BOM Management Buyer's Guide

Enable Digital Transformation with Digital BOMs

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Introducing the Buyer's Guide

Managing Bills of Material (BOMs) is a fundamental need for any manufacturer. Without effective control of product structures, companies struggle with inefficiency and errors. On the other hand, improving the maturity of BOM-related processes helps manage complexity, improve efficiency, prevent mistakes, and enhance collaboration across departments and the supply chain. The resulting benefits can be strategic, leading to increased agility and faster time to market that impact top-line financial performance. Beyond improving today's performance, driving better BOM management creates the foundation for even greater improvements as a step toward the digital enterprise.

Improving the maturity of BOM-related processes helps to manage complexity, improve efficiency, prevent mistakes, and enhances collaboration across departments and the supply chain.

This Buyer's Guide is a reference tool for manufacturers selecting a system to improve the maturity of their BOM management practices. The guide is composed of sections covering software, service, and vendor requirements plus some special considerations.

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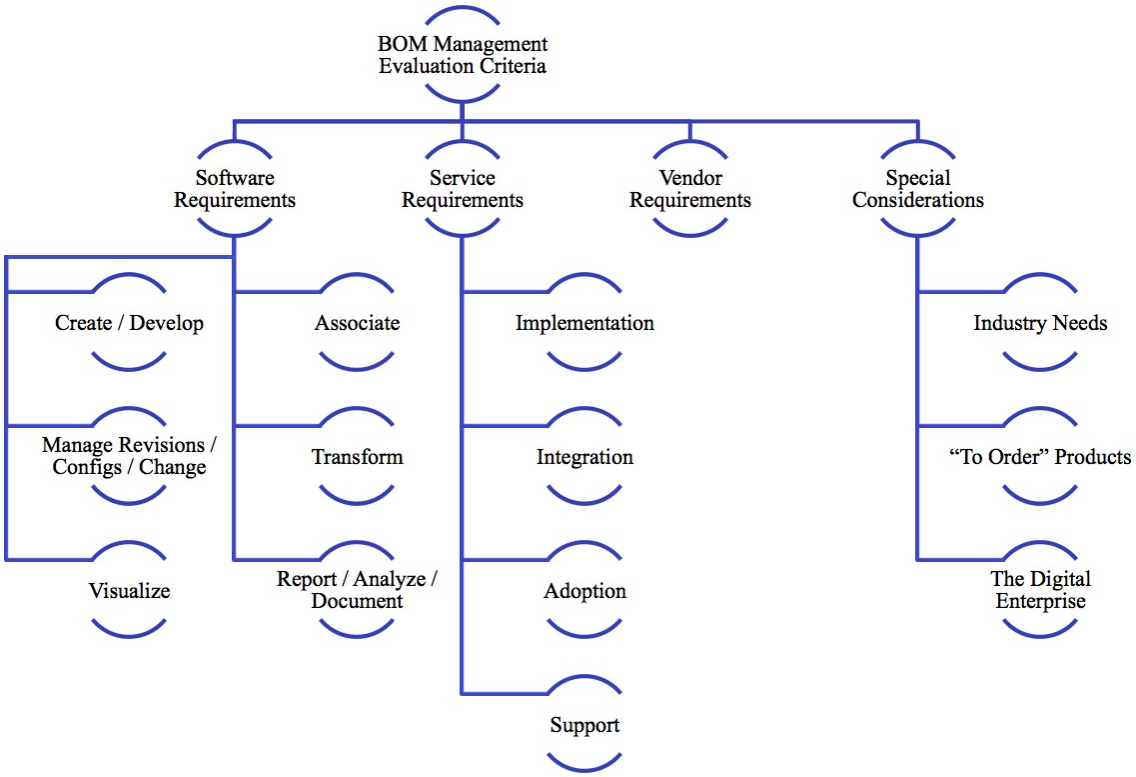

Figure 1: BOM Management Evaluation Framework

some special considerations. These are all important factors that impact implementation success and ROI.

Each of these sections includes a checklist with key requirements to investigate when selecting software to enable and improve BOM management. The guide also touches on special considerations for companies with "to order" products and a few special considerations to keep an eye on by industry. It also shares that digital BOM management is critical to support digital transformation initiatives including the digital twin, the Internet of Things (IoT), Virtual Reality (VR), and Augmented Reality (AR).

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Diagnosing BOM Management Issues

Many companies operate with ineffective and immature BOM management processes without recognizing what it costs them in poor efficiency, excess cost, and lost time. Let's review some common problems in manufacturing that can be tied back to poor BOM management. As Mark Mitchell, Senior Manager of PLM for manufacturing solutions provider Jabil, explains, "Traditional BOM management processes, like putting BOMs on manufacturing drawings, lead to errors, delays, scrap, rework, and quality issues."

Companies suffer from costly issues without recognizing the root cause is poor BOM and configuration management.

Ineffective BOM management manifests itself in many ways, including:

- Errors in manufacturing
- Poor first pass yield
- Ordering the wrong parts
- Delays due to part shortages
- Inability to confidently adopt engineering changes
- Slow time to full volume production
- Late identification of manufacturability or serviceability flaws
- Poor traceability
- Compliance issues or excess effort to comply
- Scrap and rework
- Slow review and approval processes
- More…

These BOM-related challenges result in delayed time to market, quality problems, poor productivity, and excess cost. They can also damage customer relationships. But all too frequently, companies suffer from costly issues without recognizing the root cause is poor BOM and configuration management. Let's look at how this happens. Companies simply can't afford these problems in this time where they need to innovate rapidly despite rising complexity!

The BOM Management Status Quo

Why does poor BOM management lead to so many issues? Today, many companies manage BOMs through methods that aren't enterprise ready, including documents, spreadsheets, or embedding the BOM into CAD drawings. These approaches lead to negative consequences because there isn't a single place to find current, accurate BOM information. "A lot of our BOMs are on drawings because we can control drawings," explains Paul Scroggins, PLM Architect of appliance manufacturer, Whirlpool. "But that's very hard to maintain, it's not visible, and it's nearly impossible to search."

Many companies manage BOMs through methods that aren't enterprise ready, including documents, spreadsheets, or embedding the BOM into CAD drawings.

Further, the BOM can't be locked up in Engineering. Downstream departments including Sourcing, Quality, and Manufacturing need accurate BOM information. Managing the BOM on the drawing doesn't allow others to access product data until the drawings are released, when it's too late. Instead, they should have access to the latest information and the knowledge of the current state of release. Early visibility enables concurrent design for manufacturing processes, service procedures, product documentation, sales collateral, and more.

Some companies try to provide downstream access to product structures in ad-hoc ways such as emailing spreadsheets. These informal methods inevitably lead to inaccurate data and multiple, conflicting versions. This leads people to make errors and bad decisions because they're working on the wrong data.

Because the data is developed in an Engineering-centric view, many departments will copy the data into their own spreadsheets or systems, compounding the problem. As Mr. Scroggins of Whirlpool shares, this "leads to data errors from translation." In addition, the information isn't easily refreshed as designs mature or engineering changes are made. This is part of the reason that our Reducing Non-Value Added Work in Engineering research shows that engineers work on outdated data 20% of the time, on average.

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The BOM Management Business Case

Now that we've identified some of the issues caused by poor processes, let's discuss the significant improvements that can be made by digitizing BOM management with best practice processes. First and foremost, it helps alleviate the issues reported above. "The

result for Jabil is a single source of truth, in a common environment, with standard global processes," shares Mark Mitchell. "*It took away a lot of manual touch labor so we're getting things done quicker and getting to market faster. The result is lower overall costs and higher profitability*."

Mature BOM management capabilities are also the foundation for significant additional business value. For example, having a digital BOM in place is critical to supporting a model-based enterprise (MBE) strategy. It's also the foundation for numerous digital enterprise improvements including AR, VR, and IoT.

Despite the value, many companies don't develop a formal ROI to justify their projects. They recognize it's a basic, fundamental capability for a manufacturer. "Our need for a global where-used was the biggest driver for our BOM initiative," recalls Whirlpool's Scroggins. "We wanted global visibility and the ability to design and build anywhere, but we didn't feel the need to develop an extensive business case. There was a belief that is was the right thing to do."

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Mark Mitchell
Sr Manager of PLM
JABIL

Analyze BOM Management Solution Capabilities

Perhaps the most obvious place to start when evaluating new software solutions is functionality. This section covers multiple types and uses of product structures, including Engineering BOMs (EBOM), Manufacturing BOMs (MBOM), Service BOMs (SBOM), and others such as those used for simulation or compliance analysis. For the purposes of this analysis, we've broken BOM management into six main focus areas:

- Develop Product Structures
- Manage Revisions, Configurations, Change
- Visualize Products
- Associate Information
- Transform BOMs
- Report / Analyze / Document

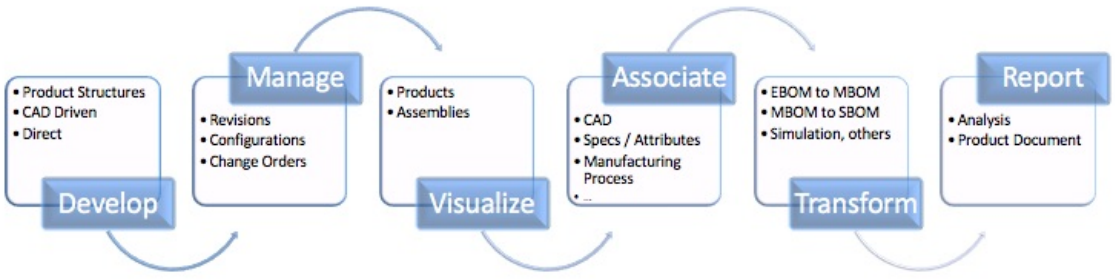
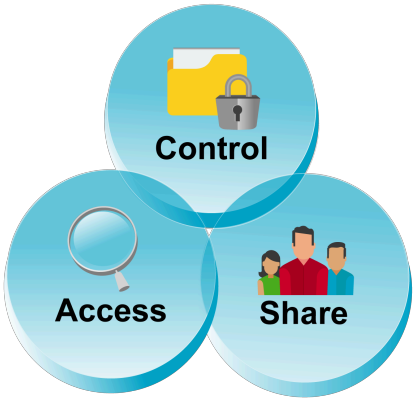


Figure 2: BOM Management Framework

It's important to recognize that these requirements are *in addition to* the basic needs of managing product data, as most companies will extend their PDM or PLM environment to manage BOMs. These solutions provide platform capabilities such as access control and IP protection that serve as a critical foundation for effective BOM management. These basic capabilities for managing data can be found in our PDM Buyer's Guide and include controlling, accessing, and sharing product data:

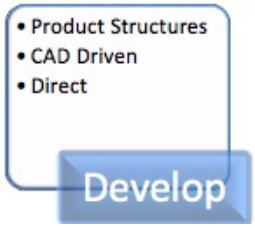
- Control and secure product-related data
- Quickly find and reuse information
- Share product knowledge with other departments (and beyond enterprise boundaries)



PDM or PLM provides platform capabilities that serve as a critical foundation for effective BOM management.

It's important to note that for each section we highlight some key features companies should look for when evaluating a solution. This guide is not intended to provide an exhaustive list of requirements. For example, this Buyer's Guide doesn't explain the detailed need for quantities, units of measure, decimal precision, or other basics. Instead, it focuses on business needs that are likely to impact the effective implementation and use of the systems being evaluated.

Create / Develop Product Structures



Perhaps the obvious place to start is with the ability to define BOMs. It's important to be able to easily develop product structures of different kinds, including EBOMs, MBOMs, and more. We'll discuss these in more depth in the "Transform" subsection.

Clearly, a user should be able to enter a BOM manually from a screen by selecting a combination of materials, components, or lower level assemblies. Systems should also be able to accept and validate an input file, for example a spreadsheet or XML file, to import / upload BOMs from another system or in a "mass load" scenario. Finally, the system should be able to automate the development of BOMs from underlying engineering tools when applicable for efficiency and to prevent manual transcription errors, also known as the "bottom up" approach.

The most complex scenario is the creation from a Computer Aided Design (CAD) tool. This scenario requires the BOM management solution to digitally interpret the contents of the CAD structure. CAD systems typically contain a lot of information about a product, making good CAD integration a primary need. "We drive our BOMs with enriched data that comes out of our CAD tools," shares Jabil's Mitchell. "*It's important to be able to drive the CAD toolset directly*."

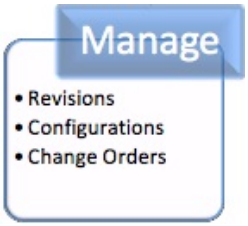
It's important to be able to easily develop product structures of different kinds, including EBOMs, MBOMs, and more.

Of course, it would be incorrect to assume that companies only have a single CAD system feeding the BOM. While many companies might have a primary CAD system, it's important to point out that many have a multi-CAD environment. This may include multiple mechanical CAD (MCAD) systems, or include an electronic CAD (ECAD) system. As Paul Scroggins of Whirlpool says, "The EBOM should have electronic data from both MCAD and ECAD."

REQUIREMENT	CONSIDERATIONS
Creation from CAD	"Bottoms up" creation from CAD interpreting embedded intelligence and metadata contained in the model
Import	The ability to mass load and validate data from external sources, with exception reporting and error handling
Manual creation	"Top down" BOM creation by selecting parts or dragging and dropping them from a list
Integrated part definition and classification	The ability to define and classify parts for inclusion in BOMs, tracking specific data by part class
Multi-CAD	The ability to integrate with different CAD systems
ECAD	The ability to integrate with electronic CAD systems
Software references	The ability to incorporate or reference product software that helps make up a product, sometimes identified as software "parts"
Supplier / manufacturer parts	The ability to incorporate or reference parts with external identifiers and references on the BOM
Multilevel BOMs	The ability to create assemblies and subassemblies, "nested" BOMs
Centralized access	A central location that makes BOMs available across the enterprise and selectively into the supply chain
Searchable	The ability to easily find and retrieve BOM data in multiple ways, including a "where used" search
Substitutes / alternates	The ability to identify valid part alternatives specific to a BOM
Reference designators	The ability to include a part multiple times within a BOM with a reference to different occurrences within an assembly or drawing

Table 1: Functional Requirements for Creating / Developing Product Structures

Manage Revisions / Configurations / Change



The next collection of requirements represents the functions needed to manage a BOM over time. Managing a BOM may seem straightforward until you consider the number and complexity of configurations and the need to support a structured change process. Each of the three topics – revision control, configuration management, and change management – could warrant their own Buyer's Guide. For this guide, we'll focus on the basics related to BOMs.

> "Change management gives us faster, more controlled releases to the factory."
>
> **Mark Mitchell**
> Senior Manager of PLM
> **JABIL**

BOMs need to support the evolution of a product over time, including a change of status or "state" that impacts availability and rules for downstream functions. For example, BOMs / product revisions can be released from a work-in-process (WIP) state to the factory for production. In the same way, companies use a controlled change management process to react quickly to market or quality changes without introducing errors. As Jabil's Mitchell comments, "Synchronizing the data set through product structure release is critical and very powerful. Change management gives us faster, more controlled releases to the factory." This typically involves the use of an engineering change order (ECO) for initial release or to introduce changes to the BOM.

It's important to recognize that not all products have a single valid revision and BOM. BOM management should also be able to manage variant configurations of products as well as "overloaded" or "150 percent" BOMs to support configured items. The requirements for configured items, typically sold in an Assemble to Order (ATO) or Engineer to Order (ETO) approach, are not covered directly here. But it's important that if these are requirements for your business that the BOM supports those needs. See the "Special Considerations" section for more on this topic.

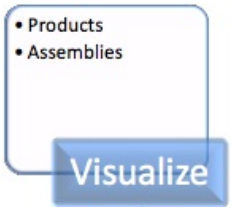
Another aspect to BOM management is the ability to quickly find and reuse BOMs. Typically, engineers do not start from scratch to develop a new product. They should be able to quickly find and modify an existing BOM in order to create a new product and selectively copy associated data. In a similar way, engineers should be able to quickly identify BOMs that are impacted by the change of a product or part. "*If we want to change an assembly, we must understand where it exists, then gather and analyze all of the related information to analyze the impact,*" advises Whirlpool's Scroggins. "We now have visibility to know what parts are being used where."

Engineers should be able to quickly identify BOMs that are impacted by the change of a product or part.

REQUIREMENT	CONSIDERATIONS
Effectivity rules	Ability to track effectivity of a BOM or BOM line item by date, status, ECO, and other applicable rules
Release control	The ability to manage the BOM release management process and state
Where used	The ability to quickly asses where a material, component, or assembly is used in higher-level assemblies (BOMs)
Change impact analysis	The ability to quickly determine the impact of changing an item or BOM
Link ECO to BOM lines	The ability to manage change by BOM and/or BOM line
BOM compare	The ability to easily compare similarities and differences between BOMs, ideally in both "redlined" views and a product visualization
Baselines	The ability to set and record specific BOM baselines independently from revision control
Review / approvals	Workflows and electronic signoffs to review and approve BOMs for release or change
Configuration rules	The ability to associate configuration codes or rules to BOM lines (approaches vary, ETO / ATO configuration requirements are not covered fully here)
Variant management	The ability to define concurrently effective variants of the same product
Mass change / replace	The ability to make automated updates across all or a subset of BOMs (for example, replacing a component or upping a revision for a component)
BOM validation	Validation that a BOM is complete and ready for release

Table 2: Functional Requirements for Managing Product Structures

Visualize



A tabular / textual view of a BOM is valuable, but it's not enough. Engineers and others in the organization need to be able to see the product in 3D based on the BOM. "Visualization is important, you need to see how the parts come together," explains Scroggins of Whirlpool. This should be available for all variants, configurations, and effectivities and ideally provide visual comparisons between them.

These multi-dimensional views can be used for product validation but also to support downstream uses such as service documentation or needs such as product catalogues. These views can go beyond a static view to share additional images and information ranging from exploded parts lists to highly rendered product videos. "We are starting to get into sharing graphics downstream. Every one of our CAD objects (MCAD) comes out with an ability for our supply chain to get to a visual object," comments Mark Mitchell of Jabil. "Ideally we would like to provide them with exploded assemblies and animation." Again, product visualization is a topic unto itself. Additional information can be found in our Design Review Buyer's Guide.

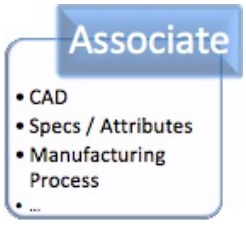
> "Visualization is important, you need to see how the parts come together."

Paul Scroggins
PLM Architect
WHIRLPOOL

REQUIREMENT	CONSIDERATIONS
3D mockup	The ability to render and visualize a BOM structure using CAD data and relative part positioning
Filtering	The ability to filter the view based on a 3D bounding box or filtering by metadata
Explosions	The ability to provide a view of the parts individually with a reference to their location
Respects effectivity, release info	Visualization and mockups available by different effectivity rules
Visual BOM compare	The ability to show differences between a BOM in a digital mockup
Animate	The ability to show motion paths and motion in digital mockups

Table 3: Functional Requirements for Visualizing Product Structures

Associate / Bills of Information



Managing an unambiguous, centralized list of parts required to produce a product is a valuable thing. But the value of an integrated BOM management system can go far beyond that. Producing, selling, and supporting a product requires a wealth of information that's typically stored in standalone, and frequently ad-hoc, systems. Expanding the BOM by creating references to applicable information extends the value of centralized, trusted, revision-controlled data to a host of other functions. "We believe in the 'bill of information'," shares Whirlpool's Scroggins.

Associating information with the BOM allows companies to manage data in the context of the product and discourages duplicating data so it can be updated centrally. It also provides the foundation to perform a much more thorough impact analysis to identify the impact of proposed changes. "Anything you can tie

into the CAD file and synchronize is very powerful," says Jabil's Mitchell, "For example, G Code, STEP files, and all the way down to AMLs or AVLs."

This unlocks data from drawings so it can be managed independently. For example, companies may traditionally include the BOM and information like an Approved Material List (AML) on the drawing. This creates a challenge because that information may be final, but can't be made available to downstream departments until the full drawing is released. "A key pivot for us on the product structure was to associate product data and control it in a centralized environment," offers Jabil's Mitchell. "Now, we have independent pieces of information the can be composed and released when it makes sense to do so."

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Items commonly associated to the BOM help provide rich data about a product:

- CAD data
- STEP
- G-Code (CNC, additive)
- Specifications
- Requirements
- Finishes
- Test procedures
- Drawings
- Sourcing information
- PCB design
- Schematics / layout
- GD&T

Note that this information could be in the form of documents, but it's much more valuable if they are objects in the database that can be searched for and interpreted programmatically.

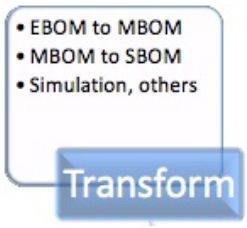
One particular way companies expand the use of their BOMs is by creating a full, systems view of their products, including mechanical, electrical, and software parts in a single, digital BOM. "It's getting more complex. Our product has exploded on the electronics and software side," explains Paul Scroggins of Whirlpool. For software, approaches vary with many companies managing the work-in-progress (WIP) software in a dedicated Application Lifecycle Management (ALM) tool and either checking in the resulting executable software file or simply a reference to the software to manage version control. They key is to provide central visibility and configuration management across design disciplines.

Associating information with the BOM allows companies to manage data in the context of the product and discourages duplicating information so it can be updated centrally.

REQUIREMENT	CONSIDERATIONS
Associate documents	The ability to reference documents stored in the database to specific BOMs or BOM lines
Manage relationships	The ability to manage the relationship between BOM items and associated information
Respects revision control	Associations and managed relationships should follow revision, release, and engineering change management processes
MCAD	The ability to associate BOM items with their respective components or subassemblies in an MCAD system
ECAD	The ability to associate BOM items with their respective components or subassemblies in an ECAD system (such as PCB designs)
Software	The ability to link to an ALM system to associate product software
AML / AVL	The ability to associate (and enforce) approved material lists (AMLs) and approved vendor lists (AVLs)
Quality plans / documents	Associate quality date directly with BOMs and change orders, for example FMEAs or CAPAs
Simulation / test plans	The ability to associate and reference simulation, validation, and quality information

Table 4: Functional Requirements for Associating Bills of Information

Transform BOMs



As mentioned in the "Create" subsection, there are many different types of product structures with multiple uses across the business. The BOM management systems should be able to not only manage these multiple different product structures, but also help create and manage them in context. These BOMs may be EBOMs, MBOMs, SBOMS, or product structures that serve special purposes like simulation or compliance. "We believe in an EBOM-MBOM-SBOM vision and dragging visual parts over to an MBOM," says Paul Scroggins of Whirlpool.

The first set of requirements is the ability to create derivative product structures for these different purposes.

The EBOM is typically the source for these downstream structures. For example, companies may add manufacturing only parts, tools, or consumables to an EBOM to create an MBOM, or add service kits containing parts and documentation to create an SBOM. This should be a guided process that allows for drag and drop and validates that all items are accounted for. The links may reference different types of items, for example a subassembly in an MBOM may be a purchased item in the MBOM or SBOM.

There are many differences between an EBOM and other BOM structures, but they're not completely independent entities. In particular, changes to the EBOM need to be reflected downstream in the derivative BOMs. In this way, derivative BOM parts and components should be able to maintain their relationships with their source. Creating a derivative should not create a copy of the BOM but create the necessary associative transformation. This approach helps support concurrent design where the product and the production processes, or the service procedures, can be developed concurrently. Companies shouldn't have to wait for a released EBOM to begin transformation, they should be able to leverage the work in progress EBOM and be notified of changes that must be applied.

One of the primary reasons to support transformation is to prevent inefficiency and data errors from re-entering information. Today, many companies face significant inefficiency, according to How Top Performers Implement, Operate, and Maintain PLM Integration, which finds that over one-half of companies suffer from inefficient / duplicate data entry and about two-thirds of companies find data inconsistencies between systems on at least on a weekly basis.

Derivative BOM parts and components should maintain their relationships with their source.

Table 5: Functional Requirements for Transforming BOMs

Report / Analyze / Document Products

The final functional subsection covers reporting BOM information in multiple forms to support a variety of objectives. It's important to be able to leverage product structure data to feed other functions. One of the first requirements is the ability to create different online views of product structure information to support different people, roles, and processes. These views should be able to pull in information such as cost, weight, obsolescence, release status, or other related data from ERP or other enterprise systems.

Other reports can support BOM-centric functions, like viewing the BOM along with release information to get a snapshot of product development status. "Nothing is better than going to a top-level BOM and being able to expand the BOM and see the development status on one screen," shares Mark Mitchell of Jabil. "*Our management can now see the maturity state of the product and what's not released. Without a product structure you don't get any of that!*" Some reporting may provide additional

Given the BOM's role as the digital product backbone, it's important to provide product structure data to support a wide variety of digital documentation / communication.

information such as leveraging BOM information to analyze weight, cost, compliance, or other factors. Finally, for more advanced functions should be able to supply BOM data to combine with big data for advanced analytics.

Given the BOM's role as the digital product backbone, it's important to provide product structure data to support a wide variety of digital documentation and communication. This can include standard product documentation, but also go beyond to accurately support animations and AR / VR product representations

REQUIREMENT	CONSIDERATIONS
Multi-level BOM	Show multi-level, indented, "exploded" BOMs
Summarized BOM	Provide a "flattened," summary report that shows all materials one level, adding up different occurrences of the same item
Parts lists	Create parts lists including reference designators to identify locations on drawings
Combine with external data	The ability to "mash up" data from other systems with BOM information
Standard reports	Solution should provide standard reports for typical BOM needs
AML/AVL reports	Reports that include AML/AVL information
Saved reports	The ability to customize and save reports
Ad-hoc reporting	The ability to quickly generate reports for unique needs
Incorporate animation	Leverage motion paths to show moving 3D mockups
Technical publications	Creation of fully associative documentation reference BOM and product data

Table 6: Functional Requirements for Reporting, Analyzing, Documenting Products

Assess Service Requirements

Implementation

Beyond the software, there are important things to consider that can help ensure an efficient, effective implementation. Processes like BOM management are well established and very few companies should need to start from scratch on processes, data model, or roles. Standard, best practice

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>
> **Paul Scroggins**
> PLM Architect
> **WHIRLPOOL**

processes should be sufficient and should be embodied in the software. This is what Whirlpool has found, according to Paul Scroggins. “We’re putting the tool to use as designed, we don’t customize it. Our vendor has created processes and tools based on best practices.”

Changing BOM processes, however, requires attention to the need to manage process change. Many companies have informal processes or processes that vary by business unit or by department. It’s important to align processes to get the full advantage of the solution. Mark Mitchell describes that they faced a common situation *“We’ve moved from the drawing board to CAD and from paper to electronic – but the process hadn’t changed!”* Many companies need help implementing new processes, so it’s important to make sure that that business process consulting and guidance are available for the solution, either directly from the vendor or from their 3rd party ecosystem. In addition, it’s important to ensure that technical resources are available as needed.

Integration

The value of BOM management is much greater when it’s integrated with other systems. It’s important to ensure the BOM management solution has integration available for your chosen design tools, including ECAD, MCAD, and ALM. It’s important to look at the detail of the integration, for example to make sure that engineers don’t need to leave their environment to update, access, or release BOM information.

In addition to tool integration, the software should have enterprise solution integration adapters. As Jabil’s Mitchel cautions, “You can have the best product structure in the world, but if you don’t end up with what you need in ERP you’ll have failures.”

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Look for integration to ERP, Customer Relationship Management (CRM), Supply Chain Planning (SCP), Manufacturing Execution Systems (MES), and any other solution that requires BOM data.

It’s important to look for integration that provides automation. Our How Top Performers Implement, Operate, and Maintain PLM Integration survey shows that the majority of companies suffer significant business impacts from poor integration, specifically the inefficiency of manually transferring data, lack of timeliness, and creating errors. “*The typical environment includes too much manual translation of data and multiple spreadsheets*,” explains Mark Mitchell of

Jabil. "That leads to lack of visibility, data duplication, version issues, mistakes, and the burden of working within different environments."

Adoption

The best software won't provide value unless the users work with the system effectively. For some complex software functions, this may come down to effective training. This training should be available in multiple forms, including self-service. In addition, it may be important to tailor interfaces to match company terminology or processes, and the software should support that capability without code modifications.

While some areas require more training and tailoring, BOM management is used by so many people that most companies can't expect training to support their casual, infrequent users. The solution should be easy to use by untrained and non-technical users with no advanced training required. "*Our system is easy to use, I can go to one screen and manage the whole BOM,*" shares Paul Scroggins of Whirlpool. Mark Mitchell explains that Jabil has an easy to use solution as well, "We have a simple web interface," he shares.

Support

Companies should also look for rapid, effective assistance for their solution. This should include help capabilities including self-service support on a global level. It should also include rapid support for new CAD, EDA, or ALM releases and other integration. These solutions aren't always upgraded at the same time as the BOM management system, so it's important to understand how updates are scheduled.

It's also important to be able to get support upgrading the BOM Management solution itself. As Whirlpool's Paul Scroggins explains, companies can make this easier by sticking with the standard software, "We minimize our customization to allow us to keep our application up to date with relatively little upgrade time and effort."

Consider Vendor Requirements

Vendor Strategy and Investment

When a company selects software to manage their BOMs they also select an important partner. One of the most important factors when evaluating a potential partner is their understanding of your business. Managing BOMs effectively goes well beyond the capabilities of a "generalist" software vendor that knows how to store and retrieve data. Companies should look for a software vendor that understands engineering, manufacturing, service, and how to manage product lifecycles. A PLM vendor with successful references in the same industry is a safe choice. In addition to industry, it's important to make sure the partner is capable of effectively supporting companies of a similar size and in the right geographies.

It's also important to choose a partner that's financially stable and investing in both current and future functionality. Companies should perform due diligence to make sure their partner will be around to support and enhance the product, in particular for integrations as discussed earlier. But there's more to it. The vendor should also be investing in the

BOM management is used by so many people that most companies can't expect training to support their casual, infrequent users.

It's a good thing if your vendor is a couple of steps ahead of you strategically, because the BOM is the foundation to any smart, connected strategy.

future. Look for their ability to support more advanced needs even if the company isn't ready for them today, for example to support the evolution to Industry 4.0, Smart Manufacturing, Digitization, and the Digital Enterprise. It's a good thing if your vendor is a couple of steps ahead of you strategically, because the BOM is the foundation to any smart, connected strategy. See the "Prepare for Digital Enterprise" section for more.

Licensing and Deployment Options

Many companies have developed guidelines on the use of new licensing and deployment models including on premise, subscription, Software as a Service (SaaS), and the cloud. It's important to understand any requirements and ensure the vendor supports a licensing model that meets company needs. In many cases, the BOM management solution will be an extension of an existing PDM / PLM solution and these options have already been determined.

Many companies are moving enterprise solutions to new models to save time, money, and reduce risk. As the PLM License and Deployment Flexibility Puts PLM in Reach eBook observes, "New options reduce barriers to entry and help add flexibility and agility. But it's important to recognize that the primary goal is to find a solution that meets company needs to combat complexity and improve business performance."

The cloud can also offer performance, security, and elastic computing benefits that many companies can't achieve internally. We believe it's important to ensure that your vendor has a cloud offering to ensure they retain market relevance, even if your company isn't ready for it. For more on deployment options, please refer to the license and deployment eBook.

Special Considerations

For most enterprise solutions there are key things to consider that might be unique to a company's business model, strategy, industry, products, geography, or size. This section covers some of those areas for BOM management. Not all of this will apply to any given company, but it's important to recognize specific needs that should be included in the selection criteria. We've identified industry needs, selling products "to order," and transitioning to the digital enterprise as additional areas of focus for this eBook.

Industry

BOM management is a relatively standard process and the majority of companies find they have similar requirements. But there are cases where an industry has special needs or puts more emphasis on certain general needs. For example, companies in very supply-chain-centric industries like Consumer Goods, High-Tech, or Medical Device should pay special attention to the ability to easily connect and collaborate with suppliers, partners, and customers. Other industries have issues based on the scale of their product structures, such as Shipbuilding or Aerospace & Defense companies that must be able to manage and visualize very complex BOMs with high part counts.

It's important to ensure that your vendor has a cloud offering to ensure they retain market relevance, even if your company isn't ready for it.

Some industries have strict regulatory requirements.

Some industries have strict regulatory requirements. For example, the aerospace industry must maintain an "as built" and "as maintained" BOM that includes serial numbers and a traceable history for the parts in a BOM. Other industries, such as Consumer Goods, Electronics, and High Tech have compliance and sustainability requirements that demand detailed analysis of the product structures. "*We sell products in many different countries so compliance is critical. We roll up full material disclosure using the BOM as the system of record,*" shares Paul Scroggins of Whirlpool.

Another industry that deserves special attention is the Medical Device industry. This industry has specific, legal mandates for tracking product structures and quality, including managing the Device Master Record (DMR), Design History File (DHR), and for some companies a Unique Device Identifier (UDI) similar to the requirements for Aerospace mentioned above. "Serving the Medical Device industry is one of the biggest drivers for us moving to better BOM management because everything has to be associated," offers Mark Mitchell of Jabil. "*All product information stays with the CAD model through its whole digital journey and you have visibility to it.*" For more on the needs of the Medical Device Industry, please refer to Tech-Clarity's Medical Device Manufacturers Software Selection Guide. "Better BOM management is critical to support audits, and for the last two years it's been seamless, we've never had an audit deficiency or received a warning," Mr. Mitchell adds.

Product Customization / "To Order"

Manufacturers are offering increased customization to their customers and allowing them to tailor products to their needs. In some industries, like Industrial Equipment, this is simply the nature of the products that need to fit into an existing environment. Increasingly, however, companies are choosing Assemble to Order (ATO) and/or Engineer to Order (ETO) as a competitive differentiator.

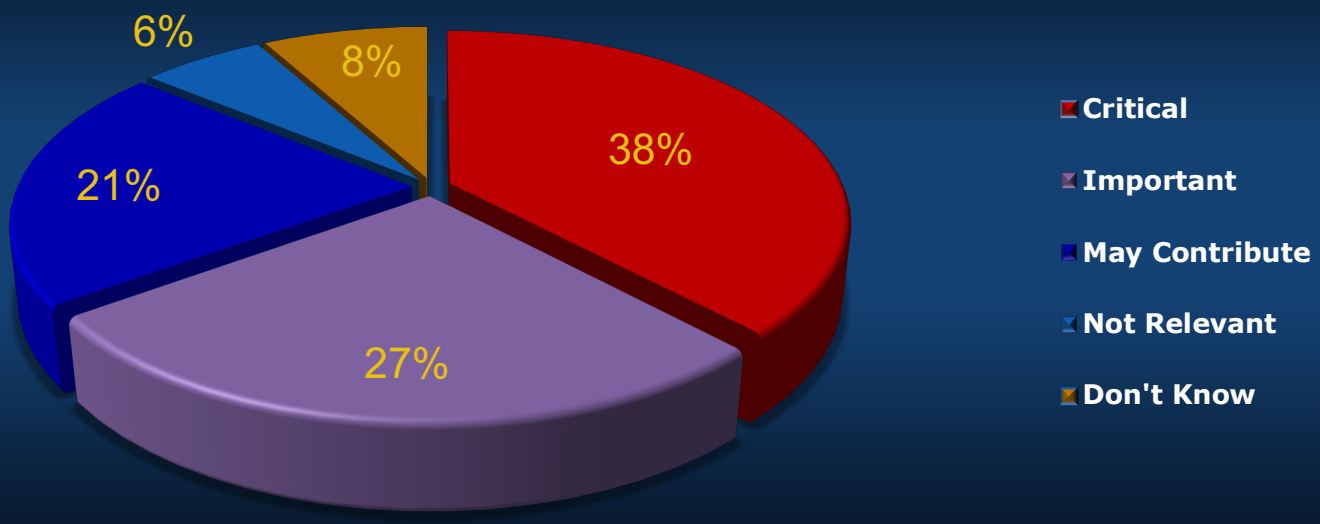
ETO and ATO requirements are out of the scope of this Buyer's Guide, but it's important to recognize the demands that this business model places on BOM management. For example, one approach is to create an "overloaded" or "150 percent" BOM that carries all possible components and assemblies. Then, the BOM is filtered based on configuration codes or rules to create an order-specific product structure, ensuring a valid configuration.

One of the key considerations for managing BOMs in an ATO scenario is that any rules or configuration options must be change managed and revision controlled along with other BOM data. These rules are crucial to revision and configuration management and should be considered an integral part of the product structure definition.

It's important to recognize the demands that an ETO or ATO business model places on BOM management.

Prepare for the Digital Enterprise

FIGURE 3: DIGITALIZATION IMPORTANCE TO BUSINESS STRATEGY



Looking beyond today, the manufacturing industry is undergoing a major transformation. Our research shows that about two-thirds of manufacturers believe that digitalization is important to achieving their business strategy, and over one-third believe digitalization is critical (Figure 4).[2]

Solid BOM practices and a database-driven approach to managing product structures is an important foundation to support the manufacturing industry in the digital age. Companies are now relying on digital data to support concepts like the digital thread that tracks product lifecycle data and the digital twin, which is used as a virtual representation of the physical product for simulations and other functions. It is practically impossible to maintain a digital twin that is accurate enough to provide value without a complete, integrated, and up-to-date product structure,. It provides the opportunity to close the loop between calculated, simulated performance and real performance to learn about product behavior.

Companies are also starting to provide manufacturing and service instructions in Virtual and Augmented Reality. This approach maps rich, digital product data into the real world to help provide information at the right time and in the right context. Without a trusted, complete understanding of the BOM, the value of these approaches is severely limited. As Jabil's Mark Mitchell shares, "Now we're trying to figure out the fun stuff like what we're going to do with IoT platforms. The opportunity is unlimited, but it all starts with the BOM."

> "Now we're trying to figure out the fun stuff like what we're going to do with IoT platforms. The opportunity is unlimited, but it all starts with the BOM."

Mark Mitchell
Sr Manager of PLM
JABIL

While many companies are just beginning to explore AR, VR, and the Internet of Things (IoT), these capabilities can quickly become crucial to

Partnering with a vendor that has both foundational capabilities like BOM and Change Management and also next generation technologies such as in IoT, AR, and VR will allow for a swift and seamless transition from traditional PLM to the next generation of PLM.

new business strategies. "It's all a part of the digital enterprise, we have to make sure we're not left behind. We did IoT and AR proofs of concept that were outstanding. To support it, we need to have a good foundation in place including the BOM," explains Paul Scroggins of Whirlpool. Partnering with a vendor that has both foundational capabilities like BOM and Change Management and also next generation technologies such as in IoT, AR, and VR will allow for a swift and seamless transition from traditional PLM to the next generation of PLM.

Conclusion

BOM management helps manage complexity and streamlines operations. It provides an important, foundational element that serves as the backbone for all engineering, manufacturing, and service activity. An accessible, trusted source of product structure information is valuable and improves traceability and control. "Our objective was to create a single, standardized global product structure and we've achieved that. Any designer at any time can collaborate and participate with a common dataset," says Mark Mitchell of Jabil. "People have the information they need, and nobody needs to call me during an audit – that's the best metric!" he concludes.

Effective BOM management provides enterprise-level benefits, improving business performance and alleviating disconnects across the business. "PLM is not about optimizing within silos, it's about connecting across silos. BOM management helps us streamline and prevent errors across the product lifecycle," offers Paul Scroggins of Whirlpool. The net result is efficiency and cost gains combined with revenue improvement from better collaboration and faster time to market, making BOM management and important operational tool and a key driver of improved profitability.

Supporting BOM management at the enterprise level requires the right solution. It's important to evaluate key solution characteristics, but also to go beyond. Companies should develop a requirements list that helps encourage a holistic decision encompassing software functionality, service-related needs, vendor requirements, and any special considerations based on their industry, size, and product strategy. Finally, the plan should look beyond current needs to support the digital future where digital twins, AR, VR, and IoT rely on sound BOM information.

"We did IoT and AR proofs of concept that were outstanding. To support it, we need to have a good foundation in place including the BOM.

Paul Scroggins
PLM Architect
WHIRLPOOL

BOM management provides an important, foundational element that serves as the backbone for all engineering, manufacturing, and service activity.

Recommendations

Based on industry experience and research for this report, Tech-Clarity offers the following recommendations:

- Think big, but remain agile and take BOM management improvements in steps
- Recognize the importance of accurate, complete, timely, and accessible product structures
- Know your needs
- Understand the value
- Look for functionality, but extend requirements to vendor and service
- Consider any special needs for your business, industry, or geography
- Build the foundation for the digital enterprise, recognizing that BOM management is a key enabler
- Get started

Companies should develop a requirements list that helps encourage a holistic decision encompassing software functionality, service-related needs, vendor requirements, and any special considerations based on their industry, size, and product strategy.

About the Author

Jim Brown is the President of Tech-Clarity, an independent research firm that analyzes the business value of software technology and services. Jim has over 25 years of experience in software for the manufacturing industries. He has a broad background including roles in industry, management consulting, the software industry, and research. His experience spans enterprise solutions including PLM, ERP, quality, service, manufacturing, supply chain management, and more.

Jim is actively focused on researching new digital enterprise initiatives and technologies including cloud computing, digitalization, smart manufacturing, AR, VR, and the IoT. Jim is passionate about improving product innovation, product development, and engineering performance.

Jim is an experienced researcher, author, and public speaker and enjoys the opportunity to speak at conferences or anywhere he can engage with people with a passion to improve business performance through digitalization, best practice processes, and software technology.

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About the Research

This is an updated version of our BOM Management Buyer's Guide published in 2017.

Acknowledgments

Tech-Clarity is an independent research firm dedicated to making the business value of technology clear. Our mission is to analyze how companies can improve the way they research, innovate, develop, design, engineer, produce, and support products through the intelligent use of best practices, software, and IT services.

Endnotes

1. Reducing Non-Value Added Work in Engineering, Tech-Clarity
2. The State of Digitalization in the Manufacturing Industry, Tech-Clarity

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