



An Arena Solutions whitepaper

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Turning Great Designs Into Great Products: The Changing World of Mechanical Design

whitepaper

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The Changing World of Mechanical Design

Not long ago, mechanical engineers created designs that were sent to the shop floor downstairs to prototype and fabricate. The product was made after a number of prototyping and redesign iterations. Throughout the “design to product” process, mechanical engineering, manufacturing engineering, component engineering and sourcing worked closely to ensure designs were manufactureable, cost-effective, compliant to regulations, and ultimately turned into marketable products.

Recent years have seen a number of critical factors fundamentally change the market landscape. The entire process from design to manufacturing has been challenged.

- **Products are much more complex** — Incorporating electronic and software components into traditional mechanical designs adds a magnitude of complexity and numerous handoffs. To ensure that mechanical engineering teams are coordinated with electrical and software design teams is a tremendous endeavor.
- **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 on non-value added activities, such as searching for the latest drawing and fixing mistakes that stem from miscommunication.
- **Outsourcing is prevalent** — Under relentless pressure to cut cost, many companies have outsourced production entirely to global contract manufacturers (CMs). While outsourcing helps reduce cost, it also introduces significant challenges into the process. Without an appropriate information infrastructure, communication can easily break down, resulting in substantial errors and delays.
- **Working across diverse geographic locations is common** — Today, it is increasingly rare that a mechanical engineer can walk down the hall and work side by side with colleagues in engineering, manufacturing, or sourcing. Often, teams working on a project are scattered across a number of locations in different time zones. This lack of proximity can present considerable barriers to the timely, smooth flow of information required for effective collaboration.
- **Regulatory, environmental and industry requirements are more stringent** — To ensure compliance with an increasing number of standards and regulations, such as RoHS, APQP, UL, FDA and ISO, designs must take these requirements into consideration early in the process.

In this demanding new 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. With optimized development and manufacturing processes and tools, great designs can then reach the market as great products with higher quality and better profit margins.

As the provider of an on-demand Product Lifecycle Management (PLM) solution, Arena Solutions has worked with over 300 companies across diverse industries to improve their product development and manufacturing processes. Through seven years of working with customers, Arena understands the daily challenges companies face in effectively turning designs to products. In this paper we hope to shed some light on this very important topic.

Turning Great Designs Into Great Products: The Changing World of Mechanical Design

The Gap Between Design and Production

PDM Tools Only Help Design Engineering

After the rigorous process of analyzing and selecting marketable product concepts, mechanical engineers typically transform the creative ideas to 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 a bill of materials (BOM). 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, BOM, 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, vast 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. PDM tools, sufficient for managing engineering design files, 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.

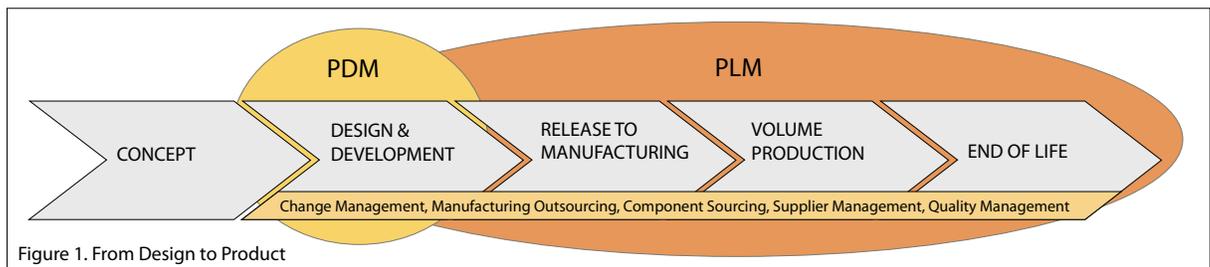


Figure 1. From Design to Product

Furthermore, for a design to be manufactured at low cost, on time and with high quality, it is essential for mechanical engineers to collaborate with suppliers and contract manufacturers throughout the product development and production phases. The first step to facilitate collaboration is to provide external partners and suppliers with easy access to product information record anytime and anywhere. PDM tools work within the “four walls” of a company and typically do not support direct access by external partners or suppliers.

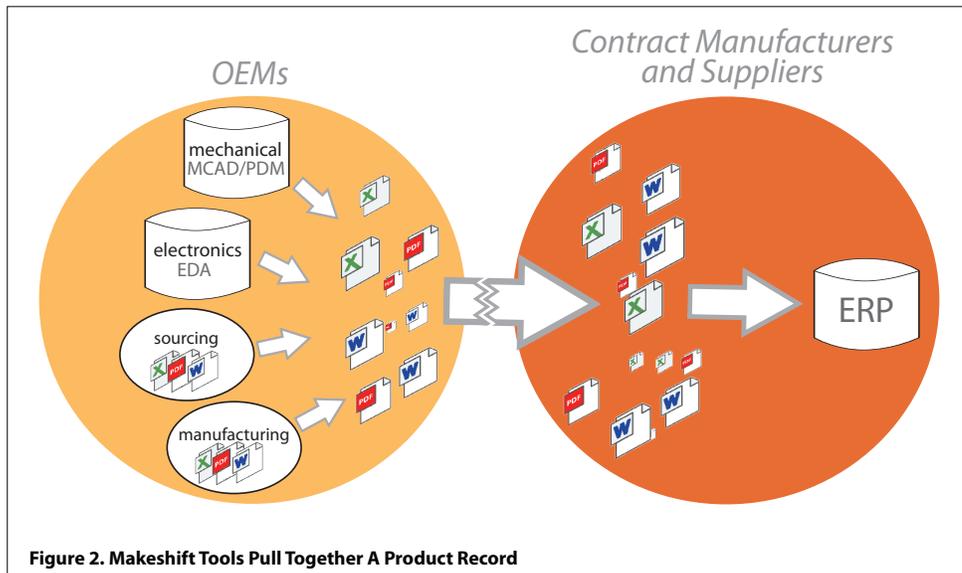
So, what tools are currently being used to manage and share product information records?

Turning Great Designs Into Great Products: The Changing World of Mechanical Design

Makeshift Tools Temporarily Fill the Gap

Many makeshift tools are typically being used to bridge the gap between the CAD design world and the production world (Figure 2).

Many companies use spreadsheet applications to manage product information for sourcing and manufacturing. However, spreadsheets are ill equipped to contend with the large, ever-changing volumes of information associated with today’s complex products. For instance a modern BOM typically consists of 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. Using spreadsheets to manage the changes to the BOM and its associated files is highly inefficient and prone to errors. Moreover, email, phone or fax is often used to share this complicated product information. These point-to-point methods cause delays and mistakes. For instance, at a contract manufacturer, an engineer needs to reference the latest BOM. He has to wait for the project manager at the contract manufacturer to contact the project manager at the customer company, who will then contact various team leads to ensure that the BOM he has is indeed the latest. It can often take several days to obtain an essential piece of product information. With teams distributed across multiple time zones, the process can be delayed even further.



In addition to spreadsheets, companies also use a variety of other static applications, such as Microsoft Word, PDF files, and plain text files, to record and share product information. They all fall short in effective change control and information sharing.

There is 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 ECOs or file management. Therefore they cannot be used to control BOM or item changes or 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.

Turning Great Designs Into Great Products: The Changing World of Mechanical Design

Lack of Product Information Management Tools Hinders Design and Manufacturing

Increasingly obvious to many leading companies, there is a gap between an engineering data repository and a complete product information record that can be accessed by suppliers and partners. As seen by these companies, this gap impedes the process of transforming innovative designs to 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 RoHS, APQP, UL, FDA and ISO. 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.

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.

PLM Solutions: 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 product lifecycle management (PLM) solutions to help remove obstacles to product information management and sharing, encourage collaboration, and improve the overall “design to product” process. Enjoying increasingly broad market adoption in the past few years, PLM solutions are effective tools that bridge the gap between the CAD design world and the manufacturing world.

Turning Great Designs Into Great Products: The Changing World of Mechanical Design

With PLM solutions, project teams, internal or external, 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 any time and 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 and across multiple BOMs to maximize parts reuse and lower overall product cost.
- Compliance management can be directly integrated with PLM 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.

However the traditional client/server PLM software does not solve supplier communication difficulty and is expensive in terms of hardware, software and IT resource requirements. On-demand PLM takes PLM solutions a step further and enables product companies to share data and collaborate with their suppliers.

Arena On-Demand PLM

Increasingly companies are turning to Arena PLM to better manage their design to product efforts. To date, over 300 companies from diverse industries have been using Arena PLM to revolutionize the way they manage their product information. Tesla Motors, Foundry Networks, Align Technology, Segway, First Alert, Desktop Factory and many other companies rely on Arena PLM to:

- Accelerate their new product introduction and reduce overall product time to market by eliminating unnecessary information errors and communication delays
- Reduce product cost and increase product quality through more effectively collaborating with supply chain partners and suppliers from early design to production
- Achieve regulatory compliance by ensuring that compliance status is always visible and that required processes and documentation are consistently recorded and tracked.

Thousands of users from these companies as well as their partners and suppliers have used Arena PLM to access a "single version of truth" of product information and project details — including design files, items, BOMs, ECOs,

Turning Great Designs Into Great Products: The Changing World of Mechanical Design

compliance requirements and status, schedules, tasks, and other critical data. With this visibility, engineering teams can access a consistent product definition that not only includes design output from CAD tools, but component, costing, manufacturing, and compliance information as well. This single, comprehensive view of product information improves project collaboration across the supply chain and reduces errors and delays in the product development and production process.

Arena PLM is delivered through an innovative on-demand service. Unlike traditional client/server PLM software, on-demand PLM provides outsourced partners and suppliers easy and selective access to product information, encouraging collaboration throughout design and production (Figure 4). Users only need a Web browser and Internet connection to access the information. Arena PLM eliminates the need for companies to acquire new hardware, software, or additional IT staff. Moreover, companies can add an unlimited number of users across their supply chains and selectively allow them to access product information and project details.

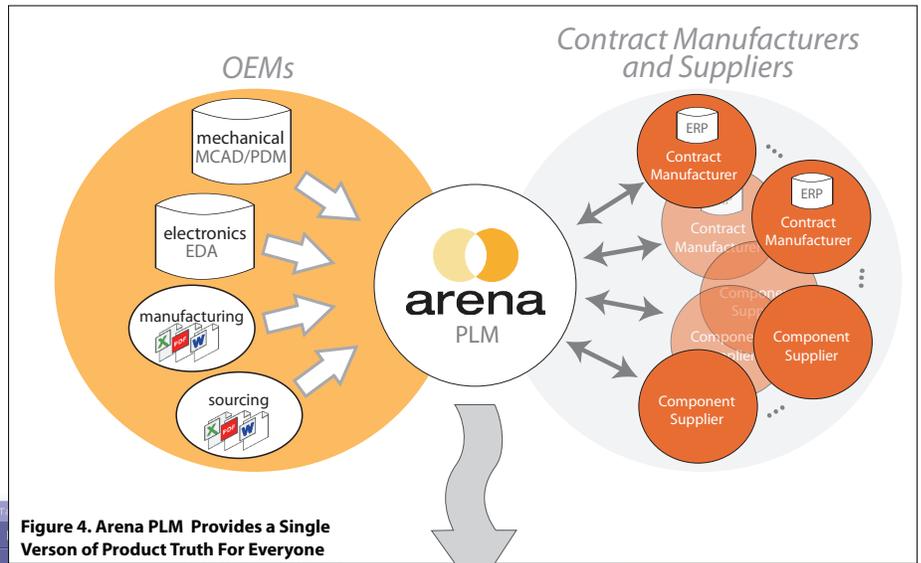


Figure 4. Arena PLM Provides a Single Version of Product Truth For Everyone

Item Number	Item Name	Phase	Files	Rqmts	Qty	Notes
823-0236 rev. A	BlueFin V900 Front Plate Assy	In Des	D3+	?	1 each	
823-0237 rev. D	BlueFin V900 Pro Rear Plate Assembly	In Des	D4+	?	1 each	New iteration of this mechanical assembly, design improvements made from previous model.
823-0290 rev. F	BlueFin Rear Board Assy	In Des	D6+	?	1 each	New iteration of this electrical assembly, design improvements made from previous model.
823-0241 rev. B	BlueFin Pro Rear Plate Board Assy	In Des	D1+	?	1 each	
499-0036 rev. A	BlueFin V950/V900 Programmed Micro	In Des	D2+	?	1 each	
906-0101 rev. A	BlueFin Rear Plate Monitor ONOFF	In Des	D1	?	1 each	
795-0011 rev. A	4 x 6 ESD Bag	In Des	D1	?	1 each	
802-0096 rev. A	BlueFin O-Ring Kit	In Des	D1	?	1 each	Replacement pack
802-0117 rev. A	Smart Grip Battery & O-ring kit	In Des	D1	?	1 each	
823-0230 rev. B	BlueFin V900 Tube Assy	In Des	D3+	?	1 each	
823-0234 rev. A	BlueFin Flip Filter Assy	In Des	D2+	?	1 each	
823-0238 rev. A	BlueFin V900 Camera Tray Assy	In Des	D2+	?	1 each	
823-0240 rev. A	SR11 BlueFin Zoom Optic Assy	In Des	D2+	?	1 each	
823-0247 rev. A	BlueFin Rear Plate Eye Piece Assy	In Des	D2+	?	1 each	
823-0293 rev. 1	BlueFin Right Threaded Handle Assy	In Prod	D2+	?	1 each	Smart Grip Handles
823-0294 rev. 1	BlueFin Left Threaded Handle Assy	In Prod	D2+	?	1 each	Smart Grip Handles

Production Cost \$4,319,312.55

Procurement Type Made-to-Specification (MTS)

Unit of Measure each

Created on July 11, 2006

Product Line BlueFin

CORPORATE CONTACT

Arena Solutions
 4100 East Third Avenue
 Suite 300
 Foster City, CA 94404
 P. 650-513-3500
 F. 650.513.3511

Arena PLM - Bill of Materials Example