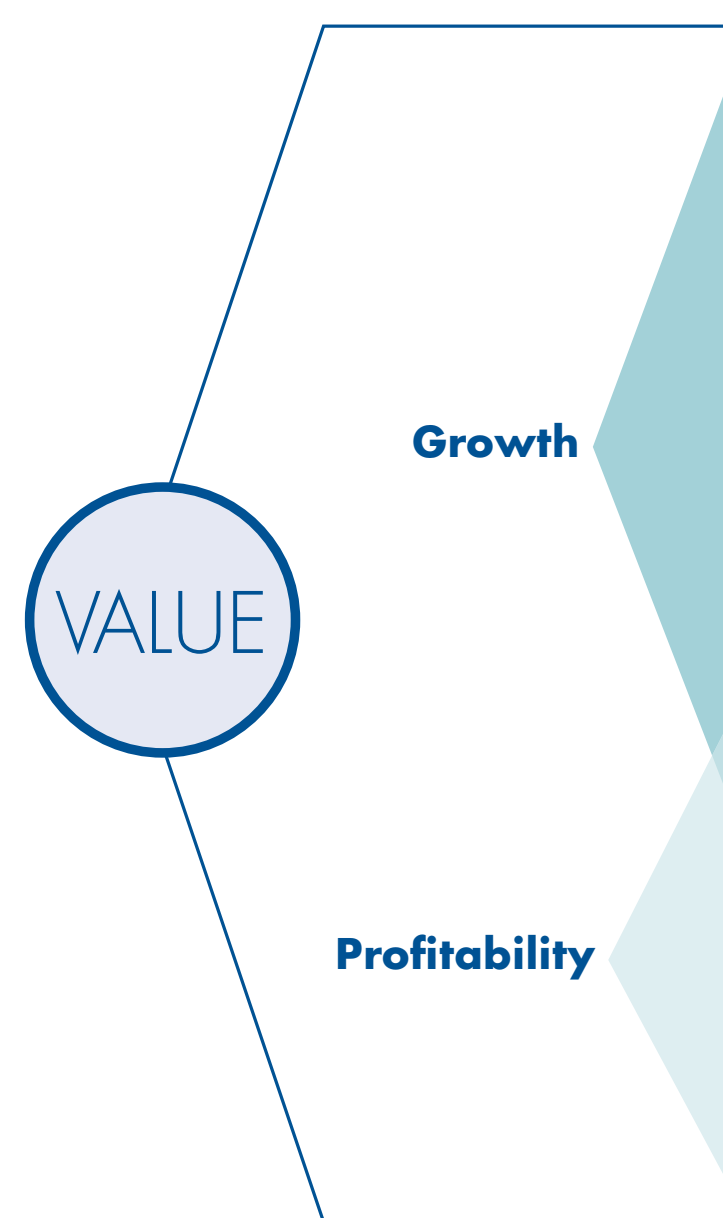


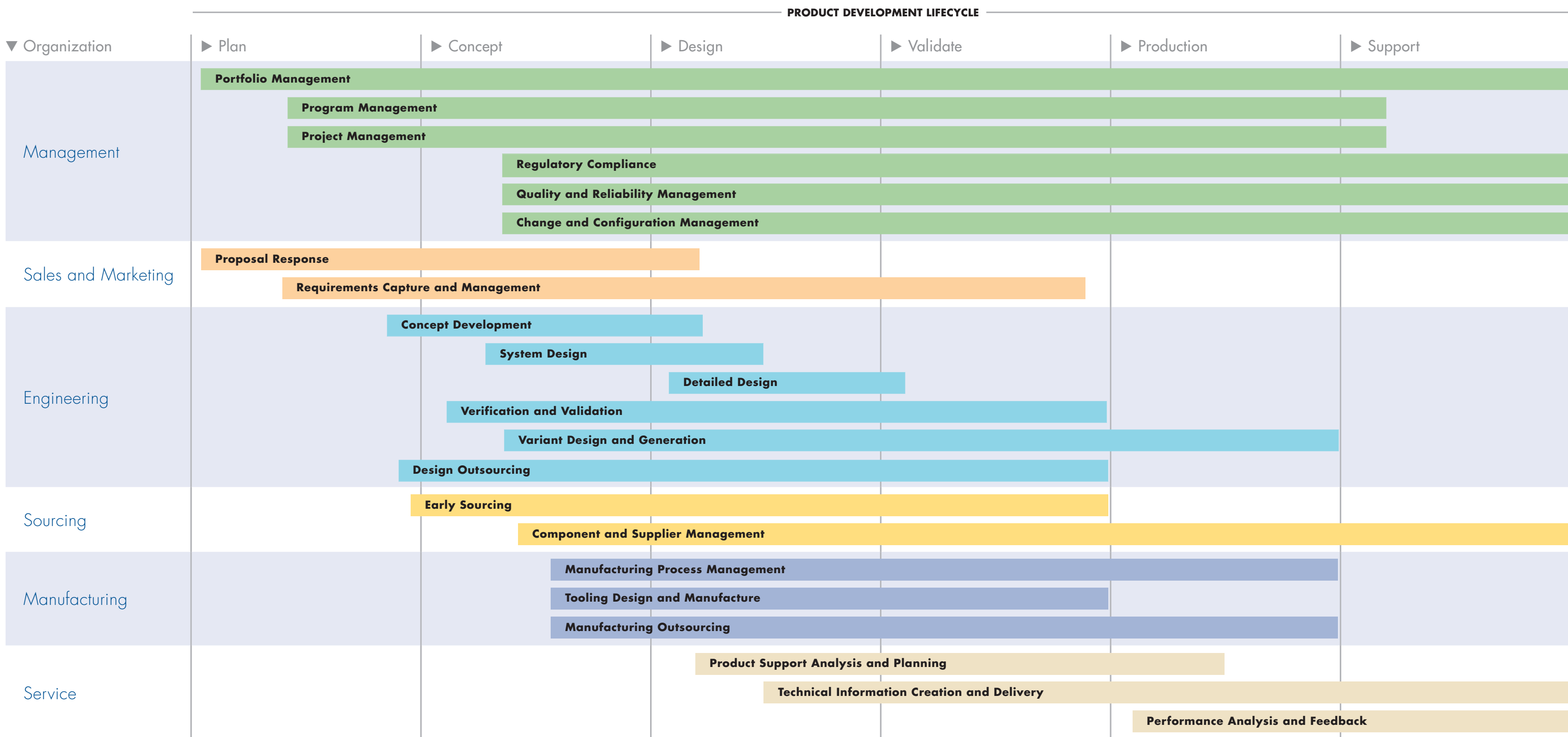
Discrete Manufacturing

Value Opportunities



▼ Organization

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Processes Part 2: **Process Landscape****Best Practices**

Industry-leading Processes and Capabilities

Management

● **Portfolio Management**

- Drive innovation, optimize collective value, manage risk, and make trade-off decisions across a set of programs while ensuring alignment with strategic objectives.
- **Program process standardization** Standardize on a phase-gate new product development process using project templates. Impart consistent project success criteria and regular governance. Improve the ability to make Go/No Go/Hold decisions and resource trade-offs.
 - **Portfolio dashboards** Provide portfolio managers with visibility to portfolio pipelines and cross-program performance to ensure optimal, strategic allocation of resources.

● **Program Management**

- Govern and coordinate development projects to mitigate risk, maintain focus on objectives, and facilitate consistent, high-quality execution.
- **Program process standardization** Standardize product development and technology development processes using project templates. Publish, automate, and enforce program management standards. Drive execution to common schedules and milestones.
 - **Program gate deliverable control** Identify critical gate deliverables for program milestones. Manage and track completion through automated workflows.
 - **Integrated program data management** Collect, organize, and manage program data across multiple projects. Simplify stakeholder access to secure, relevant information; improve program collaboration.
 - **Program dashboards** Improve stakeholder's visibility into status, progress, and overall performance through live dashboards and reports.

● **Project Management**

- Plan, execute, monitor, and control complex development efforts and dependencies spread across globally distributed project, product, and technology teams.
- **Project planning and tracking** Plan and manage project activities, milestones, deliverables, risks, and resources. Continuously update plans to identify critical path and interdependencies. Automate project task delivery and tracking.
 - **Distributed project collaboration** Provide secure and managed collaborative workspace for work in progress, such that project data is easily reconciled with system of record.
 - **Project dashboards** Improve project manager's visibility into status and project progress through live dashboards and reports.

● **Regulatory Compliance**

- Design, manufacture, dispose of, and recycle products in compliance with global directives.
- **Compliance standards definition and tracking** Capture and manage multiple, evolving regulations. Develop, codify, and maintain a proactive corporate compliance standard.
 - **Systematic environmental data acquisition and validation** Acquire environmental data directly from suppliers and from other sources. Target a level of disclosure that effectively manages risks and avoids excessive data-acquisition costs. Systematically validate, maintain, and enhance data over time.
 - **Product environmental compliance dashboards** Anticipate future environmental mandates in order to identify sources of risk and potential failure points early and throughout the product lifecycle. Provide dynamic management dashboards to support part, product, and program risk assessments supporting timely corrective action.
 - **Automated compliance documentation and reporting** Automatically generate accurate reports that demonstrate product environmental compliance, supporting due diligence for regulatory authorities, and meeting customer requirements. Provide appropriate levels of disclosure for the intended audiences, and systematically build a traceable audit trail.
 - **Compliance data-sharing to enterprise** Share compliance statuses and other environmental performance metrics to key stakeholders throughout the enterprise. Build environmental performance management into standard business processes.

● **Quality and Reliability Management**

- Conduct systematic planning, prediction, and simulation to ensure designs meet reliability and lifecycle cost targets.
- **Systematic quality planning and risk assessment** Front load failure mode and effect analysis, reusing past experience to identify critical components and plan mitigation. Distribute failure mode definition and analysis across multiple engineers for concurrent development.
 - **Early reliability prediction and simulation** Predict component, assembly, and system failure and availability rates early and iteratively, based on standard prediction models, as well as test and field performance data.
 - **Maintainability and lifecycle cost prediction** Estimate maintainability costs early and iteratively, based on predicted availability, repair logistics, and sparing strategies.
 - **Reliability dashboards and tradeoffs*** Allow visibility for program stakeholders into the design's evolving reliability and maintainability performance against targets. Perform tradeoff analysis against other performance characteristics; assess design alternatives.
 - **Closed-loop field performance feedback** Establish a field product performance feedback loop into engineering. Expose common failure modes. Drive mitigation strategies and systematic improvement in future designs.

● **Change and Configuration Management**

- Evolve products in an orderly fashion, from concept through retirement.
- **Standardized, automated change process** Implement a closed-loop standard change process. Adapt routing workflows according to change severity. Automatically capture change history, electronic signatures, and audit trails. Notify affected parties of change effectivity.
 - **Integrated, cross-discipline change management** Implement a change process across the complete product definition, and through the common product information repository. Provide stakeholders with access to necessary product data during evaluation, review, approval, and implementation of changes. Capture and associate revision and iteration history of affected digital product information with each change.
 - **Partner change integration** Integrate partners into engineering change review, approval, and implementation activities. Increase visibility by ensuring problem and impact are fully understood. Improve quality and efficiency of changes.
 - **Integrated product issue management** Implement a flexible online issue/change request process. Allow any affected party to indicate and substantiate the need to rectify a problem or improve a design/process. Ensure problems are understood and prioritized effectively.
 - **Change dashboards** Provide an online change dashboard to expose trends regarding volume and severity of changes, and change processing cycle time.
 - **Product configuration lifecycle management** Manage evolving product configurations over entire lifecycle. Accommodate rule-based configurability (e.g., per revision or maturity), substitute parts, serialized parts, effectively (e.g., time- or lab-based), and organization-specific BOMs (e.g., as-maintained, as-planned). Provide traceability between upstream design and downstream configurations to ensure change visibility and appropriate change propagation.
 - **Product configuration-sharing to enterprise** Automate sharing and synchronization of product configuration information across enterprise systems. Ensure new engineering information is effectively incorporated into other business processes.
 - **Unified hardware-software configuration management** Ensure release of the correct version of software with the overall product configuration, eliminating quality problems, late-stage changes, and delays.

Sales and Marketing

● **Proposal Response**

Respond to a customer's request for proposal, pricing, or information by collaboratively creating a timely, accurate, and competitive formal response.

- **Proposal planning and tracking** Plan and manage proposal activities, milestones, deliverables, risks, and resources. Continuously update plan to identify critical path and interdependencies. Automate project task delivery and tracking.
- **Distributed proposal collaboration** Provide a secure and managed collaborative workspace for evolving proposal project data. Ensure the entire proposal team is working with the latest information. Incorporate customer and supply chain into proposal process. Standardize and automate proposal review processes. Reduce time spent searching for necessary customer information.
- **Proposal library management** Establish a library of proposal information to facilitate reuse and provide audit history. Include related reference documents, product data, and supply chain feedback generated during proposal response projects.

● **Requirements Capture and Management**

- Translate the voices of customers into prioritized requirements, targets, and constraints while establishing bidirectional traceability between requirements, analysis documentation, product designs, BOMs, and verification data.
- **Requirements lifecycle management and control** Manage and control individual requirement definitions and specification approval throughout the lifecycle.
 - **Requirements flowdown** Establish traceability between customer needs, market requirements, and their associated technical specifications/designs. Ensure that all requirements are allocated to the product design.
 - **Requirements verification** Establish test requirements describing verification methods at each level of decomposition in the system design. Provide systematic means to ensure requirements have been met by the design.

Engineering

● **Concept Development**

Define alternate product concepts, investigate feasibility, and select the best candidates.

- **Distributed collaboration** Enable collaboration on work-in-process design data. Share product information throughout enterprise in order to facilitate front-end ideation, concept development, and design refinement.
- **Associative conceptual engineering*** Relate and reuse 2D engineering concepts in 3D designs in order to shorten design cycles.
- **Standardized engineering calculations** Capture, standardize, and automate the reuse of company and industry-standard engineering calculations across programs.
- **Flexible reverse engineering** Automate the transfer of physical prototype surfaces into CAD for reuse in design.
- **Efficient and effective customer review** Provide life-like product design review experience using photorealistic digital prototypes for early market feedback.
- **Design studies and tradeoff analyses** Perform design sensitivity studies to establish performance envelopes and tradeoff curves.
- **Associative industrial designs** Use associative modeling techniques to enable product styling concepts and detailed designs to be developed concurrently. Accommodate iterative changes without time-consuming rework.

● **System Design**

Develop the functional and physical architecture, model of the product, associated specifications, and derived requirements.

- **Requirements flowdown** Establish traceability between customer needs, market requirements, and their associated technical specifications/designs. Ensure that all requirements are allocated to the product design.
- **Requirements verification** Establish test requirements describing verification methods at each level of decomposition in the system design. Provide systematic means to ensure requirements have been met by the design.
- **Functional/logical structure management** Formalize the definition and management of system functions. Provide traceability, from requirements to design solutions.
- **Modular architecture definition** Design a modular product architecture to enable increased levels of design reuse, and increase the ability to tailor products for specific markets or customers.
- **Interface definition and management** Identify, document, and publish key module interfaces to establish design boundaries and enable concurrent product development. Manage and communicate changes to interfaces.
- **Generic product platform design** Streamline development of a common platform by capturing and managing a generic product structure.
- **Platform CAD structure management** Relate product structure and CAD assembly structure to support efficient modular platform development, visualization, and variant generation.

● **Detailed Design**

Define the product design completely, such that it meets requirements and is sufficiently documented for manufacturing.

- **Distributed collaboration** Enable collaboration on work-in-process design data. Share product information throughout enterprise in order to facilitate front-end ideation, concept development, and design refinement.
- **Integrated, cross-discipline BOM** Manage and relate cross-discipline product information (e.g., mechanical, electrical, software, product documentation) in a single product structure. Establish a single, synchronized source of product data.
- **Top-down design** Proactively plan and structure larger CAD assemblies to support team-based development without concurrency gridlock. Reuse and associate early product structures with CAD structures.
- **Associative 3D part modeling** Create 3D models of all mechanical parts and assemblies to ensure design accuracy while reducing or eliminating the need for expensive physical prototypes. Use digital part models in downstream manufacturing activities.
- **Associative routed systems** Concurrently develop logical schematic, 3D cabling, and piping design, as well as harness and piping manufacturing instructions.
- **Associative drawings** Automate the generation of 2D production drawings from the 3D master model design data. Eliminate errors, and enable concurrent design and drawing development.
- **Drawingless design** Document and deliver 3D designs for downstream consumption and eliminate or reduce the reliance on 2D drawings.
- **ECAD-MCAD collaboration** Streamline exchange of incremental design changes between electrical and mechanical domains in PCB design to improve cross-discipline communication and decrease design cycle time.
- **Work practice standardization** Establish best practices for design standards and data reuse. Automate validation of digital product designs for compliance with design standards and lower costs by early detection of potentially expensive manufacturing problems.
- **Efficient design review** Provide easy and timely access to latest design data to facilitate asynchronous design collaboration, regardless of the data size or type. Encourage continuous feedback, and manage formal design review preparation, execution, and follow up.
- **Large MCAD assembly management** Optimize system performance and workability of complex CAD assemblies.

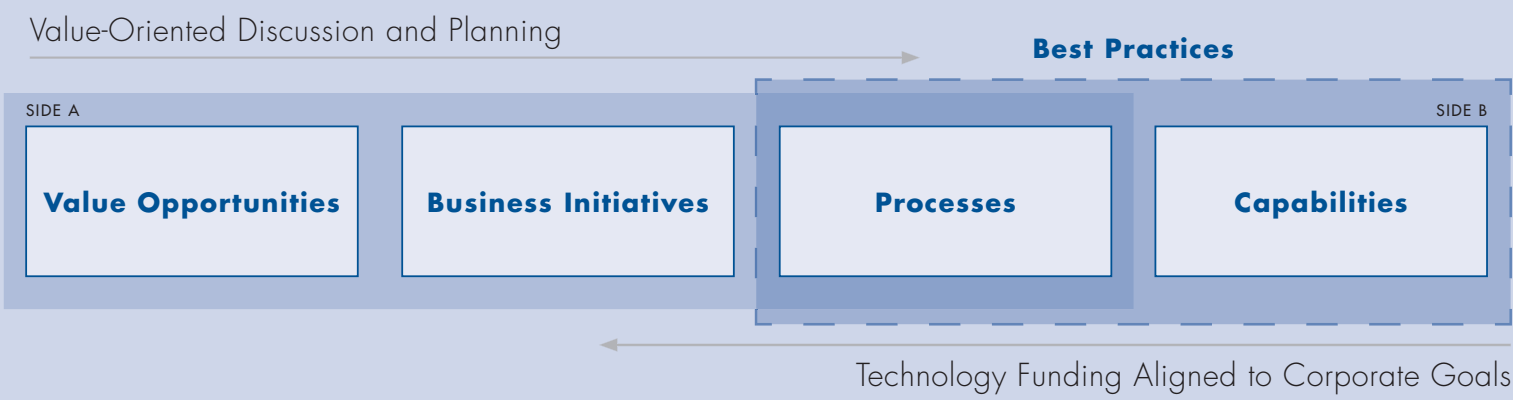
Overview

The PTC Value Roadmap is a structured collection of rich intellectual property for the purpose of helping product development organizations meet their financial objectives. Its content has been shaped by interactions with thousands of customers, by engagements with numerous consultants and leading academics, and by PTC's heritage in supporting product organizations for more than twenty-five years.

How to Use the PTC Value Roadmap

The most common way to use the Roadmap is to guide value-oriented discussions and planning. This process begins on Side A with the identification of relevant, corporate-driven value opportunities and the prioritization of corresponding business initiatives. This approach continues by identifying the processes and capabilities (which together represent a series of best practices) that enable these initiatives to be realized.

It's equally possible to use the Roadmap as a means to align technology funding initiatives with corporate goals. This approach begins on Side B with an identification of desired best practices and process improvement areas, and continues by working backwards through alignment with associated initiatives and value opportunities on Side A.



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Sourcing

● **Early Sourcing**

- Involve sourcing teams early by leveraging strategic supplier relationships to achieve target product costs, meet DFM/DFA goals, and minimize product environmental impact.
- **Distributed supplier collaboration** Proactively partner with suppliers to identify cost drivers and enable early mitigation strategies for critical components. Provide a secure and managed collaborative workspace for relevant design data. Ensure the entire team is working with the latest information.
 - **Target cost dashboards** Establish cost targets for components. Provide program stakeholders with visibility into target costs and cost estimates.

● **Component and Supplier Management**

Enable global organizations to effectively find, select, and incorporate preferred parts and suppliers during product development and sourcing.

- **Part search and classification** Rapidly locate parts and components based on key attributes. Organize part libraries to enable efficient and effective search and navigation; reduce part duplication.
- **Supplier qualification management** Provide a standardized process for qualifying and maintaining preferred suppliers. Identify important sourcing/selection scenarios and define supplier preferences by part classification. Enable effective finding, selection, and incorporation of preferred suppliers during product development and sourcing activities.
- **New part introduction standardization** Implement a lean and controlled new part introduction process. Facilitate reuse of existing parts, lowering associated costs for duplicating parts. Ensure Design-for-X (e.g., environmental, assembly) methods are considered early.
- **ECAD/MCAD library integration** Integrate and synchronize ECAD component libraries with MCAD libraries in PLM/ERP to eliminate redundancies and errors.
- **Supplier change management** Provide a standard, predictable change process to integrate changes to supplier parts. Increase visibility by ensuring problem and impact are fully understood. Improve quality and efficiency of changes.
- **Approved manufacturer and vendor lists** Create and manage approved manufacturer and vendor lists (AML/AVL) for supplier parts. Ensure consistency of utilization of suppliers for multiple product lines across multiple geographies.

Manufacturing

● **Manufacturing Process Management**

Define and manage the manufacturing processes to be used to fabricate parts, to assemble final products, and to perform inspection.

- **Automated NC process planning** Embed manufacturing process data into design features to enforce the automatic reuse of proven and standardized manufacturing methods.
- **Integral manufacturing data management** Enable enterprise management of manufacturing data and deliverables. Provide a common, central repository with a comprehensive data model supporting product, process, and resources.
- **Associative eBOM/mBOM** Transform engineering bill of materials (eBOMs) into multiple plant-specific manufacturing bill of materials (mBOMs) while maintaining bidirectional traceability.
- **Digitally defined process plans** Digitally define, manage, and analyze process plans describing how parts are manufactured, assembled, inspected, and maintained.
- **Dynamically generated manufacturing documentation** Dynamically generate accurate and on-demand rich, visual shop-floor work instructions.
- **Integral engineering to manufacturing change management** Enable end-to-end change process automation and control services. Streamline changes from engineering to manufacturing; ensure accuracy of manufacturing deliverables.
- **Automated release-to-production** Automate release of engineering, manufacturing, and change information to production systems (ERP/MES).

● **Tooling Design and Manufacture**

Design and manufacture necessary tooling (e.g., molds, dies, electrodes, mold bases) required to produce a part.

- **Associative tool design** Use associative modeling techniques to enable concurrent development of product designs and tooling designs. Automate design change propagation and eliminate time-consuming rework.
- **Dynamically generated manufacturing documentation** Dynamically generate accurate and on-demand rich, visual shop-floor work instructions.
- **Integral manufacturing data management** Enable enterprise management of manufacturing data and deliverables. Provide a common, central repository with a comprehensive data model supporting product, process, and resources.
- **Automated engineering-to-manufacturing change propagation** Enable end-to-end change process automation and control services. Streamline changes, from engineering to manufacturing; ensure accuracy of manufacturing deliverables.

PTC Value Roadmap Version 6.1

Identifying and Realizing Value in Product Development

Discrete Manufacturing

● **Manufacturing Outsourcing**

- Engage a third-party manufacturer to produce a part, component, or product.
- **Traceable product data sharing** Enable effective collaboration with manufacturing partners by sharing product data. Provide different methods tailored to support the needs of alternative business relationships. Provide traceability to what was delivered, received, and accepted.
 - **IP protection support** Control access to sensitive IP by securely compartmentalizing data within the system (e.g., role-based and policy-based access, digital signatures, export control and classification) and by controlling data once it has left the system (e.g., low-fidelity representations, watermarking, digital rights management).
 - **Work practice standardization** Standardize execution of outsourcing projects, aligning business processes and work methods between OEM and suppliers.
 - **Partner change integration** Integrate partners into engineering change review, approval, and implementation activities. Increase visibility by ensuring problem and impact are fully understood. Improve quality and efficiency of changes.

Service

● **Product Support Analysis and Planning**

Define the service activities and intervals necessary to meet the targeted operating performance of a product.

- **Early reliability prediction and simulation** Perform early, iterative prediction of component, assembly, and system failure and availability rates based on standard prediction models, test, and field performance data.
- **Maintainability and lifecycle cost prediction** Estimate maintainability costs early and iteratively, based on predicted availability, repair logistics, and sparing strategies.
- **Systems-based supportability planning*** Define and manage supportability plans based on systems and sub-systems to ensure consistency and enable reuse across products.
- **Applicability-driven supportability planning*** Define supportability plans to address all product and utilization variations and enable the delivery of equipment-specific service information.

● **Technical Information Creation and Delivery**

Leverage, author, publish, and deliver product information that describes the capabilities, operation, repair, maintenance, and support of a product.

- **Structured authoring and automated assembly and publishing** Provide structured authoring of reusable information for template-based automated publishing of personalized product- and language-specific content.
- **CAD-based 2D and 3D technical illustrations** Automate the creation of high-quality, intelligent 2D and 3D illustrations and animations from 3D CAD models.
- **Single-source content and workflow management** Enable centralized management of structured document components and automated access/review/approval/change workflows.
- **Translation outsourcing management** Identify document components that need to be translated; create, route, and manage translation work packages for language service providers (LSP) or translation systems*, and ensure integrity of links between localized components and source documents.
- **Associative change management for product information** Intelligently link technical product information to real-time product design data and streamline change propagation for illustrations and product information outputs as engineering designs change.
- **Interactive product information delivery** Deliver interactive, task-based product information to consumers, improving the usability, relevance, and timeliness of the content.

● **Performance Analysis and Feedback**

- Collect and evaluate historical product and service information to recommend continual product and service improvements.
- **Closed-loop field performance feedback** Provide field product performance feedback loop into engineering to identify common failure modes and drive mitigation strategies and systematic improvement in future designs.

*Support contingent upon future software releases; plans subject to change at PTC's discretion.