In today’s increasingly competitive environment, companies are under constant pressure not only to design new products faster, but also to ramp-up production with minimal time-to-market, predictable cost, and required quality. Improving the MPM business process is essential to hitting these challenging cost, time, and quality targets.

Defining Manufacturing Process Management (MPM)

While the focus of many engineering-centric processes is on “what” product to produce, manufacturing process management defines “how” a product is to be produced. By definition, MPM receives the digital product definition from engineering, considers the capabilities and capacities of internal plants and external suppliers, and delivers the set of manufacturing plans required to produce the product.

MPM also entails giving early feedback from manufacturing to engineering based on preliminary versions of the manufacturing processes. Additionally, the MPM process communicates with production systems (ERP/MES), delivering optimized routings, as well as manufacturing bills-of-materials (mBOMs) and work instructions, including all supporting documents needed by production operators to build the product.

Effective manufacturing process management (MPM) can have a significant positive impact on profitability.

Source: DARPA RaDEO Project

**Possible Cost Reduction**

10% to 40% reduction in manufacturing cost.

**Possible Cost Reduction**

10% to 40% reduction in manufacturing cost.

10% – 40% reduction in manufacturing cost.
Understanding the Need to Optimize Manufacturing Process Management

Optimizing the MPM process is becoming increasingly important to companies. Unfortunately, the process itself is also becoming more difficult to streamline. Products, while becoming more complex, must remain configurable to meet market needs. At the same time, production volume, cost, and time-to-market targets are shrinking. Manufacturing organizations must adapt their manufacturing environment to ramp-up new designs with higher productivity, flexibility and quality.

There are four key areas where companies can typically improve their MPM process:

1. Define the Manufacturing Process During the Product Design Phase. Generally, designers “throw the design over the wall” to manufacturing engineers. However, if manufacturing engineers were given direct access to the ever-evolving design information, they could define the manufacturing process in parallel with product design. Furthermore, with this information, manufacturing will become better equipped to handle concurrent product development and better able to adapt to in-process engineering changes.

2. Provide Manufacturing Engineers with Access to Engineering Data. Accurate manufacturing process definition requires that manufacturing engineers be able to directly reuse engineering data, including parts, classification, 3D mockups, and manufacturing requirements, such as GD&T information. Yet, typically, manufacturing engineers lack direct access to this information.

3. Eliminate Manual Processes. Today, most process plans are defined using a spreadsheet program, and work instructions are created using a word processor. This use of manual tools leads to a variety of issues: slow execution of the process, data duplication and inaccuracy, and chaos whenever a change occurs to the engineering definition of the product.

4. Improve Enterprise Collaboration. Since manufacturing environments typically span multiple plants and time zones, and with manufacturers seeking to implement “design anywhere, build anywhere” strategies, it’s difficult for manufacturing engineers to capture and share their knowledge, and ensure consistency across the enterprise.

Benefits of Optimizing Manufacturing Process Management

Typical benefits from improving the MPM process include:

Improved Efficiency of Manufacturing Engineers

- Enables direct reuse and manipulation of engineering information in process plans, to avoid data duplication
- Enables reuse of standardized and normalized processes and resources
- Reduces time required to create and update work instructions though their dynamic generation

Improved Production Ramp-up and Productivity

- Reduces training time and learning curve with accurate and meaningful 3D work instructions
- Reduces production trial-and-error method of optimizing manufacturing processes with digital validation

Reduced Cost of Changes

- Identifies required design changes earlier in the design, with timely feedback from manufacturing
- Streamlines change impact identification and propagation
- Increases engineering visibility to the potential manufacturing impact of a change, to facilitate cost-effective design decisions
- Provides an integral change management system, which supports both engineering and manufacturing needs

Reduced Scrap and Rework

- Reduces the risk of producing incorrect product configurations by eliminating discrepancies between the latest process definition and the work instructions used on the shop floor

Unless manufacturing processes can be planned, designed, modeled, and ramped-up, there is no scalable business potential.

– AMR Research
The Solution: PTC’s Windchill MPMLink

The MPM process is generally characterized by the following steps:

1. **Define Manufacturing Strategy.** In this step, manufacturing engineers evaluate both the design requirements and the manufacturing capabilities and capacities necessary to support the manufacturing strategy. They identify which partners will be required, and any long lead items that will need immediate attention.

2. **Advanced Manufacturing Planning.** (“Advanced”, in this context, means “early”) In this step, manufacturing engineers work concurrently with engineering, as early as possible in the design process, using preliminary design information. Together, they create preliminary versions of the manufacturing bill-of-material (mBOM) and process plans, initiate new tooling requests, and produce time and cost estimates. Factual feedback or requests-for-change are also provided to engineering in the early stages of product design to improve manufacturability.

3. **Optimize Process Plan.** In this step, manufacturing engineers create several manufacturing process alternatives to compare and optimize the manufacturing process. Manufacturing process alternatives can represent either different alternatives in one plant, alternatives between different plants, or make-versus-buy options. Optimization methods typically include line balancing, but can also involve more specialized types of simulation, such as work-center simulation or whole-factory discrete event simulation.

4. **Document Process Plan.** Once the process plan and product design are mature, the manufacturing engineer must detail and document the manufacturing processes that have been selected from the previous optimization step. PTC’s Pro/ENGINEER® or other 3D CAD/CAM tools are used to define NC (numerical control) tool paths or CMM (coordinate measuring machine) inspection programs. Work instructions are produced for the operator, and typically include images of the product, which are dynamically generated from the process definition with Windchill MPMLink. These images can be associatively defined using Pro/ENGINEER or PTC’s ProductView® visualization solution, so that they may easily be kept up-to-date.

5. **Pre-production and Production.** In this step, the manufacturing process definition is electronically released to production systems (ERP/ MES). Work instructions are made available to the shop floor in either printed or electronic format. Electronic work instructions can also be used to collect feedback from the actual execution of the process, such as deviations, waivers and as-built BOMs.
Critical Capabilities

With Windchill® MPMLink, PTC’s Product Development System supports the MPM process with an integral solution that includes the following capabilities:

- Integral Product, Process, and Resource object model: The industry’s only integral PLM (Product Lifecycle Management) solution where both product definition and process definition data are managed in a single system, without any data duplication.

- Integral change and configuration management covering both engineering and manufacturing impact.

- Associative eBOM-mBOM transformation with the ability to transform engineering bill-of-materials (eBOM) into multiple manufacturing bill-of-materials (mBOM), while keeping associativity with traceability links.

- Create and manage alternate BOMs describing the different manufacturing variations that can produce the same part.

- Quickly identify and analyze discrepancies between the eBOM and mBOM, with visual indicators and BOM comparison reports.

- Embedded 3D environment (provided by included ProductView capabilities) enabling users to:
  - Visualize engineering designs.
  - Select parts from 3D to create mBOM and to allocate part to process plan operations.
  - Dynamically generate 3D representations of the mBOM, process plan and operations.
  - Include 3D annotations and markups.

- Process plans that allow the definition of plant-specific processes with alternate and parallel sequences of operations and sub-operations.

- Completely define process plan operations with parts, resources, standard procedures, documents, and time breakdown.

- Review and analyze process plan definitions in an easy-to-use, interactive Gantt chart, including resource usage and loading.

- Manage a common library of manufacturing resources, such as Plant, Work Center, Tooling, Process Materials, Skills, and standardized processes.

- Dynamically generated rich work instructions.

- Electronically share manufacturing deliverables with ERP or MES systems using secure Windchill integration technology.

PTC – Uniquely Qualified

An automated and optimized MPM process not only requires the implementation of superior technology, but it also requires companies to streamline their day-to-day processes. Just as important, companies need to ensure that everyone across the organization understands and adopts the new processes and technology.

After 20 years of deploying process and technology improvements across thousands of customer sites, PTC Global Services understands all the components required for companies to achieve their product development goals. We offer solutions that include the right blend of process consulting, system implementation, and education services, so customers realize the most value from their PDS investment.

We implement industry best practices that fully leverage PTC technology, so companies can take full advantage of the technology’s potential while avoiding costly customizations. Plus, each of our solutions incorporates a unique training approach that accelerates the adoption of new technology and processes.

© 2009, Parametric Technology Corporation (PTC). All rights reserved. Information described herein is furnished for informational use only, is subject to change without notice, and should not be construed as a guarantee, commitment, condition or offer by PTC. PTC, the PTC Logo, Windchill, MPMLink, ProductView, Pro/ENGINEER, and all PTC product names and logos are trademarks or registered trademarks of PTC and/or its subsidiaries in the United States and in other countries. All other product or company names are property of their respective owners.