

Synchronous Product Development: A New Mantra for Rapid Innovation to Market

a PLM Whitepaper
Prepared by ENOVIA MatrixOne

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Introduction

Today, companies across numerous industries find themselves on the cusp of a product development revolution. The incorporation of software and electronics into mechanical-based products is driving a wave of new innovation as products become more like “intelligent systems” that are interactive, proactive, changeable and upgradable.

With software and electronics driving so much new product value, leading companies have begun to view and develop their products as “systems.” No longer do leaders develop the physical, mechanical product first and then merely force-fit the intelligence portions in at a later date. Instead, they take a systems-based approach that requires simultaneous and connected development to occur between software, electronics and mechanical functions at the earliest design stages and to continue throughout the product development cycle.

This systems-based approach to designing products is drastically changing the product development landscape in the traditionally mechanical-based industries of Automotive, Aerospace & Defense and Machinery. It is also profoundly affecting product development and innovation in the Apparel, Consumer Products and Electronics industries. Consider just three recent examples of products that rely on the convergence of software, electronics and mechanical:

- **Automotive Drivetrains:** Traditionally 100% mechanical, drivetrains are now almost 50% composed of electronics controlled by software to enable “drive-by-wire” maneuvering.
- **Mobile Telephones:** Convergence and a systems approach to new product development have led to the availability of mobile phones that play music, video, gaming and more. Moreover, new innovations occur so rapidly that shelf life has diminished to less than six months in some cases. Nevertheless, mobile phone development still remains quite profitable for industry leaders.
- **Footwear:** New athletic shoes are now equipped with microprocessors that automatically adjust the levels of support in the sole in order to match the terrain and runner’s activity level.

The functionality leaps apparent in these products and countless others are clear proof of the impact that a systems approach to product development has on innovation across industries.

In addition, a systems approach enables companies to significantly increase product modularity. If designed with an optimal systems view, many products need only have their software and/or electronics modified to offer varying levels of functionality and performance. As a result, a single major product can serve multiple target markets and multiple segments within those markets.

But while embracing the wave of convergence between software, electronics and hardware that drives innovation and product modularity is critical for winning in today’s market, many companies struggle to synchronize efforts in two areas critical to a systems-based approach to product design:

- Alignment of the design disciplines of electronics, software and hardware throughout the new product development cycle
- Alignment of the product management, design and manufacturing teams needed to ensure that core products can be manufactured as intended in each geography.

To overcome these challenges in systems design, industry leaders are adopting a strategy of Synchronous Product Development to guarantee the alignment of all product development stakeholders and the information they need to share. Those companies that best drive a Synchronous Product Development strategy will enjoy sustainable competitive advantage for years to come by launching market-winning products faster and at lower costs than their competitors.

What is Synchronous Product Development?

Synchronous Product Development, or SPD, is a set of business processes that coordinate and synchronize the activities and deliverables of global product development teams, working in multiple engineering disciplines, in any phase of the product lifecycle. (See Figure 1 below.) SPD serves to bridge together the various design disciplines, and at the same time, ensure that designs reflect the needs of customers and the capabilities of the various manufacturing sites.

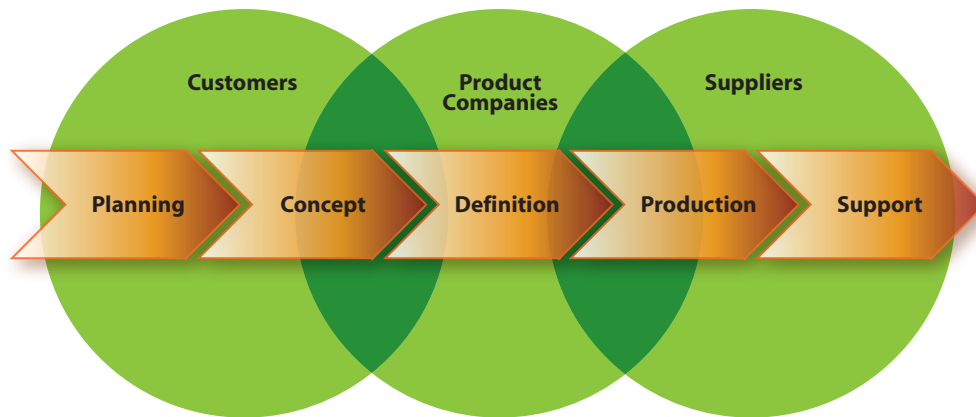


Figure 1. Synchronous Product Development

A major impediment to system development is ensuring that design activities are properly aligned with market requirements. This is even more complex when the product's capabilities require early design collaboration between multiple design disciplines. Engineers and designers in each discipline perform fantastic feats to squeeze maximum functionality out of their designs. However, efforts are often compromised when they are confronted with limitations imposed upon their designs by the other engineering disciplines trying to fulfill competing product needs.

Consider this scenario: A new interactive product that is being developed requires significant software modifications in order to meet new marketing requirements. The software modifications (enhancements) result in unacceptable response times, so a new processor is required to provide greater computational speed and capacity. But the new processor puts out more heat and thus requires changes be made to the product package to improve heat dissipation. Because identification of the need for a new processor and an upgraded package occur late in the design cycle, product launch has to be delayed.

Which design team made a mistake? Did they all make mistakes? Which team needs to re-work its product design and slip far behind schedule on this project and perhaps on other projects as well? And who will be responsible for the extra costs incurred for re-developing a solution? Situations like this often give rise to software, electronics and mechanical design teams viewing and treating one another as adversaries rather than as teammates working together toward a common goal.

Scenarios such as the one outlined above make systems design a real challenge. In addition, product development teams must also cope with late-stage design changes caused by shifting customer needs and site-specific manufacturing capabilities. As demonstrated in Figure 2 on the following page, design teams face a second dimension of challenges to satisfy the needs of product management and manufacturing teams.

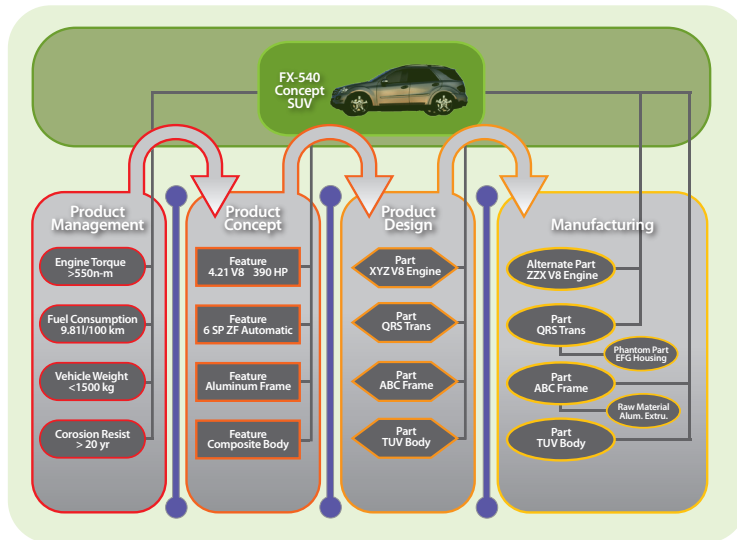


Figure 2. New Car Product Development Lifecycle Without SPD

As seen in Figure 2 above, there is little benefit from designing an incredible new product if it does not satisfy product management (customer requirements) or cannot be manufactured at a reasonable cost, if at all. Yet, many companies have disjointed processes in place for keeping design teams abreast of shifting product requirements and manufacturing-based design parameters. Design teams must focus on design, not on tracking down requirements of the upstream and downstream teams that should be providing product requirements data to the designers. This is where having a strategy of Synchronous Product Development pays off. With a SPD strategy in place, designers work from a single source of product information that is continuously updated by upstream and downstream functions.

Moreover, changes are automatically pushed to the various design teams as soon as they occur, which enables designers to focus on their core work and adjust designs before they are locked.

Figure 3 below depicts an organization that has effectively implemented SPD processes to streamline all dimensions of product development through information-sharing between design realms and their upstream and downstream stakeholders of product management and manufacturing. As the figure illustrates, processes are in place to automatically furnish the design teams with all the information they require to do their job right – the first time.

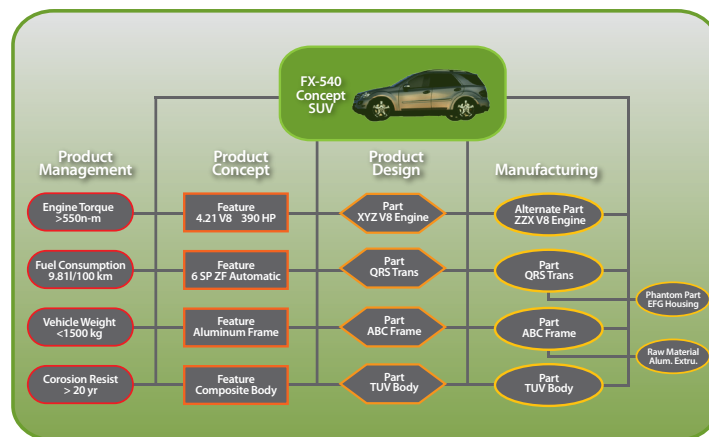


Figure 3. New Car Product Development Lifecycle With SPD

How to Implement Synchronous Product Development

Synchronous Product Development is achieved when companies establish and adhere to the three crucial components of product development. These are:

- ***A Product Planning Framework***
- ***One Unified Product Design***
- ***Aligned Product Views Between Design and Manufacturing***

A Product Planning Framework

A product planning framework, often referred to as “system design,” is a top-down approach to decomposing products into planned product options and features across all design disciplines to ensure consistent and interoperable development processes.

Most companies’ software, electronics and mechanical design disciplines utilize independent design logic and processes. But systems-based design provides one unified set of processes and logic to ensure that all design disciplines are operating in unison. A product planning framework enables and mandates that all design disciplines take the following critical steps when designing components parts to ensure a systems approach:

- Capture market/customer requirements
- Plan product options and features to account for multiple design disciplines
- Track design iterations
- Validate that requirements have been satisfied
- Design for part re-use and modularity

This type of requirements management and product planning inherent in system design has proven successful in software development environments and Aerospace & Defense product development environments – both of which have traditionally had a highly specialized need to continuously capture and validate requirements data. But today, as companies in all industries need to develop increasingly complex products to meet shorter market opportunities, they too must establish a product planning framework – prior to defining their products.

One Unified Product Design

With a solid understanding of a product’s requirements (from the product planning framework), product development teams can begin to design the product itself. This “product design” occurs in two stages: “informal” and “formal.”

Informal product design occurs when designers are free to explore any solution to satisfy a product’s requirements. In this stage, designers must have the ability to “white board” their ideas and collaborate on them in an environment that is unencumbered by design rules. Informal product design should also enable designers to view and mark-up one another’s work within any design tool and across multiple design tools. Such a free-flowing, ad hoc environment enables designers to be as creative as possible, enabling true innovation to take place.

“Formal” product design brings order to the creative environment. In the formal product design stage, rules are applied to design processes to ensure that all of a product’s component parts are accounted for and seen by all stakeholders - in a unified environment. The rules mandate that design teams take the following steps:

- Consolidate part design content into a single definition of the engineering BOM
- Adhere to one cross-functional engineering change process
- Qualify and manage purchased parts

Taking these steps, designers are able to follow a path to product development success that is predictable, consistent and repeatable.

Aligned Product Views Between Design and Manufacturing

Many product companies have adopted a Design Anywhere, Build Anywhere strategy, and as a result, have manufacturing sites spread around the world. Very often, manufacturing plants require product design changes to suit their “local” needs and/or capabilities. Not all plants can work from the same Manufacturing BOM because of variables

such as local supplier constraints, manufacturing capabilities and/or local market requirements and regulations. To ensure that each site manufactures products to specification (as design teams intended), manufacturing teams must be able to collaborate with design teams on unreleased Engineering BOMs to detect and correct problems before release to manufacturing.

Aligning design and manufacturing views of the product can be achieved by combining Engineering BOM management with Manufacturing BOM management. This step is easy to achieve if companies leverage their formal product definition environment, the previous stage in Synchronous Product Development. By bringing Manufacturing BOM management into the formal product definition stage within engineering, design and manufacturing teams can apply all the rules and processes of the formal product definition environment to the Manufacturing BOM. The result: streamlined product launch and fewer costly product recalls.

Many product companies already leverage elements of Synchronous Product Development and should not look to throw away processes that already prove effective for launching new products. Doing so would disrupt design teams too much and interfere with ongoing competitive practices. However, bringing planning and order to existing product development activities will provide greater levels of speed and consistency in driving new products to market. Thus, companies should look to improve their current product development activities by identifying areas for improvement and applying SPD best practices and solutions to them in a staged approach. This approach provides several key benefits:

- Product development teams can continue to work in an environment that is comfortable and well-known to them
- ROI of SPD investments can be proven at each stage of implementation prior to investment in subsequent stages
- Companies can target the areas of greatest need first to gain competitive advantage and then obtain executive commitment for future stages

Overcoming the Tool Vendor Mantra

To successfully implement a strategy of SPD, companies need to look at product development holistically, rather than from the standpoint of a single development tool. For too long, tool vendors selling CAD, CAE, EDA and other task-specific products have proliferated the use of disparate tools to the detriment of synchronous product development efforts. When product development teams focus on tools, they lose sight of the overall product planning framework and product definition processes needed to align the entire organization's product development efforts. Taking a narrow, tool-driven approach to product development can have dire consequences, including:

- **Over-reliance on Innovative Designs:** Design innovation, while important, is only one element of successful new product development. Companies that consistently win do so by excelling in multiple areas of product development:

- *Understanding customer needs*
- *Reaching market faster than competitors*
- *Minimizing product scrap and re-work*
- *Designing for manufacture*
- *Streamlining supplier collaboration*
- *Embracing only those design tools which correspond to true design needs*

- **Tool-encumbered Product Development:** If the design tools are the only source of product development activities, then companies' product development efforts can only progress as quickly as their design tools do.

- **Extreme Competitive Disadvantage:** While competitors synchronize product development efforts and streamline time-to-market through SPD, tool-dependent companies miss market opportunities and eventually become irrelevant.

Introducing the ENOVIA MatrixOne Solution for SPD

As a leading PLM vendor, ENOVIA MatrixOne has long supported the product information needs of new product development teams. The Matrix platform serves as the foundation for PLM, and consequently, a Synchronous Product Development strategy. Because the platform provides a single, unified product data environment, ENOVIA MatrixOne users are able to easily extend PLM implementations beyond mechanical engineering data management into the realms of software and electronics, product management and manufacturing.

The ENOVIA MatrixOne solution targets its support for the three key components of Synchronous Product Development: (1) a product planning framework, (2) informal/formal product design and (3) alignment between manufacturing and design.

ENOVIA MatrixOne for Product Planning

ENOVIA MatrixOne supports a product planning framework by providing the ability to efficiently identify, organize and document a product's ever-changing requirements. These requirements can be allocated to appropriate product features describing how the needs will be fulfilled in specific product versions. Throughout each product's lifecycle, users can capture, update, track and control the functional, design and test specifications associated with specific product features. In turn, product features are linked to parts to ensure design engineers have complete access to the requirements and specifications that their designs and, ultimately, their products, should meet.

ENOVIA MatrixOne's solution for SPD goes beyond the minimum requirements for the product planning framework by providing specific advanced features for both Marketing and Design teams. First, Matrix users can associate compatibility rules to a feature at any level of the product structure and always enforce the rule, across all products. Engineering and Marketing organizations can leverage this capability to define design-specific constraints between features and a product, or between products, simply by indicating incompatibilities or co-dependencies. In addition, the parts and designs from past projects are associated to features in order to promote re-use

in future projects that must deliver the same capabilities. After the key feature capabilities for a new development project are identified, the system identifies these previously designed parts to automatically generate a full or complete Engineering BOM.

Leveraging a robust product planning framework based on Matrix, product development teams can quickly advance the product lifecycle to what they do best — innovate.

ENOVIA MatrixOne for Product Design

ENOVIA MatrixOne provides an environment for both informal and formal product definition activities. More importantly, this environment is completely tool-independent, eliminating the need for costly proprietary technologies, such as multiple CAD workgroup managers. In addition, designers are free to leverage their tools of choice, be as creative as possible and collaborate without compatibility concerns. After all, collaboration is the key to innovation when software, electronics and mechanical domains converge.

Following are the key collaboration capabilities inherent in the Matrix platform's informal product definition environment:

- **Meeting Capabilities:**
 - *Design teams review and collaborate on design data in real time*
 - *Discussion threads and markups are captured during review meetings and can be referenced at any time in the future*
- **Workflow:**
 - *Workflow capabilities enable a designer to obtain feedback when an online meeting is not possible*
 - *Workflows can be defined with serial or parallel tasks for review and/or approval of design content*
- **Visualization:**
 - *A web-based visualization component for both 2D/3D designs and documents enables data review in the native environment*
 - *No files are downloaded to clients, ensuring a secure work environment*

The importance of ENOVIA MatrixOne's ability to provide work-in-process data management across all design tools cannot be overstated. It enables design teams to recognize the impact of design changes as they occur, make adjustments "on the fly" and avoid design re-work and product launch delays later in the product lifecycle.

When it comes to managing the formal product design across multiple tools, ENOVIA MatrixOne has clearly established itself as the leader. ENOVIA MatrixOne's products have proven successful by focusing the formal product definition in four key areas:

- **Design Data Management**
- **Product Structure Management**
- **Part Management**
- **Engineering Change Process**

Design Data Management

From the native design application, designers can easily access data that is vaulted in the highly scalable Matrix PLM platform instead of using the independent workgroup data managers of various electrical, mechanical and software design tools. The ENOVIA MatrixOne solution is designed to work with very large design sets by distributing metadata and files across the WAN. This results in higher rates of user adoption and acceptance.

Designers can create folders within Matrix workspaces with access privileges for secure content sharing between other team members. Local workspace management on users' desktop allows users to easily compare their work-in-progress to the master designs in Matrix. Matrix keeps track of all design activity and enables users to create personal collections for short-term storage of designs that will be used again.

Rapid review of design ideas is imperative to achieve faster design throughput. Matrix users have the ability to subscribe to a design and set events for notification. When any user changes a design in a work-in-process environment, all users that have subscribed to that design are automatically notified of the change, reducing last minute mistakes.

Product Structure Management

Matrix enables users to build, compare, markup, edit and copy BOMs. In addition, a number of configurable reports are included, such as:

- **Multi-Level "Where Used" Report:**
This report provides component usage information to any level in the product structure and analyzes the impact of a change.
- **BOM Comparison Report:**
This report compares BOMs and indicates when there is a part or part quantity difference. It also contains a summary that indicates components that are shared and unique to each assembly.
- **Quantity Summary BOM Report:**
This report creates a single-level part quantity list that is summarized from part usage and quantities in a multilevel BOM. This report is very useful for the procurement planning process.
- **Multi-Level BOM and AVL Reports:**
This report provides a view of the product BOM structure to all or selected levels. The multi-level Approved Vendor List (AVL) report adds additional Manufacturing Part Number (MPN) and manufacturer details. In addition, manufacturing location specific AVL reports provide the data needed to support outsourced global manufacturing.

Part Management

Matrix makes it easy to create, revise and retire parts and associated CAD models, drawings and other technical documentation. Standard and company-specific attributes are used to capture product specifications, performance, material and other part characteristics. Any combination of attributes can be searched, promoting design re-use. Advanced component management capabilities allow users to track MPNs and associated manufacturers by location. Intelligent links are maintained among associated objects and their revisions at all times, enabling users to search or navigate related information with ease.

Engineering Change Process

Matrix provides tools to formalize, document and control the engineering change process for newly released and existing products. They include:

- **Engineering Change Requests (ECRs):**
ECRs enable users to identify problems or required changes relating to parts or assemblies. The ECR originator can attach sketches, parts or drawings in order to fully detail the work that is needed to implement the change. Multiple ECR requests can be incorporated into a single ECO, as required.
- **Engineering Change Orders (ECOs):**
ECOs are automatically created as a result of an approved ECR. An ECO defines how a change will be implemented and includes new and revised items as attachments. ECOs also specify the workflow steps and product team member approvals required to complete the ECO.
- **Configuration Management (CM):**
CM incorporates best practices, such as revision control, multiple effectivity types and history audit trails to ensure design integrity and change traceability.

Aligned Product Views between Design and Manufacturing with Matrix

As stated earlier, aligning manufacturing with design can be done easily to support a Design Anywhere, Build Anywhere (DABA) strategy so long as the Engineering BOM management and Manufacturing BOM management occur in the same environment. Matrix does just that.

With Matrix, an initial Manufacturing BOM is automatically created when the Engineering BOM is released and design intent is communicated to manufacturing engineers. Part attributes, such as “find number,” “reference designator,” “quantity” and “design versus purchase” decisions are preserved. Thus, the manufacturing engineer has the flexibility to perform the following types of MBOM tasks:

- Assign the effectivity of manufacturing change orders and associated parts on a plant-by-plant basis
- Re-structure/flatten the BOM to indicate manufacturing sequence and phantom part creation/maintenance
- Create/insert manufacturing specific parts such as raw materials and phantom parts
- Set a make/buy flag on any part in the MBOM to indicate to ERP whether an item is procured from a supplier or an internal plant, or if the item is made internally
- Select Engineering-defined, alternate/substitute parts for use in an MBOM

The ENOVIA MatrixOne solution includes a number of configurable reports/views which provide the information needed to make informed decisions. This is particularly important as manufacturing and supplier capabilities can vary widely by geography.

Conclusion

Synchronous Product Development (SPD) minimizes the risks faced by innovative, global product companies. Leveraging SPD, companies enable an environment for streamlined information sharing that forms the core for lean manufacturing and modular product development.

ENOVIA MatrixOne uniquely provides an environment to enable a SPD strategy so that product companies can drive new innovations and their follow-on products to market faster than the competition. By hitting new markets fast with a variety of new product choices, companies can virtually “lock out” competitors’ offerings or force competitors to forego any attempt to enter newly-formed markets. For product companies, the bottom line of SPD with ENOVIA MatrixOne is increased margins for longer periods of time.

MatrixOne, Inc. was acquired by Paris-based Dassault Systèmes in May, 2006 and today is part of its ENOVIA PLM Collaborative Environment family of solutions. The ENOVIA MatrixOne solutions enable companies to accelerate product innovation to achieve top line revenue growth and improve bottom line profitability. ENOVIA MatrixOne is focused on helping companies across the automotive, aerospace & defense, consumer, machinery, medical device, semiconductor and high-tech industries solve their most challenging new product development and introduction problems. More than 850 companies use ENOVIA MatrixOne solutions to drive business value and gain a competitive advantage, including industry leaders such as BAE Systems, Bosch, Comau, General Electric, Honda, Johnson Controls, Linde AG, NCR, New Balance, Nokia, Philips, Porsche, Procter & Gamble, REI, Sony Ericsson, STMicroelectronics and Toshiba. ENOVIA MatrixOne (www.matrixone.com) is headquartered in Westford, Massachusetts, with locations throughout North America, Europe and Asia-Pacific.



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