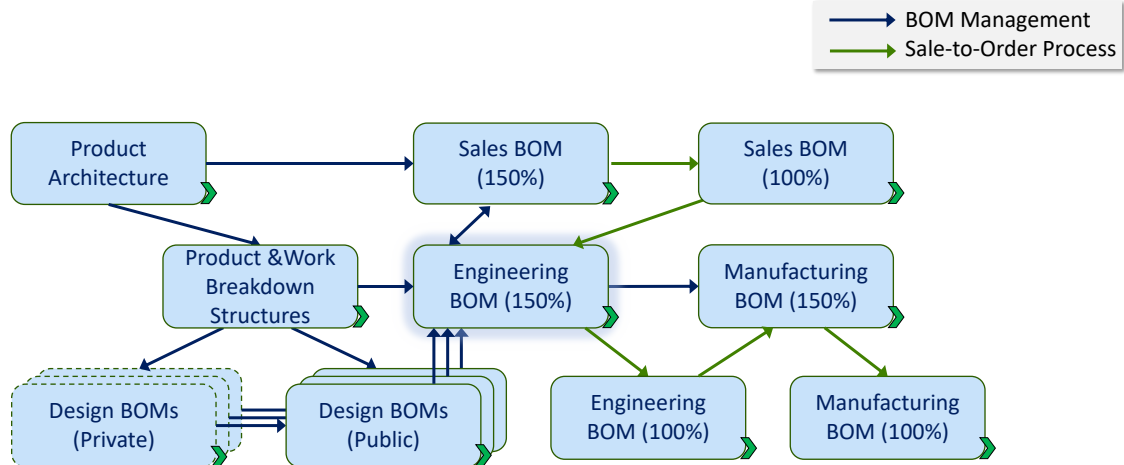
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Example 2: Specialty High Tech Equipment

Scope



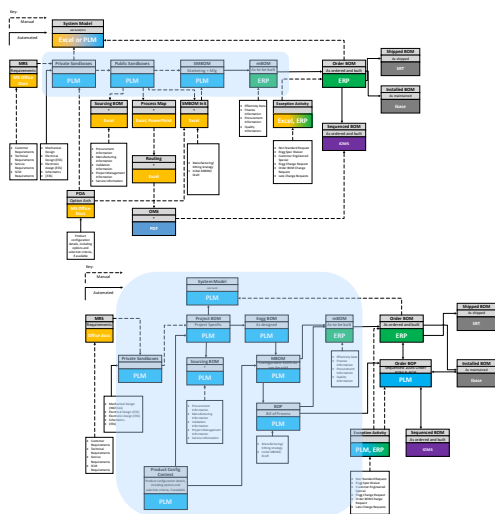
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Example 2: Specialty High Tech Equipment

Solution transformation



Initial State

Central to this solution is the manual harvesting of design information from design team shared workspaces into a sales/manufacturing BOM (s/mBOM), all within the PLM, and direct integration of the s/mBOM in the PLM to the As-to-be-built manufacturing BOM (mBOM) in the ERP

Future State

In several phases over several years

- Four BOMs will be implemented and integrated within the PLM
 - Project BOM
 - eBOM
 - mBOM
 - Order BOM
- Many additional BOMs will be elevated from an ad hoc status to be integrated within a managed and automated lifecycle information flow

■ PLM ■ ERP ■ Ad Hoc

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Example 2: Specialty High Tech Equipment

Business value – Select benefits

- A single source of truth in the 150% and 100% eBOM will reduce search time and improve confidence that correct reference data is used, speeding processes and improving quality
- Data quality will be improved as Design Engineers will manage eBOM, Manufacturing Engineers will manage mBOM and downstream structures
- Decoupling eBOM/mBOM will reduce need for ad hoc communication and speed up manufacturing changes
- The PLM-native program management solution will enable associating deliverables to activities, and reporting will highlight missing or late deliverables, enabling mitigation
- Formality of lifecycle state within eBOM will reduce Manufacturing and Service Engineering uncertainty
- The mBOM can be created in parallel to the eBOM shortening timelines and providing early validation of eBOM content and manufacturability
- DfX processes and simulations can be run on the eBOM improving product quality



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Example 3: Medical Devices

Business situation

Problem Statement

- A critical issue when designing, engineering, manufacturing, and servicing complex products subject to stringent regulatory requirements is the relationship between various product configurations and Bills of Materials (BOMs) used in the Engineering, Manufacturing, and Servicing sections of their company
- Growing recognition of persistent pain points—points of friction, complexity, or instability – that erode the productivity and quality of product information flow through the lifecycle

Goal

- Redefine configuration management (CM) strategy and associated enabling platform to
 - Address the engineering and manufacturing views, and
 - Include upstream and downstream views of product BOMs, such as Sales, Support and Services
 - In support of a growing and complex product mix within an extremely competitive market

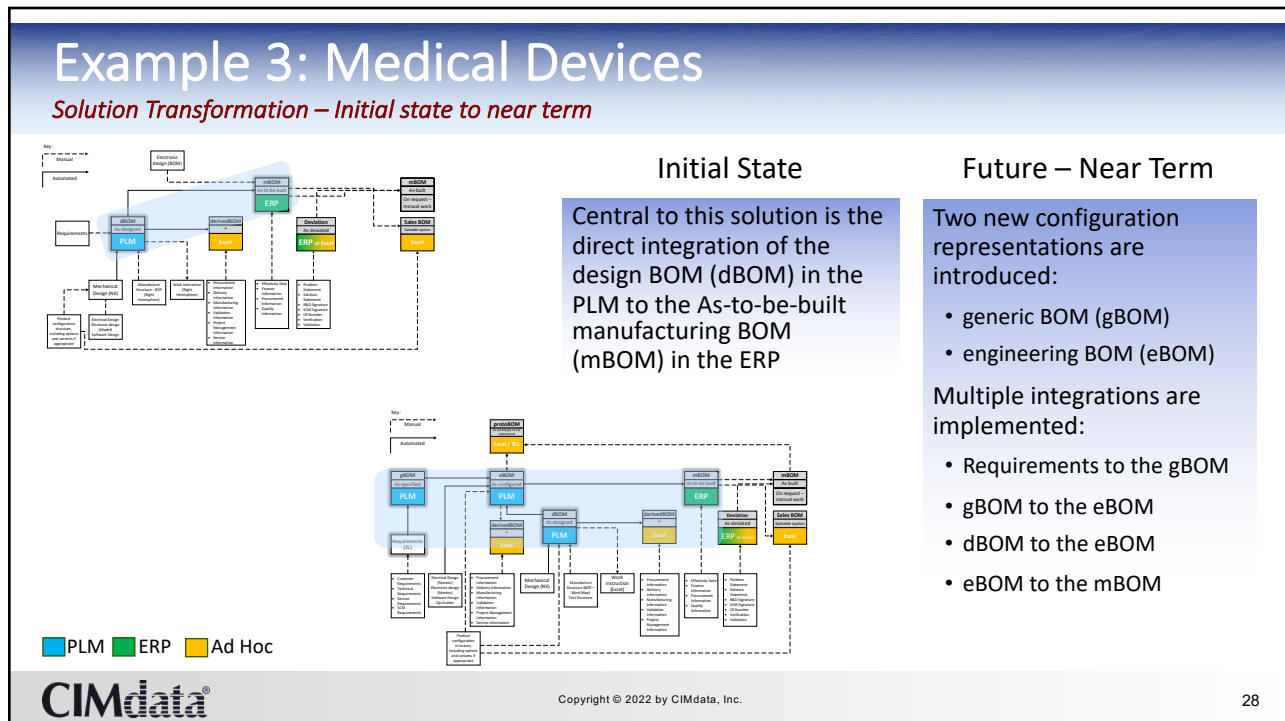
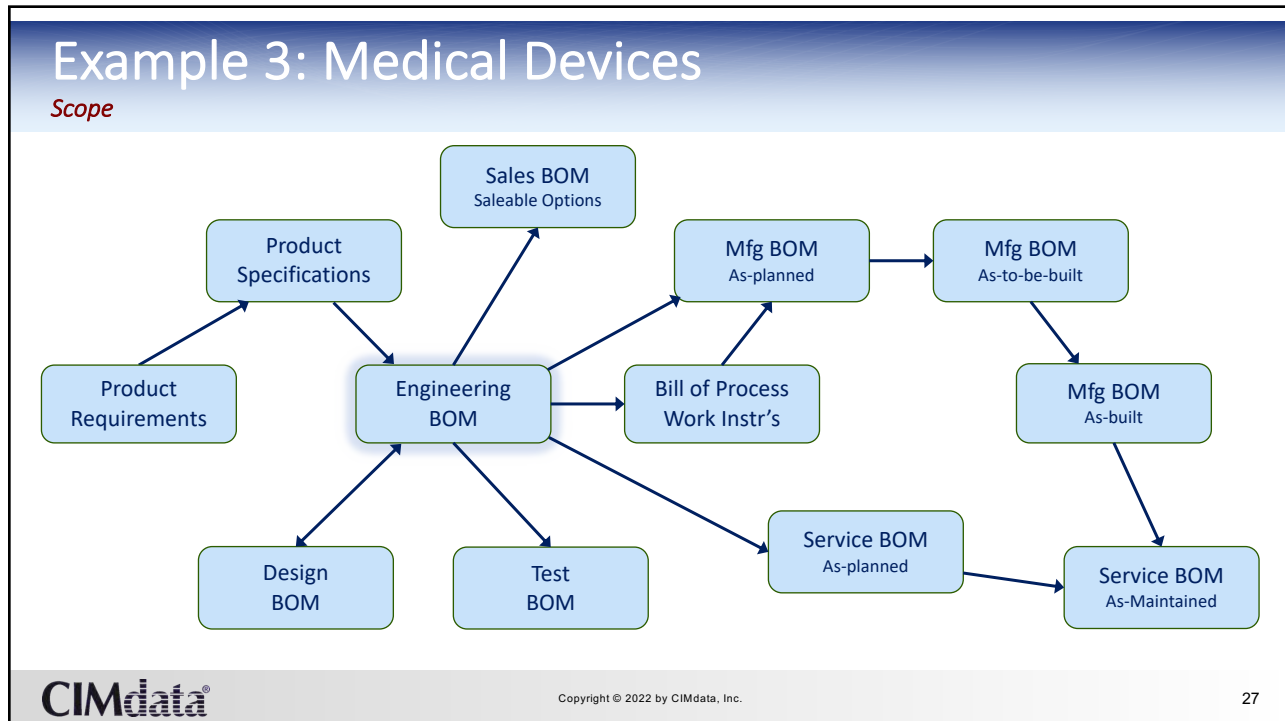


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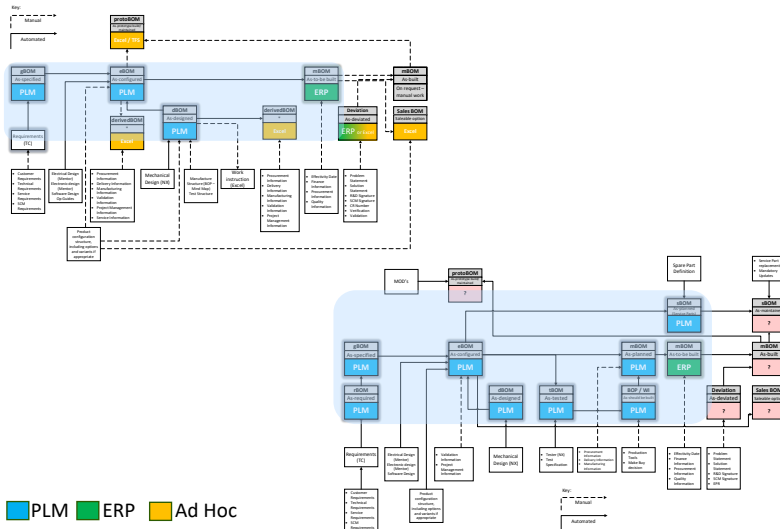


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Example 3: Medical Devices

Solution transformation – Near term to long term



Future – Long Term

In several phases over several years

- Process and organization dimensions of eBOM/mBOM will be implemented
- Five additional BOMs will be implemented and integrated with the gBOM and eBOM within the PLM
- Many additional product structures will be elevated from an ad hoc status to be integrated within a managed and automated lifecycle information flow

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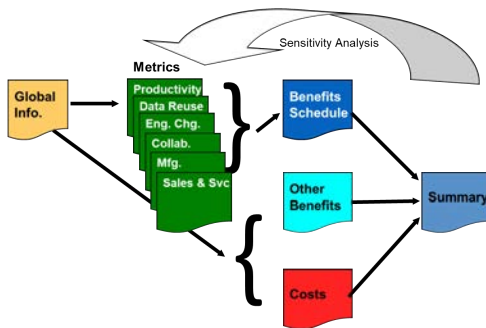
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Example 3: Medical Devices

Business value – Estimates are much lower than normal industry experience

Process Overview



CIMdata Observations

- Far fewer benefits claimed, and those claimed were lower than CIMdata normally sees from other similar companies
- There were several contributing factors
 - Linkage not established between strategic business objectives and the business transformation that would be enabled by a Lifecycle CM Program
 - The user community not formally surveyed to assess current state issues and opportunities
 - The BOM Management team deployed a partial eBOM/mBOM solution and received user feedback of increased workload without perceived benefit
 - Lifecycle CM concepts were new within the company and an understanding of value was only beginning to develop

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Example 4: Aerospace OEM

Business value – Select benefits

Benefit	Rationale	Type	Impact
Reduce Manufacturing Engineering effort to release Manufacturing parts, assemblies and routings	Currently, Product Engineering releases all parts, assemblies and routings developed by Manufacturing Engineering Manufacturing Engineering spends 20 hrs/PN to prepare and follow up on the request for release In the future, this work will be done by Manufacturing Engineering, and they expect to spend 25% less time than Product Engineering to process the release	Cost	25% during Development 25% during Production
Reduce Manufacturing Engineering effort to resolve plant production issues	Autonomy of Manufacturing Engineering results in flexibility, efficiency and speed in resolving plant production issues Currently, Product Engineering processes changes requested by Manufacturing Engineering Manufacturing Engineering spends 20 hrs/request to prepare and follow up on the change request In the future, this work will be done by Manufacturing Engineering, and they expect to spend 50% less time than Product Engineering to process the change	Cost	50%
Increase speed and more thoroughly address plant production issues	Currently, Product Engineering processes only 70% of changes requested by Manufacturing Engineering to resolve plant production issues and spends 40 days elapsed time to process each request In the future, this work will be done by Manufacturing Engineering. They will process 100% of requests and expect to spend 75% less elapsed time than Product Engineering per request	Schedule	2-10% reduction in build schedule
		Quality	2-10% reduction in build quality issues
Increase efficiency in resolving customer service issues	Autonomy of Services Engineering results in flexibility, efficiency and speed in resolving customer service issues Results is accelerated time to market and increased quality of customer service	Schedule	2-10% in customer issue response time

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Business Opportunity

Engage with industrial clients to deliver Multi-view BOM transformations

- Establishment of Multi-view BOM methods within any industrial company, large or small, is, for them, a major transformation of processes, roles and enabling technology
- Critical high-value solution provider capabilities include
 - Vision and to-be solution definition
 - Value driven implementation roadmap definition
 - Holistic transformation planning and management
 - Enabling technology development and implementation support
- For technology and/or service providers with the right engagement model and capabilities to assist with such transformations, the opportunities to deliver value and reap financial rewards are substantial

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Concluding Remarks

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- The Multi-view Approach for implementation of eBOM, mBOM and related product lifecycle structures, is core to the concept of Digital Thread
- With recent advances in PLM technology, enablement of the Multi-view Approach has become technically possible, including for industries producing complex products, such as automotive, aerospace and high tech
- Industry implementations are only now starting to roll out and go live, so there is not much available in the way of lessons learned or actual value realized
- In this presentation CIMdata has described several case studies and the expected business value identified by industry leaders making early investments in multiple-view bill of materials solutions



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To Learn More...

- Access A&D PLM Action Group resources at www.ad-pag.com
 - Multiple View Bill of Materials (BOM) Solution Evaluation Benchmarks, report, Jul 2020
 - Multiple View Bill of Materials, position paper, Feb 2019
 - *Problem Statement, Desired State, and Requirements*
 - *Appendix A: Glossary*
 - *Appendix B: Concept Definition and Use Cases*
- Access CIMdata resources at www.CIMdata.com
 - Why an mBOM Alone Isn't Sufficient, webinar, Oct 2021
 - The Digital Thread is Really a Web, with the Engineering Bill of Materials at Its Center, webinar, Sep 2021
 - Making Multi-view BOM a Reality, webinar, Mar 2020
- Contact for further discussion
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