

# A Getting Started Guide to a Part-Centric BOM

Digital transformation starts with one small step



## Does Your World View Revolve Around Drawings?

If your organization is like most, it's grappling with how to optimize product development in the face of growing product complexity. As increasingly innovative offerings come to market, a growing number of products include mechanical, electronic and software components. Success hinges on your organization's ability to adeptly manage all of these moving parts during development and beyond – and for all stakeholders throughout the product lifecycle to streamline processes and stay aligned. That means your engineering, manufacturing, and service groups – among others – need to easily access the most up-to-date product information in a timely fashion...even as it changes.

Yet most organizations are challenged to make this happen. For decades, organizations have used engineering drawings as the cornerstone of their product definitions. When products were simpler and manufacturing was handled manually, it made sense to manage parts in drawings and then within spreadsheets with the dawn of the computer era. Now that products are much more complex, this drawing-centric view of product design often slows all related processes, from design and manufacturing planning to purchasing and service.

To scale operations and remain competitive, your organization needs to move beyond a drawing-centric product development process to one that focuses on the actual parts that make up your products. Doing so will yield numerous benefits, including organizational agility, faster time to market, simplified processes, and lower costs.

This eBook explains the challenges of being drawing-centric, the benefits your organization can realize by shifting to a part-centric way of developing products, and a simple path for getting there.



By 2018, 60% of large manufacturers will bring in new revenue from information-based products and services, while embedded intelligence will drive the highest profitability levels.”

– Modern Materials Handling, IDC FutureScope:  
Worldwide Manufacturing 2017 Predictions



## The Drawbacks of Drawing-Centric Product Development

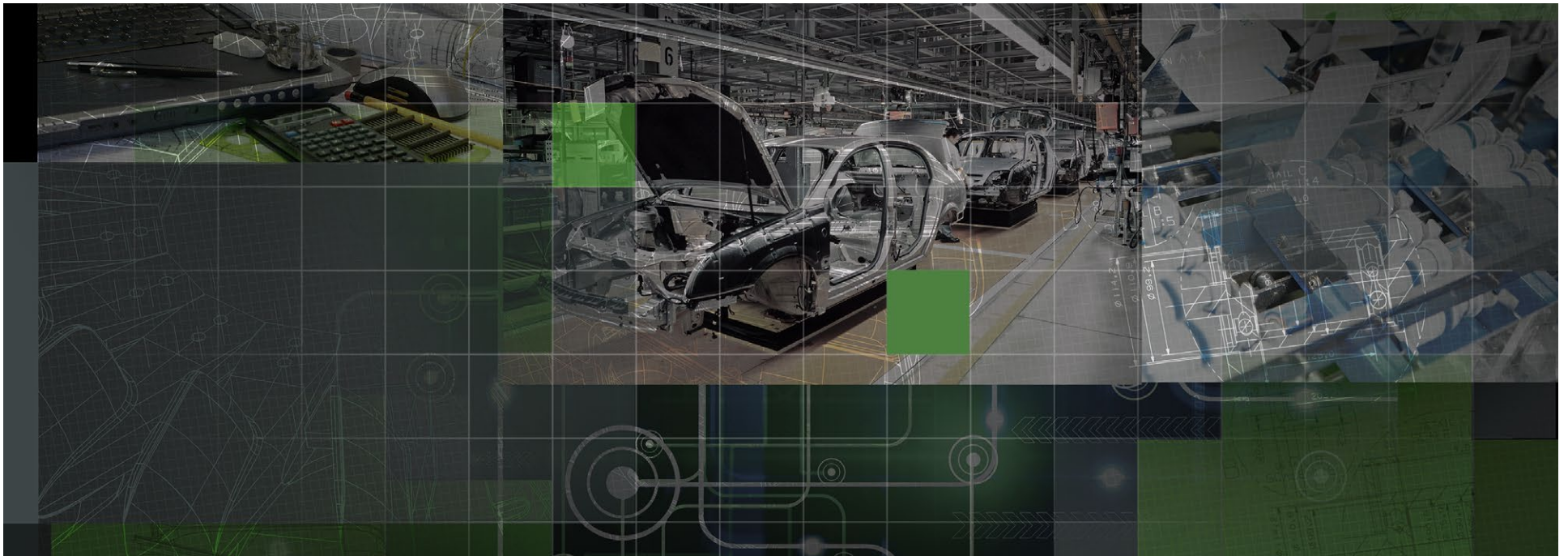
As your organization prepares to introduce a new product – or update an existing one – your engineering team very likely creates design drawings. These contain all information about the product. And that means they are complicated. Think holistically about your products — from design to manufacture to service — and integrate processes to ensure that each function benefits from the other.

This is important information that others across your organization need to understand and plan around in order to perform their jobs downstream. But before anyone outside of engineering can access the product design drawing, someone (and sometimes more than one person) must review it and approve its release. Only then can teams from manufacturing, service, supply chain, and other areas access this information.



Think holistically about your products — from design to manufacture to service — and integrate processes to ensure that each function benefits from the other.”

– IDC, Smart, Connected Products in Manufacturing, June 2015



When they do access it, they often have to “massage” it to fit their needs as they enter relevant details into the systems they use to get their jobs done. These usually include manufacturing execution system (MES), supply chain management (SCM) system, enterprise resource planning (ERP) system and other essential systems across the organization. This work, frequently done manually, can be error prone and time consuming leading to further downstream challenges.

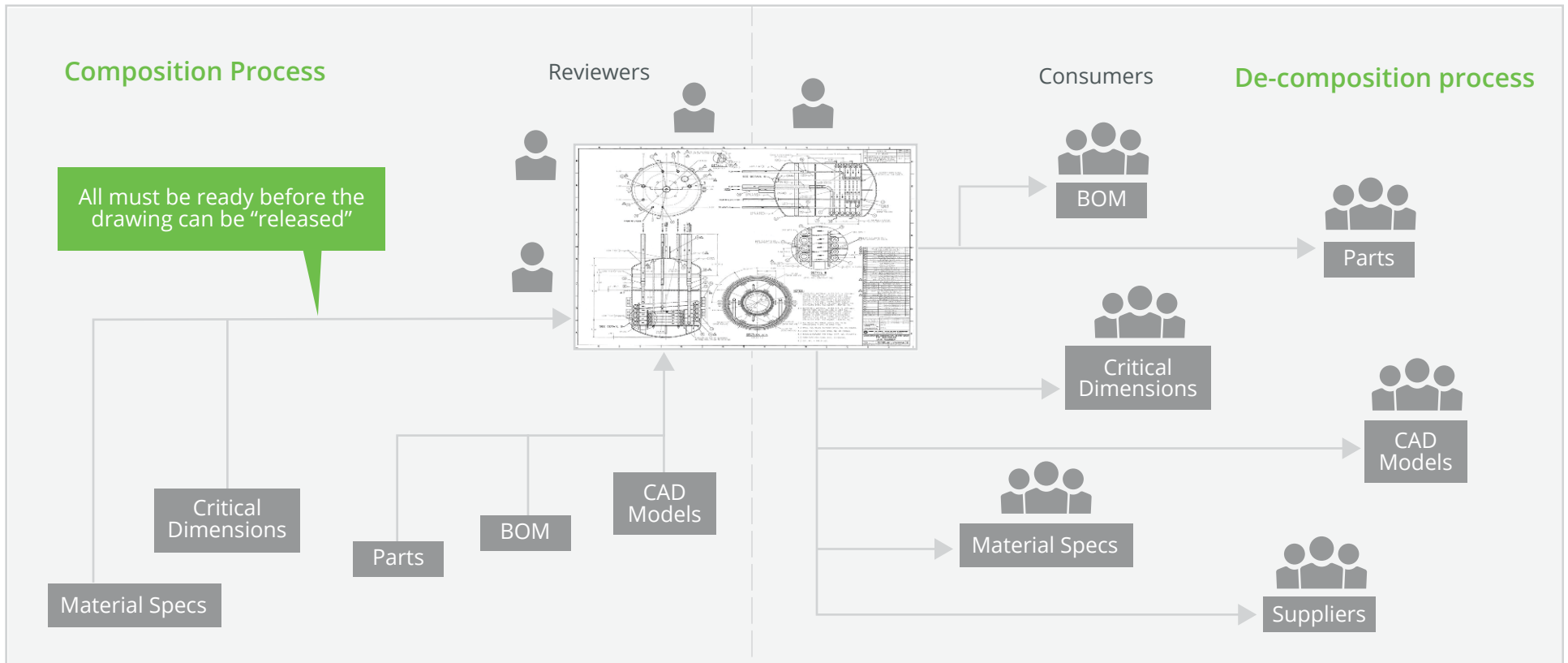
You can see how the traditional process for creating, reviewing and approving a design drawing can slow your organization to a crawl:

- Software and electronics engineers cannot design their portions of the product until they can convert the drawings into a realistic view of the complete system.
- Manufacturing cannot get started on its process – such as setting up the assembly line and developing work instructions – until it can access the engineering BOM.
- Procurement cannot determine preferred suppliers and components to negotiate volume discounts.
- Service cannot develop service manuals until it can develop a service BOM based on the design drawing.

Without the design drawing in hand, the rest of your organization cannot perform its functions. In other words, they become victims of “the waiting game.”



## The Waiting Game



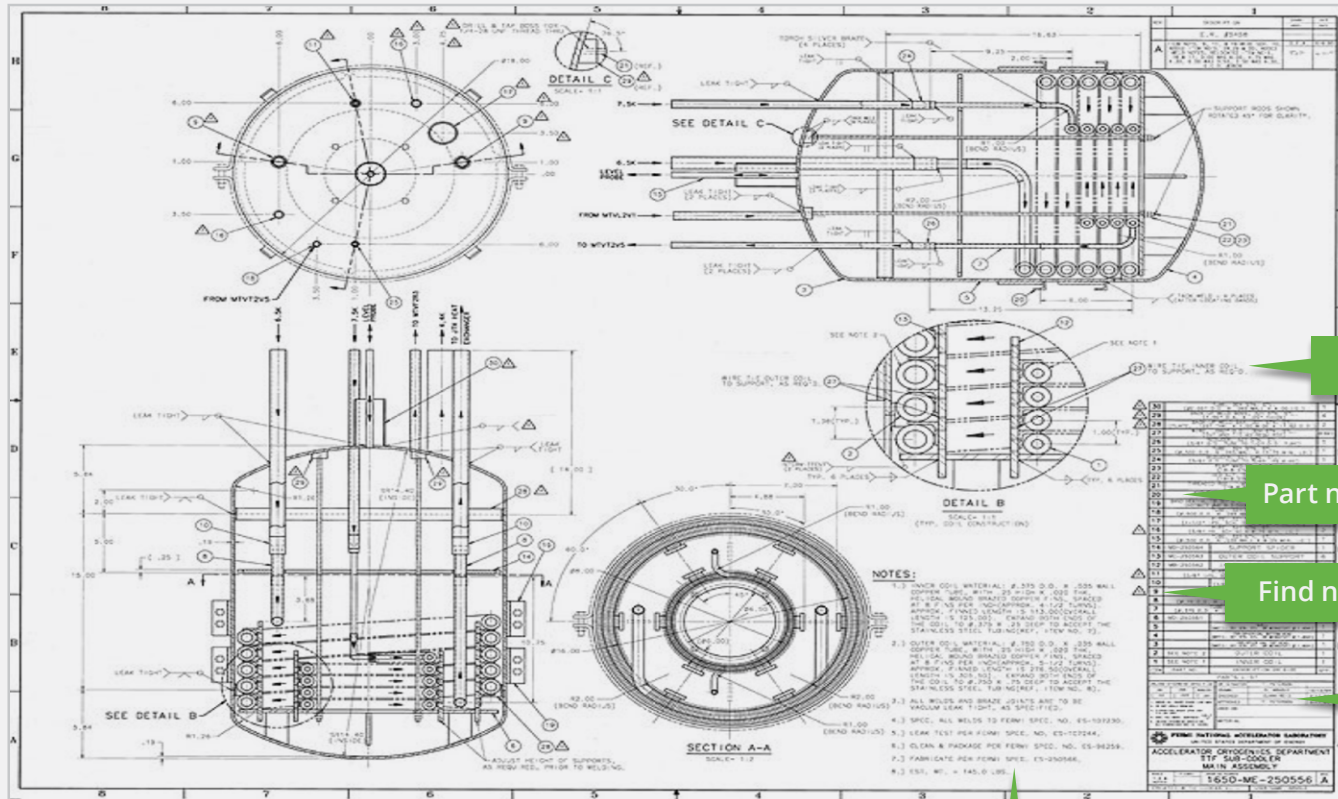
A drawing-centric approach leaves your company stuck in the “waiting game”

The waiting game can cost your company quite a bit of time and money, particularly as product complexity grows. If product specifications such as quantity, part number, process, or assembly change, then your product drawing must change as well. And that means your engineering team needs to repeat the product development process to incorporate this new information. In his book “Configuration Management Metrics”, Frank Watts states that 90% of companies use multiple data sources for their BOMs including drawings, spreadsheets, ERP as well as other tools.

A lack of broad and early access to product data delays downstream processes and burdens engineering teams with requests for data and rework.

A single change on a drawing could affect ten or more downstream activities and deliverables.

- Quantity
- Process
- Part number
- Part name
- Assembly BOM
- Part used
- Find number



BOM

Part number + part name

Find numbers

Quantity

Process receipts

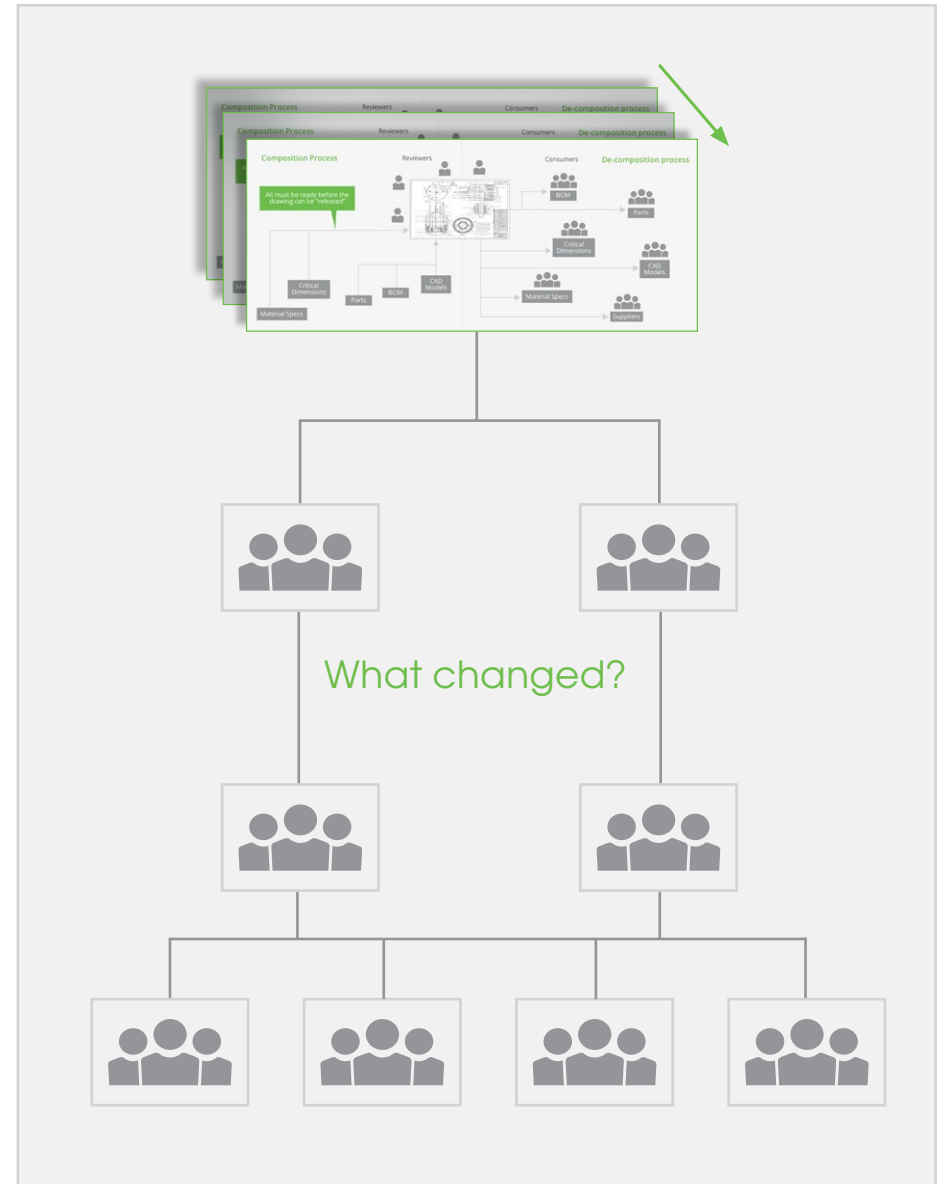
Anatomy of a product drawing: shows an example of the various parts and components of a drawing

Moreover, this process exacerbates the data silo issue suffered by many organizations. Every time the drawing is updated, each downstream group must be notified and then determine whether or not the change requires an update in their system of record. Soon your company is dealing with a spiderweb of misaligned information. And your product development engineers are bogged down with requests for data access and product-related information.

Potential oversights and errors in updating changes in each discrete system can cause another set of significant issues:

- Procurement might order the wrong part
- Service may publish a user manual with the wrong instructions
- Supply chain managers make the wrong inventory decision, leading to low part reuse and high inventory levels
- Manufacturing might not adjust its machines in time to satisfy the product release date

Collaborating across multidisciplinary teams using siloed tools only leads to inefficiency, inaccuracy, and heightened costs.



One change to the product drawing can affect 10 or more downstream activities and deliverables

## Streamline Product Development with a Part-Centric Approach

Fortunately there's a tried-and-true way to overcome these issues: by creating and managing a complete, part-centric BOM using a part-centric BOM management solution.

Parts form the foundation of the BOM structure, and can identify a single item like a bolt or an entire product, such as a commercial aircraft comprising hundreds of thousands of parts. BOMs contain all critical product details, such as part quantity, unit of measure, and other key product characteristics.

Yet if yours is like most organizations, it increasingly needs to manage more than the BOM – it needs to manage a complete digital product definition, including everything related to the electronic, mechanical, and software aspects of your products. This definition needs to be understood across all disciplines contributing to a product's development. Ideally, your organization can manage its complete digital product definition with a multidimensional, multidisciplinary BOM that extends back into requirements management processes and out into service and use.

There are significant benefits of this approach for the different stakeholders in the product development process

## Streamline Change Management with Windchill

When stakeholders across the organization can manage and track changes and configurations to a holistic digital product definition, your organization will:

- Ensure all participants access the most up-to-date product information
- Ensure data remains accurate and relevant
- Increase transparency and collaboration

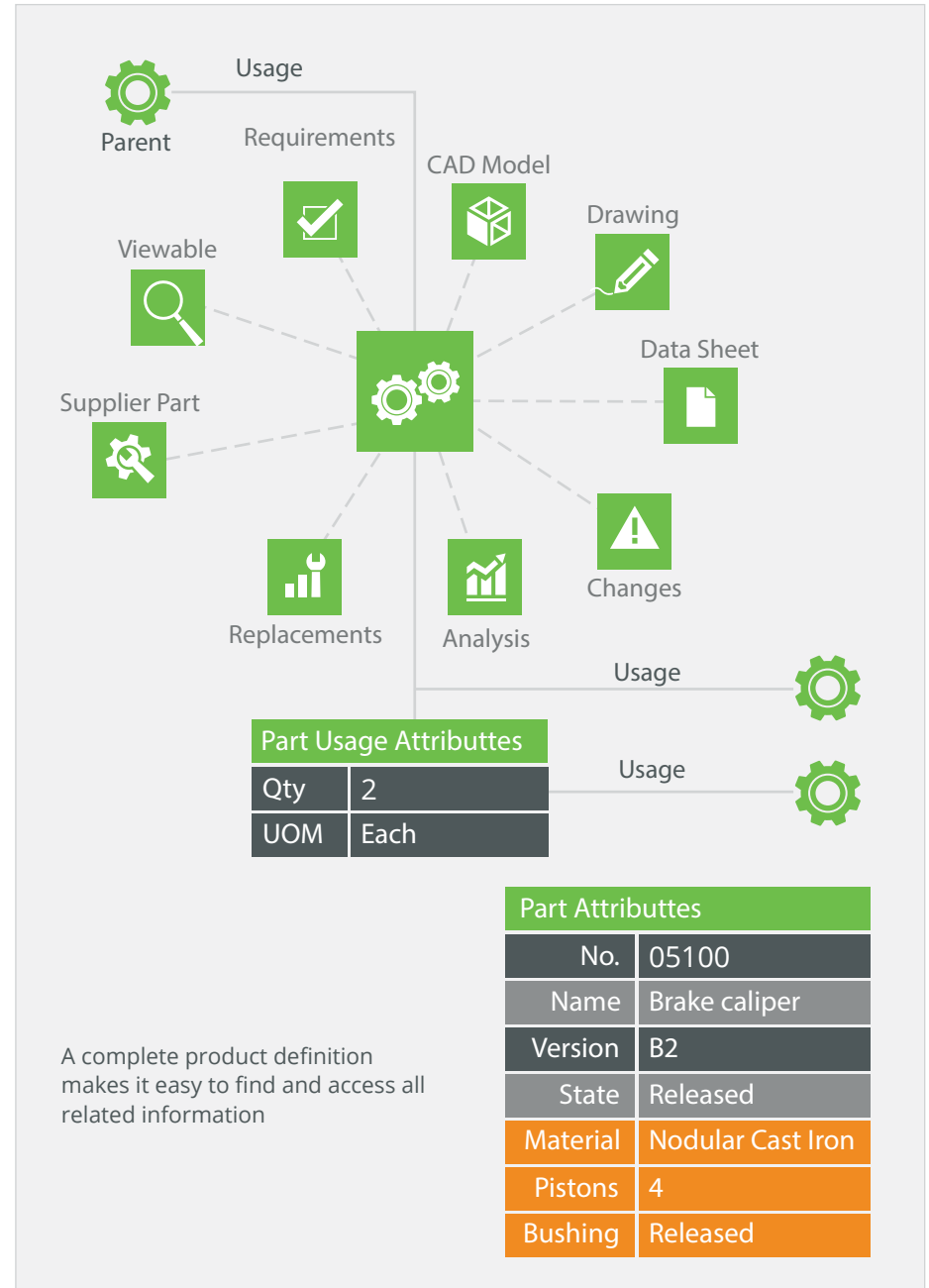




## Parts bring it all together

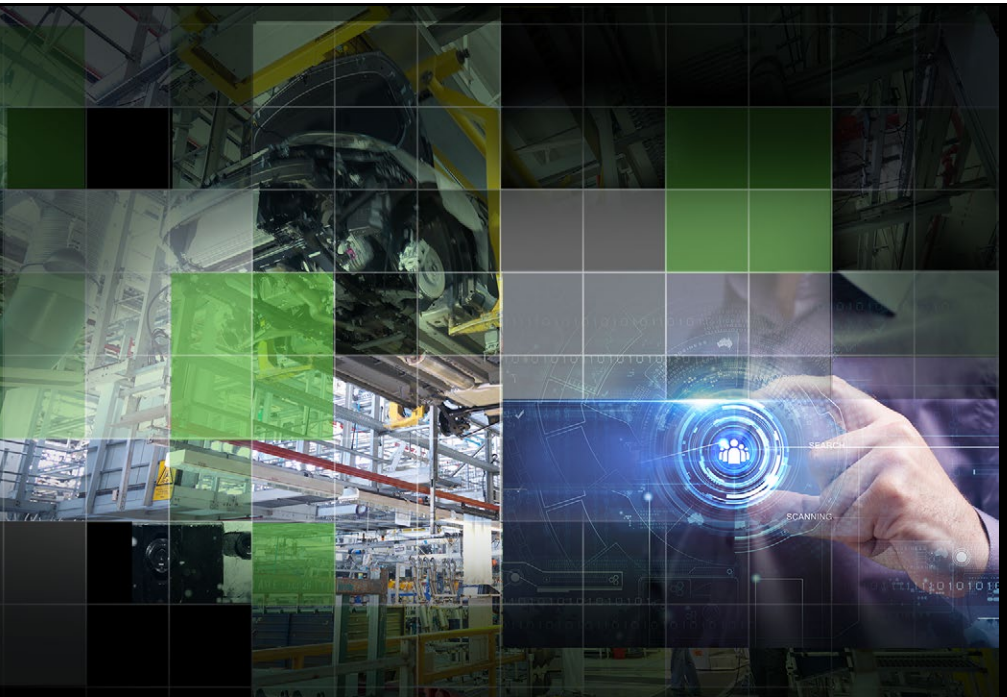
A part-centric approach unites the broad set of product development information, enabling enterprise users to access the right information at the right time. Of course, parts are the basis for creating and managing a BOM. Moreover, compiling all product-related information in a part-centric approach helps more logically relate information such as CAD drawings, visualization, documents, changes, requirements and more. This broad set of relationships enables a richer enterprise definition of the product (i.e., digital product definition) while at the same time providing better information access and traceability. Some of the relationships include:

- CAD. MCAD and ECAD can be related to the part or even used to drive part information.
- Viewables. Users can quickly access a lightweight visual product representation that can be used for collaboration and analysis.
- Attributes. Metadata used to describe the part's characteristics can include basic and classification attributes.
- Documents. A wide array of documentation can be related to the part, from specifications and test information to analysis results and supplier information.
- Changes. Provide traceability to the changes used to mature the part throughout the development cycle.
- Replacements. Alternate and substitute parts define alternative parts that can be used in place of a certain part.
- Supplier parts. Vendor and manufacturer purchased parts.



From any part within the BOM, users can easily find and access the complete product definition. They are no longer forced to look in multiple locations that might be out of sync. The benefits start to compound with this information. For example:

- A user needing to change the product design can quickly find the related CAD, specification document and supplier documents to include in the change.
- Viewables on the part can be “marked-up” digitally, making it easy to share and engage in conversations about the design across the extended enterprise.
- Supply chain can now use these relationships to gather all data needed by a supplier to make the part in a traceable fashion.



## Reduce supply chain complexity with Windchill

Through an optimized BOM, you can manage and align parts, material, and supplier information to realize:

- Streamlined sourcing process
- Higher engineering productivity
- Better volume pricing opportunities



## Eliminate the waiting game

When everyone involved in the product development process can easily access accurate and relevant product-related information at any time – even as it evolves – and get their work done efficiently. Specifically, they will waste less time searching for information, and dealing with data redundancies and rework. Altogether, this enables your organization to deliver product to market more quickly.

### Design Engineers

By evolving beyond drawings to incorporate parts, design engineers can reduce the time they spend disseminating product information and gain more time to spend on developing innovative products. They will also help ensure an accurately configured product and less rework and waste, and better contribute to faster time to market.

### Manufacturing Engineers

Knowing the exact part, manufacturing engineers can create a manufacturing BOM (MBOM), enabling manufacturing to set up machines according to part tolerances. Manufacturing engineers can also develop work instructions earlier.

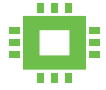
### Quality

By becoming part-centric, organizations give their quality personnel earlier and ongoing visibility into compliance, performance and risk. They will be able to plan for and predict product problems earlier in product development, and reduce the number of issues by continuously improving product and process quality.

### Purchasing

With accurate details about parts, procurement can identify preferred suppliers and components and negotiate volume discounts.

## Windchill and the Digital Engineering journey



### Digital Product Definition

Define and manage the lifecycle of the multidisciplinary digital product definition (BOM : Mechanical, electrical, software) and supporting data (CAD, visualization, sourcing, quality)



### Universal Data Access

Define, manage and control the access to the digital product definition IP Enterprise Search 3D visualization



### Performance Based Analysis

Leverage real world product data to predict, track and analyze system and component reliability, availability and maintainability, and initiate corrective actions



### Digital Product Traceability

Control product iterations through change management process to accurately capture design intent. Connect project deliverables to product data. Associative BOM transformation from Engineering to manufacturing and service.



### Design for Connectivity

Identify, prioritize, and mitigate product and process risks with standard processes including FMEAs and Fault Trees. Multi-discipline(HW & SW) BOM Mngt, Manage Creo instrumented assembly



### Data Driven Design

Connect customer and product performance data with digital product configuration (BOM) and change management process.



### Collaborative AR/VR Design

Setup, collect, and manage Design Review artifacts (CAD, documents, execute Design Review & capture feedback; publish results and initiate follow-up actions



### Constant Analysis

Control product iterations through change management process to accurately capture design intent. Connect project deliverables to product data. Associative BOM transformation from Engineering to manufacturing and service.



### Predictive Performance Improvement

Leverage FMEA models to quickly build and operationalize predictive models. Correlate product performance analysis and Product configuration for future product iteration assembly



### Digital Twin

Source of the multidisciplinary digital product configuration (Mechanical, electrical, software) and representation of the Digital Twin



### Outcome-based Design

Correlate product usage and operating conditions with product configuration & features



### Distributed AR/VR Product Review

Provide relevant product data (2D, 3D, documents, quality, etc.,) In the virtual environment. Collect real time feedback for product performance improvements.

A part-centric approach helps organization evolve their digital engineering capabilities

## Gain a competitive edge

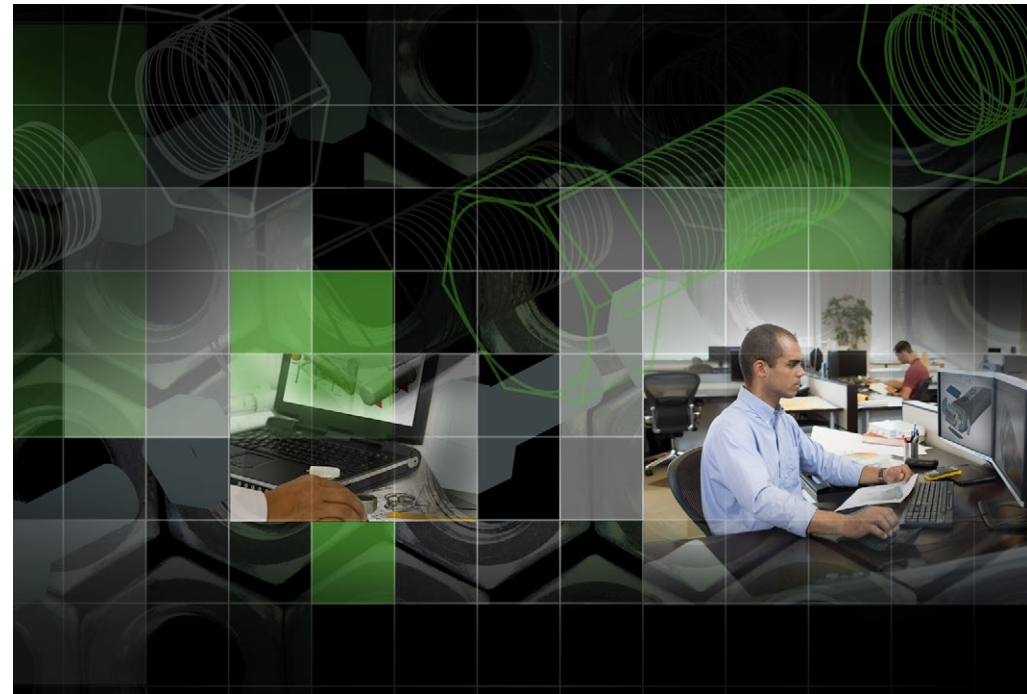
At PTC, we have found that engineers and designers spend roughly 60% of their time pulling and disseminating product data to downstream teams. By evolving your BOM, you make it possible to easily synchronize your downstream, upstream, and supply chain teams. This paves the way for your engineers to spend more time on product innovation, leading to faster time to market and significant cost savings. It also enables better decision-making and better product quality. With higher product quality, you can lower operational and service expenses. Simply put, your organization will be operating like a well-oiled machine.

## Minimize waste and maximize margins

With access to accurate product information, all downstream participants can make smarter, on-the-fly decisions. This will help your organization:

- Improve part reuse
- Reduce scrap and waste
- Decrease inventory holdings
- Realize immediate cost savings by identifying preferred suppliers

Imagine if your engineers and supply chain managers could easily identify the precise hex bolt required and avoid producing the wrong hex bolt cap screws – and eliminate the associated costs and inventory issues.



## Participate in a connected world

When your smart, connected products are in use, you can capture data in real time. Parts are the digital key to bringing this information back to the product development process. As your downstream teams learn from a product's operational behavior, they can respond in ways that allow your organization to outperform the competition. Simply put, with access to real-time product usage and performance insights, your teams can improve features that customers use most, configure offerings to usage patterns, redesign parts or systems to improve quality, and even open new revenue streams by introducing new services.



## Improve data sharing and collaboration with Windchill

Through a part-centric BOM and a role- and task-specific application within Windchill, you can easily consolidate and share the most up-to-date, relevant product data in support collaboration that makes it possible to:

- Quickly turn around data to external stakeholders
- Execute quick and easy Vendor Quote Packages (VQP)
- Improve compliance through traceable data sharing



## Evolve to a Part-Centric Approach at Your Pace

Whether your organization is taking a first step towards an optimized BOM structure or is ready for next-level technologies such as Internet of Thing, it can do so in a phased manner. On your path to realizing a complete digital product definition, you can implement a part-centric BOM management solution incrementally, in a way that encourages confidence across your organization.

### Step one: Create parts

So what's a good place to begin? The right first step will depend on your organization's needs and priorities. Just remember: you don't need to get to a complete digital product definition to realize the value of a part-centric approach. It's true that a complete digital product definition will enable earlier and broader access to product information for everyone involved in your development process.

Creating parts is the prerequisite for realizing any of the benefits enabled by a part-centric approach. Your organization can use several methods to create parts in your part-centric BOM management solution; the right approach depends on your needs.

- Manually. Create and auto-number parts as needed while following enterprise rules for when and how a part is created and released.
- From CAD. Create parts through a "bottom-up" process, providing a link to the CAD drawing, attributes and viewables. Another option is to create a part "top down," delivering a framework for engineers and designers to fill in.
- Mass create. Create a mass of parts from existing data, such as from CAD or from a spreadsheet. This is a fast way to start a part-centric process without requiring users to re-create or re-enter information manually.



For the first time, anyone across the organization can view the current BoM from anywhere and know it is accurate. Prior to this, everything was managed in spreadsheets and documents and people could not find information. We did away with that and are now a forward-thinking agile company with information at our fingertips. No more hoping that spreadsheets aren't out of date!"

– Kar Dehal, Mechanical Engineer, iRobot

### Step two: Classify parts

Part classification helps people easily find parts that meet their needs (i.e., reuse parts) and avoid creating a new part. While classification is an optional step that not all organizations elect to take, it can lead to significant impact across the enterprise.

When you classify parts in your part-centric BOM management solution, you add information to the parts description to make it easy to break

parts down by category. These categories could include attributes that better describe hardware, electrical, sourced components and more.

- Examples might be a bolt in the hardware category and classified as a “HEX HEAD, HEAVY” with attributes that include the length, thread pitch and finish. A capacitor might be categorized as a “FILM, SURFACE MOUNT” with attributes that describe its capacitance, voltage, temperature rating and more.
- With access to this type of information, users can easily find parts that meet their design needs and avoid creating a new part. In other words, classification paves the way for better inventory control – and lower costs.

A part-centric approach empowers your organization to create and maintain logical relationships between all parts in a complex product and associate all related information, such as CAD drawings, requirements, changes and more. As a result, different departments can easily see the view of part relationships – and related details – that matter to them. This is just not possible when capturing the fixed physical relationships of parts in a drawing.

A part-centric approach empowers your organization to create and maintain logical relationships between all parts in a complex product.





### Step three: Create BOMs

Before we dive into the four common ways to create BOMs, let's make sure we're on the same page. As mentioned earlier, parts form the foundation of your BOM structure and can identify a single item like a bolt or an entire product, such as an automobile comprising thousands of parts. BOMs contain all critical product details and product characteristics, and also related information such as product requirements, the CAD drawing, relevant supplier documentation and more. Simply put, the BOM shows the relationship between parts and suppliers, and maintains a record of all related part information.

With views into additional "relationships" between parts (CAD, electrical, mechanical and so on), everyone gains a deeper understanding of the entire product. This gives teams across your organization a holistic, accurate view of all product data, eliminating issues that arise with a drawing-centric approach. The full definition of the product is in one location, allowing users to collaboratively create and manage the complete definition. People from across the enterprise with the right role-based permissions now can consume this full product definition without hunting and gathering from across multiple silos.

Four common ways for product development to create BOMs in a part-centric BOM management solution are:

- **Manually.** Similar to how users can manually create parts, they can manually build BOMs with existing and new parts. While creating the BOM, users can define required information such as quantity, Find Number or other attributes about the parts. This provides the framework for a complete BOM – or complete digital product definition – that includes mechanical, electrical, software-related information and more. Your organization can gather this additional information using one of the methods described below.

### Classify parts with Windchill

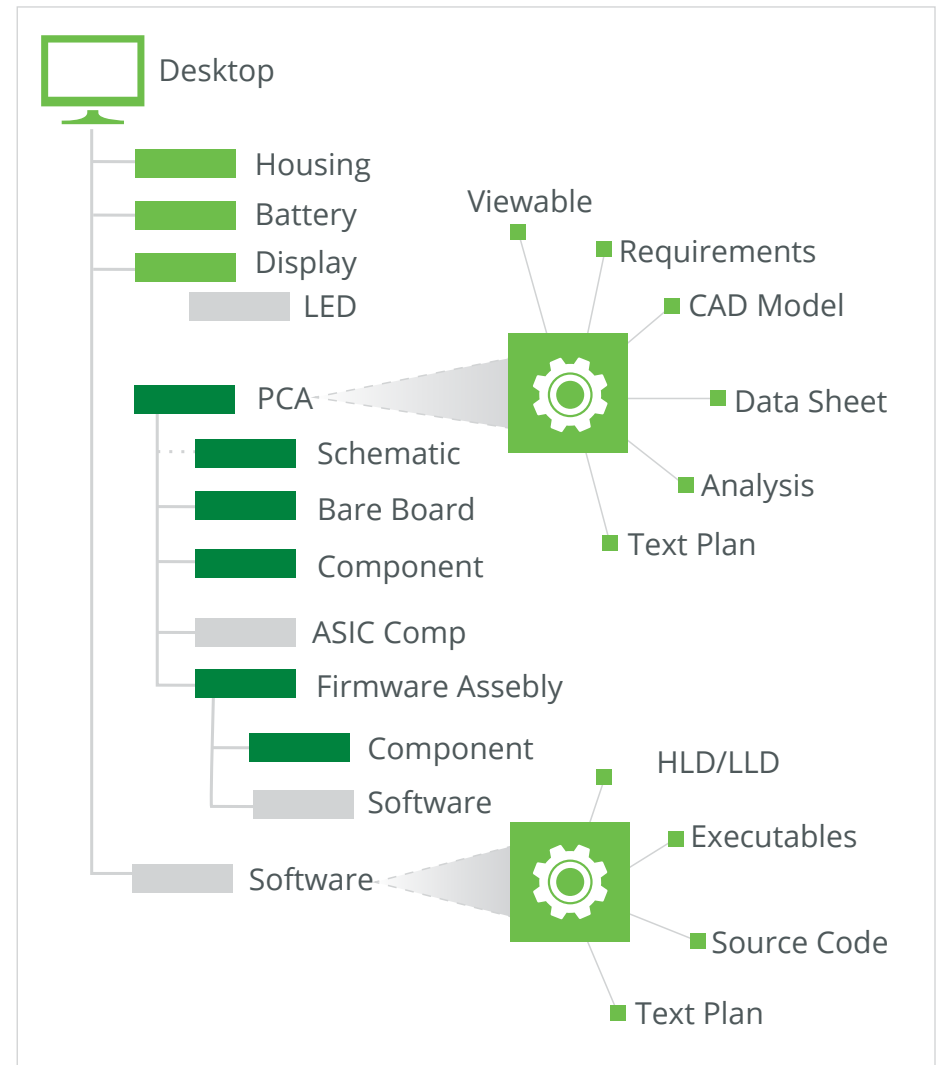
Classify parts into related categories (e.g., function, physical characteristics, etc.) to reduce likelihood of part duplication. Search capabilities within Windchill – such as searching on parts classification and attributes simultaneously – enable users to quickly and efficiently find and reuse information. It is also easy to filter results and see searched keywords in the context of a document. When key stakeholders can quickly and effectively find needed parts, your organization will:

- Get to market faster
- Increase reuse of parts and components
- Reduce the costs associated with part inventory



- **From CAD.** By leveraging existing CAD models and assemblies – such as MCAD and ECAD – you can generate a BOM from scratch. As mentioned earlier, this is generally known as the “bottom-up” method, which allows you to rapidly create a BOM. Your enterprise can decide which CAD should drive the BOM structure and which is just information needed for CAD modelling. This lowers effort while accelerating the BOM creation. It also allows for a more complete BOM definition by incorporating a broader range of information into the BOM.
- **Import from spreadsheets.** One of the quickest ways to create a BOM is by calling upon existing data in legacy systems or provided by supply partners in the form of a spreadsheet. Spreadsheets are a common tool for massaging this data before importing it into a part-centric BOM management solution to create the BOM. Certain solutions will enforce your enterprise policies as this data is fed into the system.
- **Reuse existing parts and BOMs.** Just as your company can shave costs by reusing parts, it can reduce costs by reusing assemblies across multiple product lines. Rather than rebuilding BOMs, you can reuse existing BOMs to more quickly and efficiently create new products. You can reuse BOMs as-is or by saving them to a new BOM that you tweak within the part-centric BOM management solution.

It is important to note that these methods are not meant to be used exclusively. In fact, you can leverage one or more of them simultaneously as makes sense to minimize product development effort while maximizing reuse and improving quality. Perhaps you want to create the upper level of a product manually while filling in lower levels from CAD drawings and by reusing existing BOMs.



The BOM contains the complete product definition

## Take your first steps to value

In addition to making part and product information more consumable across your organization, by creating your parts and BOM, you can immediately realize additional value, such as:

- **Comparing BOMs.** In a drawing-centric process, users must view the correct versions of drawings to determine what has changed over time. In many cases, they must manually extract the changes from the drawing. With a part-centric process flow, users can more quickly and easily understand how the current version of the BOM differs from previous versions, such as part quantity, Find Number, Reference Designator, and other related details. As a result, they can more readily and effectively plan for changes to the product.
- **Creating reports.** While it is critical to access the product definition from your BOM, it is also essential to provide ways to review and understand the BOM outside of the part-centric BOM management tool. Through reports, you can deliver different levels and types of information such as the following:
  - A consolidated parts list that enables supply chain users to easily create a count of components used in a product.
  - Detail of the BOM at all levels for users outside of the BOM management system, such as supply partners.

## Realize additional value with Windchill

In Windchill users can easily access the broad range of product definition information including Parts, Documents, CAD, Viewables and more.

An extension to Windchill makes it possible to collect, analyze, and leverage data from products in use. This empowers your organization to more quickly and accurately identify the root cause of an issue and take corrective and preventive action before a problem becomes a costly warranty or recall.



- **Collaborating.** When everyone throughout your organization has earlier and easier access to a complete BOM and broader set of data – based on their roles – you can more readily collaborate. Internally, manufacturing can access the BOM earlier in the product development cycle enabling them to reduce time to market with earlier process planning. This allows them to provide feedback to engineering throughout the cycle. Supply chain personnel can interact with and provide partners with BOM information resulting in feedback earlier in the process, leading to higher part quality and reduced development times. Externally, a traceable package including the BOM(s) and product deliverables ensures the appropriate versions of data is sent to suppliers. In other words, everyone throughout your organization can be confident that they are sharing the correct information at the right time.

The BOM Compare tools within Windchill make it easy for users to understand changes to the BOM, part attributes, related documents, CAD drawings, part replacements and supplier parts.

## Optimize your BOM structure and reporting with Windchill

By streamlining product data into a single and easy-to-read, easy-to-understand format – and source of truth – you will:

- Provide a holistic digital product definition
- Reduce scrap and waste caused by incorrect or outdated information
- Eliminate time spent on rework, redundancy, and search



## Conclusion: Get on the Path to a Complete Digital Product Definition

While a drawing-centric approach has served the needs of manufacturers for generations, it presents issues that thwart efforts to optimize the product development process. Fortunately, your organization can now take advantage of a part-centric BOM management solution that addresses the drawbacks of a drawing-centric process and empowers you to realize a digital product definition.

As you guide your organization through this process – realize that digital product definition is not achieved overnight, and varies by organization. Each company has a unique set of systems, challenges, and business needs that will impact its priorities and roadmap. You might need to better organize product data in a BOM to easily consolidate relevant information for external stakeholders, or, better manage organizational change to eliminate rework or data duplication.

The way you get to a parts-centric approach is insignificant so long as it is achieved. There are several steps that you can take now to transform incrementally in a way that drives confidence and collaboration across enterprise teams. If your organization can put aside the notion of an ‘infrastructure overhaul’ and take digital transformation as a series of steps– it will quickly realize both short and long term value for teams across the enterprise.

By connecting your product BOM and all related information and assets, your organization will position itself to achieve the agility, higher quality and lower costs that drive manufacturing success in the 21st century.

PTC enables the evolution of manufacturing business models – from product-centricity to service-centricity to complete product-as-a-service offerings. PTC has built a compelling solution footprint to support manufacturers on this journey.”

– IBill McBeath, Chief Research Officer,  
ChainLink Research

Windchill unified and streamlined engineering process enabled SRAM to increase the number of engineering projects while at the same time empowering other business units with collaboration tools to utilize the most accurate, up-to-date information.”

– 2017 Nucleus Research ROI Study