

Whitepaper

Turning Great Designs Into Great Products

*The Changing World of
Mechanical Design*

The Changing World of Mechanical Design

Once upon a time, mechanical engineers created designs that were sent downstairs to the shop floor to be made, following a number of prototyping and redesign iterations. Throughout the process, mechanical engineering, manufacturing engineering, component engineering and sourcing worked closely together to ensure that designs were manufacturable, cost-effective, compliant to regulations and ultimately turned into marketable products.

Global innovation and new technologies have shifted this landscape dramatically. Designers are now just as likely to work with someone across the world as across the building, and more compressed product lifecycles have made the ability to share current and accurate product data in real-time a necessary part of bringing new products to market.

How we got here—the changing landscape

- *Product complexity is greater than ever before* — Incorporating electronic and software components into traditional mechanical designs has led to additional requirements, more complex integrations and numerous handoffs. Ensuring that mechanical engineering teams are coordinated with electrical and software design teams requires a more adaptive manufacturing process.
- *The pace of innovation has dramatically increased* — The compressed product lifecycle demands higher efficiency from product development and production. Neither engineering nor manufacturing can afford to waste time searching for the product specifications and fixing mistakes that stem from miscommunication.
- *Outsourcing is prevalent* — Under relentless pressure to cut costs, many companies have outsourced production entirely to global contract manufacturers (CMs). While outsourcing helps reduce costs, it also introduces significant challenges into the process. Without appropriate information infrastructures communication can easily break down, resulting in substantial errors and delays. The pace of innovation makes these errors even more costly.
- *Regulatory, environmental and industry requirements are more stringent* — To ensure compliance with an increasing number of standards and regulations, such as ISO, UL, FDA, CSA, RoHS and REACH, manufacturers must consider these requirements early in the process.

In this demanding market environment, it is those companies that find innovative ways to optimize the path from design to production that will have the best chances for success.

As the company that invented cloud-based product lifecycle management (PLM) tools, Arena Solutions works with a diverse set of industries to improve product development and manufacturing processes. Arena understands the daily challenges companies face in turning designs to products, and we have worked with hundreds of manufacturers in all sectors to develop effective and affordable solutions for companies of all sizes. collaborate on product changes with strategic partners across the globe. Arena understands the obstacles companies face in effectively managing and sharing their product information, and in this paper we hope to provide insights to these challenges and innovative solutions that help companies succeed.

The evolution of tools: from notes and spreadsheets to today's Cloud PLM

As the nature of product development shifts to keep up with the pace of global innovation, manufacturers must understand that using the wrong tools can cripple a company's ability to innovate and deliver quality products on time. Even important manufacturing innovations such as MCAD, PDM, EDA and ERP tools can't substitute for the sophisticated real-time bill of materials (BOM) and change management capabilities provided by cloud-based PLM.

To learn why, we present an overview of manufacturing tools over the past few decades:

After the rigorous process of analyzing and selecting marketable product concepts, mechanical engineers typically transform their creative ideas into designs with mechanical computer aided design (MCAD) software. The output of these designs often resides in 3-D models, drawings, image files, specifications and other files. They are also organized into BOMs.

For products that have electronic components, electrical engineers create designs with electronic design automation (EDA) tools. The designs are represented by schematics, Gerber files, netlist, layout, BOMs and other data. Coordinating these complicated designs, requirements and specifications from mechanical engineering, electrical engineering and software is a complex, time-consuming endeavor for everyone involved in the project. Product Data Management (PDM) tools are often employed to vault and control engineering files and to facilitate design collaboration. This type of data repository allows members from different design teams to share files systematically, checking them in and out of the vault one at a time to avoid accidental overwrites, deletions and revision confusion.

PDM tools are primarily used by mechanical engineering teams to coordinate efforts with each other during the design phase. To prototype and manufacture a design, engineering groups, operations teams, manufacturing teams, outsourced contract manufacturers and suppliers must be included as an instrumental part of a project team. The innovative designs in the form of drawings, specifications, schematics and layout will be transformed into great products only after many iterations of changes have been made, components have been sourced, rigorous tests have been performed, compliance requirements have been met and products have been made and packaged (Figure 1). Therefore, in addition to design files, product information—such as BOMs, items, costing information, engineering change orders (ECOs), approved vendor list (AVL) and compliance status—is required to transform designs into manufacturable products. While PDM tools are sufficient for managing engineering design files, they are not equipped to facilitate the process of taking the product information from creation, through numerous changes by global cross-functional teams, and all the way to manufacturing.

For a product to be manufactured at low cost, on time and with the quality the market demands, mechanical engineers must collaborate closely with suppliers and contract manufacturers throughout the product development and production phases. This requires that external partners and suppliers have easy access to a centralized product record. PDM tools work within the “four walls” of a company and typically do not support direct access by external partners or suppliers.

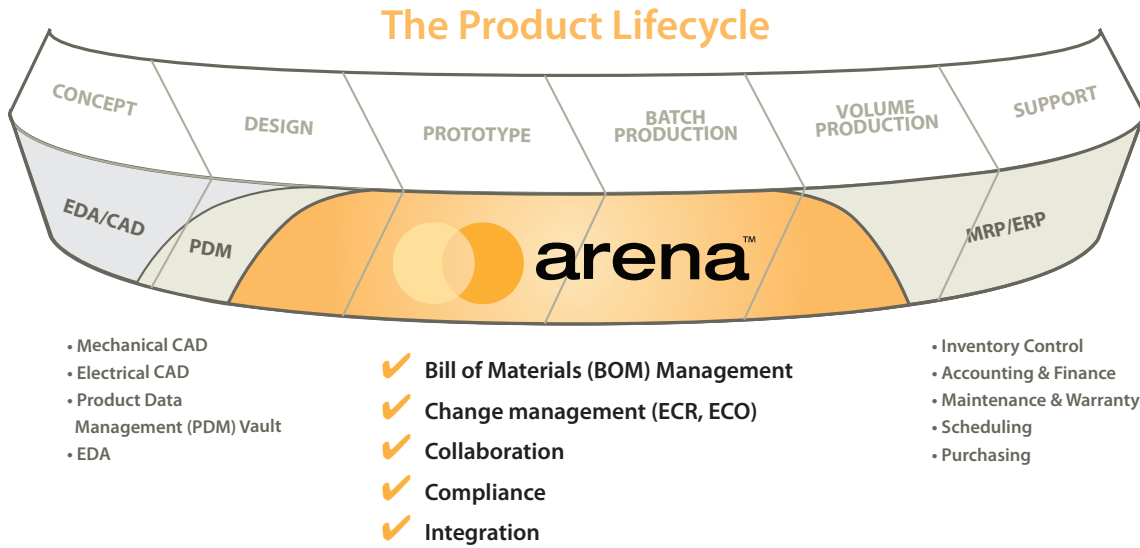
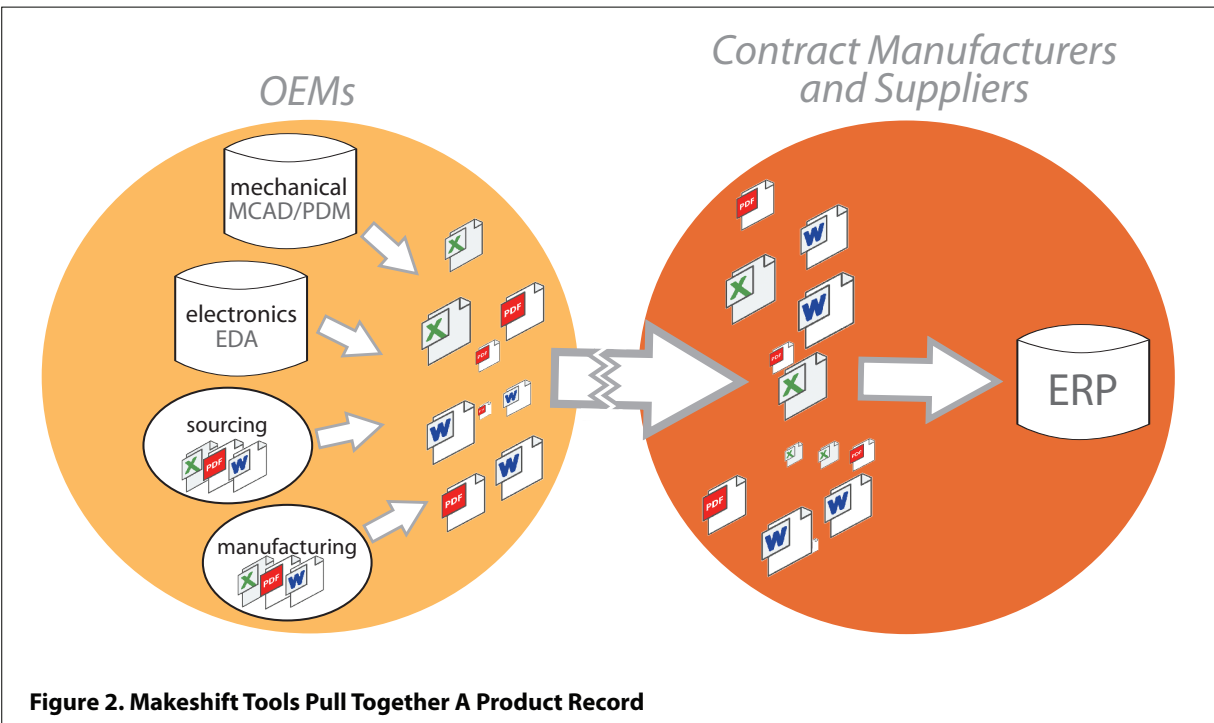


Figure 1. From Design to Product

Many makeshift tools have been used to bridge the gap between the CAD design world and the production world (Figure 2). Companies have used spreadsheet applications like Microsoft Excel to manage product information for sourcing and manufacturing, though spreadsheets are ill equipped to contend with the large, ever-changing volumes of information associated with today's complex products.



A typical BOM comprises hundreds to thousands of items. It is highly relational and includes numerous associated data and files. Throughout the lifecycle of a product, the product BOM and its associated data are frequently changed and updated by multiple teams.

Before cloud-based PLM, manufacturers relied on spreadsheets to manage the changes to the BOM and its associated files, which was highly inefficient and prone to errors. This complicated product information was then shared via phone, fax or email, with no way to ensure that the data was current and accurate. This made remote collaboration challenging, and slowed time to market considerably.

In addition to spreadsheets, companies also used a variety of other static applications not specific to the needs of manufacturers, such as Microsoft Word, PDF files and plain text files, to record and share product information. All fell short in effective change control and information sharing.

Though many companies have evolved their processes from that point, there is still a misconception that Enterprise Resource Planning (ERP) systems can be used to manage all product information after design—including changes and communication. Unfortunately, even though the final production BOMs, the Item Master and costing information are ultimately loaded into ERP systems, these systems do not have integral processes for engineering change orders (ECOs) or file management. Therefore they cannot be used to control BOM or item changes or to manage associated files. Furthermore, as a tool primarily for internal groups, ERP systems cannot be used by external partners and suppliers to obtain product information. Furthermore, during the product development and manufacturing process, it is often useful to trace back the changes to specific revisions of the BOM and make design or part comparisons. It is nearly impossible to do so with a collection of BOM revisions in different spreadsheets.

Lack of Product Information Management Tools Hinders Design and Manufacturing

There is a gap between an engineering data repository and a complete product information record that can be accessed by suppliers and partners. Unaddressed, this gap impedes the process of turning innovative designs into great, marketable products in a number of ways:

- Mechanical engineers spend a significant amount of “non-value-added” time looking for and compiling the right design data and product information for the downstream supply chain—sourcing, manufacturing, compliance, suppliers and outsourced contract manufacturers. This reduces their ability to spend quality time applying their skills to product innovation. When they should be moving on to a new product design, they are still bombarded with questions and requests related to product information, most of which would not be necessary if a centralized shared data management infrastructure existed.
- Much of the product information resides and is only accessible within the four walls of a company. Suppliers are not able to directly access the latest product information, making it difficult for them to contribute in the design process. Without suppliers’ participation, engineering may miss the opportunity to make component performance and cost tradeoff decisions early in the design phase.
- Similarly, without direct access to product information, contract manufacturers lack the visibility required to provide valuable feedback on the manufacturability of a design early in the process. As a result, more costly design changes are made further into the development phase.

- Suppliers and contract manufacturers do not always have the latest product BOM or ECOs. This potentially results in wrong builds, leads to obsolete inventory and impacts the bottom line.
- Under increasing environmental and regulatory compliance pressure, companies must seek cost effective solutions to meet product and process compliance requirements, such as ISO, UL, FDA, CSA, RoHS and REACH. To do so, it is imperative for manufacturers to integrate compliance efforts into the design process as early as possible. Managing compliance after turning the design into product may cause re-design delays and cost overruns.

A centralized product information management infrastructure is required to bridge the CAD design world to the manufacturing world. To be effective, this product information management infrastructure must be accessible anytime and anywhere by design, sourcing and manufacturing teams within a company as well as external partners and suppliers.

Bridging the Gap Between Design and Manufacturing

It is frustrating for mechanical engineers to create a great design, only to see chaotic downstream workflow and processes compromise the ultimate quality of the finished product and delay the introduction of the product to the market. In recent years, many leading companies have implemented PLM solutions to help remove obstacles to product information management and sharing, encourage collaboration, and improve the overall “design to product” process. With increasingly broad market adoption in the past few years, these types of solutions are effective tools that bridge the gap between the CAD design world and the manufacturing world.

Once PLM is implemented, internal and external project teams are able to collaborate effectively in the definition, management and distribution of product and compliance information throughout the product lifecycle. Teams can also define, organize and automate workflows and processes from design to production. Specifically:

- Teams have selective access to the latest design files and product information at anytime and from anywhere. Mechanical engineers no longer need to spend time locating, compiling and communicating product information in order to field requests from downstream groups. This improves their productivity and allows them to focus on their core responsibilities: designing innovative products.
- Automated change control processes ensure that all product and process data and documents are under revision control. All document originators, actions, approvals, signatures, decisions and supporting documentation can be tracked and recorded. This simplifies the ECO process for project teams, including mechanical engineers, and reduces ECO cycle time.
- Similarly, with direct access to product information, contract manufacturers are able to provide feedback on the manufacturability of a design and suggest potential cost saving alternatives. Ultimately, design engineers can more fully leverage contract manufacturers' expertise, which has been accumulated from working with hundreds of product companies.
- Engineering and operations teams are able to manage the Item Master file across multiple BOMs to maximize parts reuse and lower overall product cost.

- Compliance management can be directly integrated with these solutions in order to efficiently track, document and report on compliance. In an outsourced environment, companies are able to assess compliance risks of all outsourced activities, implement necessary control and create documentation to establish an audit trail. Traditional client/server PLM software does not solve supplier communication difficulty and is expensive

in terms of hardware, software and IT resource requirements. Arena designed BOMControl specifically to enable product companies to share data and collaborate with their suppliers in real time. With full product specifications, associated documentation and extensive change history available securely to your extended supply chain, BOMControl is the next generation of PLM, and is used by innovative manufacturers of all sizes and stages of development.

Arena BOMControl: Manufacturing in the Cloud

Leading manufacturers are increasingly turning to BOMControl to better manage their design to production efforts by revolutionizing the way they manage their product information. These companies rely on BOMControl to:

- Manage their bill of materials, control product revisions, costs and history securely in the cloud.
- Get control over their change process, reduce scrap and rework and get their product to market quickly and accurately.
- Enable their company to communicate and collaborate in real-time with partners and suppliers throughout the product's lifecycle.

For more information on Arena BOMControl and other products from Arena, please visit arenasolutions.com/products.

About Arena

For over a decade, Arena has been redefining PLM with a suite of cloud applications that enable engineering, manufacturing and their extended supply chains to work better together—from first prototype to full-scale production. Arena helps innovative manufacturers bring better products to market faster with cloud PLM offerings that speed prototyping, reduce scrap and help manufacturers collaborate on product changes with strategic partners worldwide.



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