Prosperity Heights Software

Domain-specific Engineering for Productivity and Quality

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Domain-specific Engineering

- **What is it?**
  - **– Problems it solves**
  - **– Concepts, experience**
- **How does it work?**
  - **– Creating a domain**
  - **– Producing customized products**
- **How do you start?**

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Symptoms of a Problem

- **An organization repeatedly builds similar systems, with excessive costs, delays, and errors.**
- **Customers' needs are often unclear or misstated.**
- **With incomplete or unclear requirements, developers resort to arbitrary development choices that are difficult to change.**
- **Predictable changes in requirements or technology force substantial rework of systems.**

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Source of the Problem: The Software Process

- **Optimized to creating unique products, one at a time, to address precise, unchanging requirements**
- **Lacks automation beyond record keeping aids**
- **Results in products that are unreliable and expensive to change**
- **Level-of-effort funding that conflicts with a need to invest in software capability**

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The Alternative: Domain-specific Engineering (DsE)

Standardization of the most effective solutions to a class of similar problems

- **Identify a product line business area whose customers need similar products.**
- **Develop a shared understanding of how and why needed products are similar.**
- **Create a means to produce standardized, customized products rapidly.**
- **Transition systematically, with tailoring and incremental improvement.**

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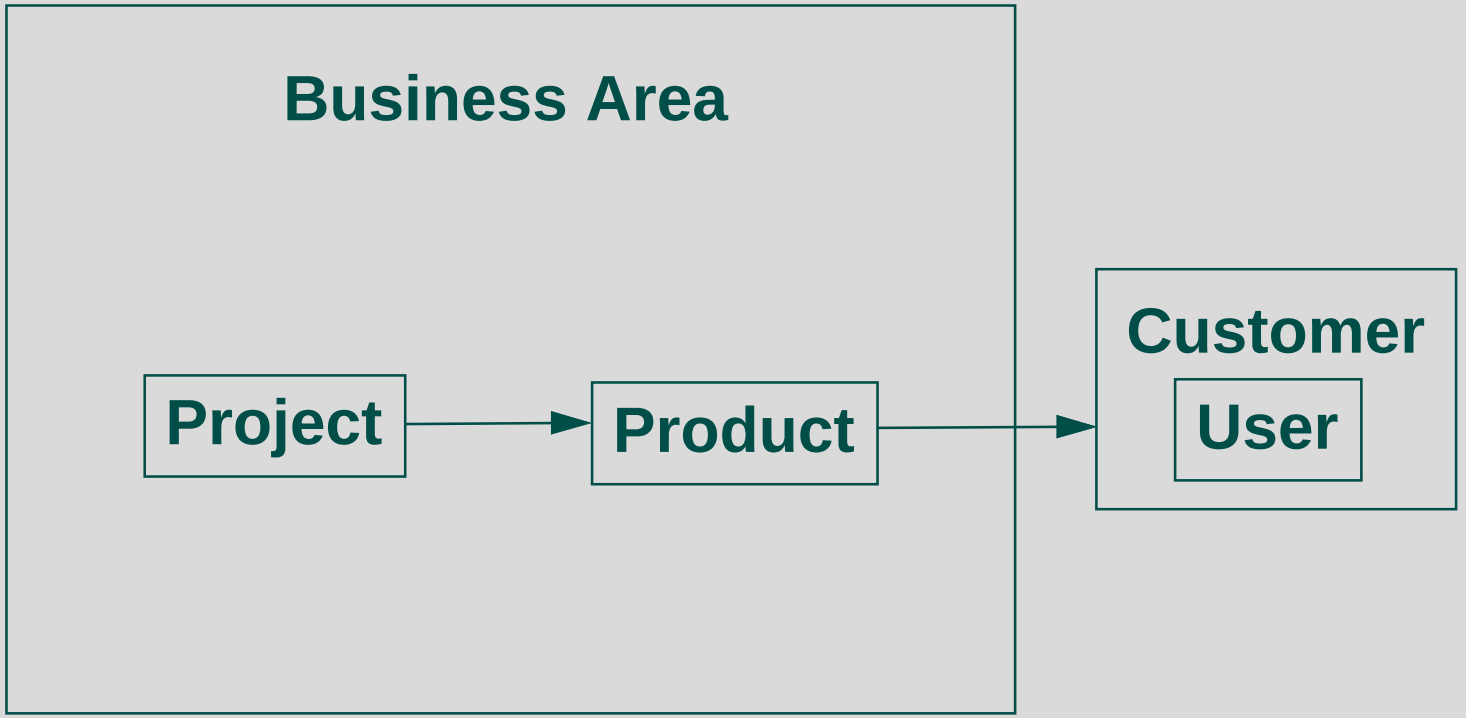
Conventional Organizational Model



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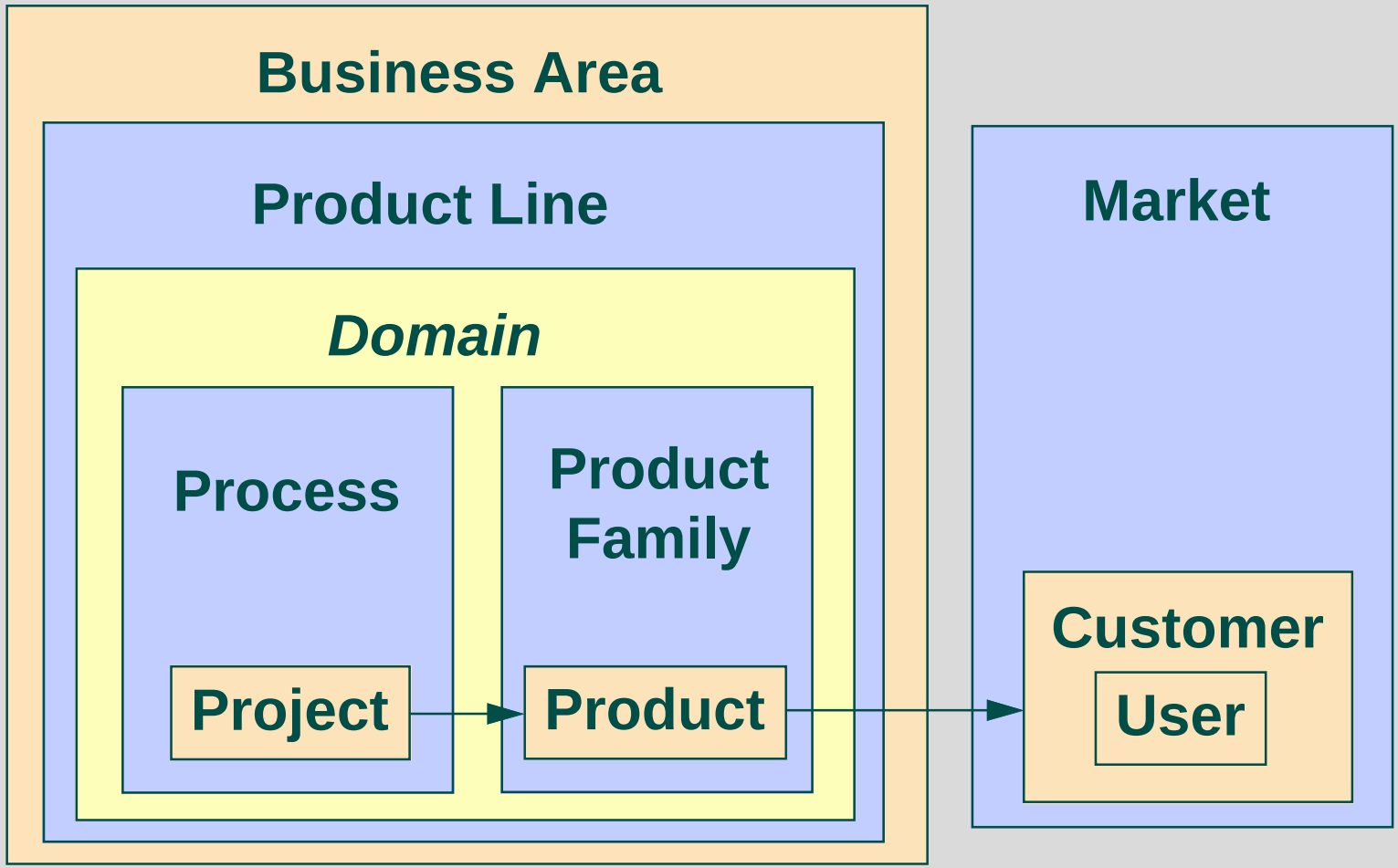
Organizational Model for DsE



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Goals of Domain-specific Engineering

- **Customized products in less time at lower cost**
- **A revised product rapidly when a customer's needs change**
- **Less redundant work, due to standardization and reuse, when creating similar products**
- **A shared understanding of problems and solutions**
- **A framework for disciplined engineering methods**

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Implications

- **Management focuses on domain investment, not costs of single-product crafting**
- **Projects focus on resolving key problem/solution variations, with reuse across projects**
- **Marketing focuses on selling product line capabilities, with better cost-risk estimates**
- **Fast, flexible responses to diverse and changing customer needs**

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Benefits

- **Cost-reducing standardization:**
  - **Market-focused business objectives lead to explicit limits on product diversity.**
  - **The development process is reduced to its essentials for a particular product line.**
- **Market-responsive flexibility:**
  - **A product can be tailored to each customer's specific needs.**
  - **A new product version can be produced whenever a customer's needs change.**
  - **Alternate versions of a product can be built (or modeled) to let a customer choose a preferred solution.**

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Basic Tenets of Reuse

- **The only sound basis for reuse is an envisioned set of *similar* products or components: a family.**
- **Similarity implies both *commonality* and *variability:***
  - **Commonality is the basis for *standardization* of products and process (to form a domain).**
  - **Variability characterizes the *flexibility* needed to accommodate differences in customers' needs.**
- ***Adaptability* is an explicit representation of similarity, characterized by a set of deferred/changable *decisions* sufficient to designate a particular member of a family.**

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Industrial Experience

- **Rockwell**
  - **– Message switching systems software**
  - **– Global Positioning Services**
- **Boeing**
  - **– Flight training systems software**
- **Lockheed-Martin**
  - **– Command center software**
  - **– Satellite avionics software**
  - **– Test equipment software**
- **Thomson-CSF (multiple domains)**

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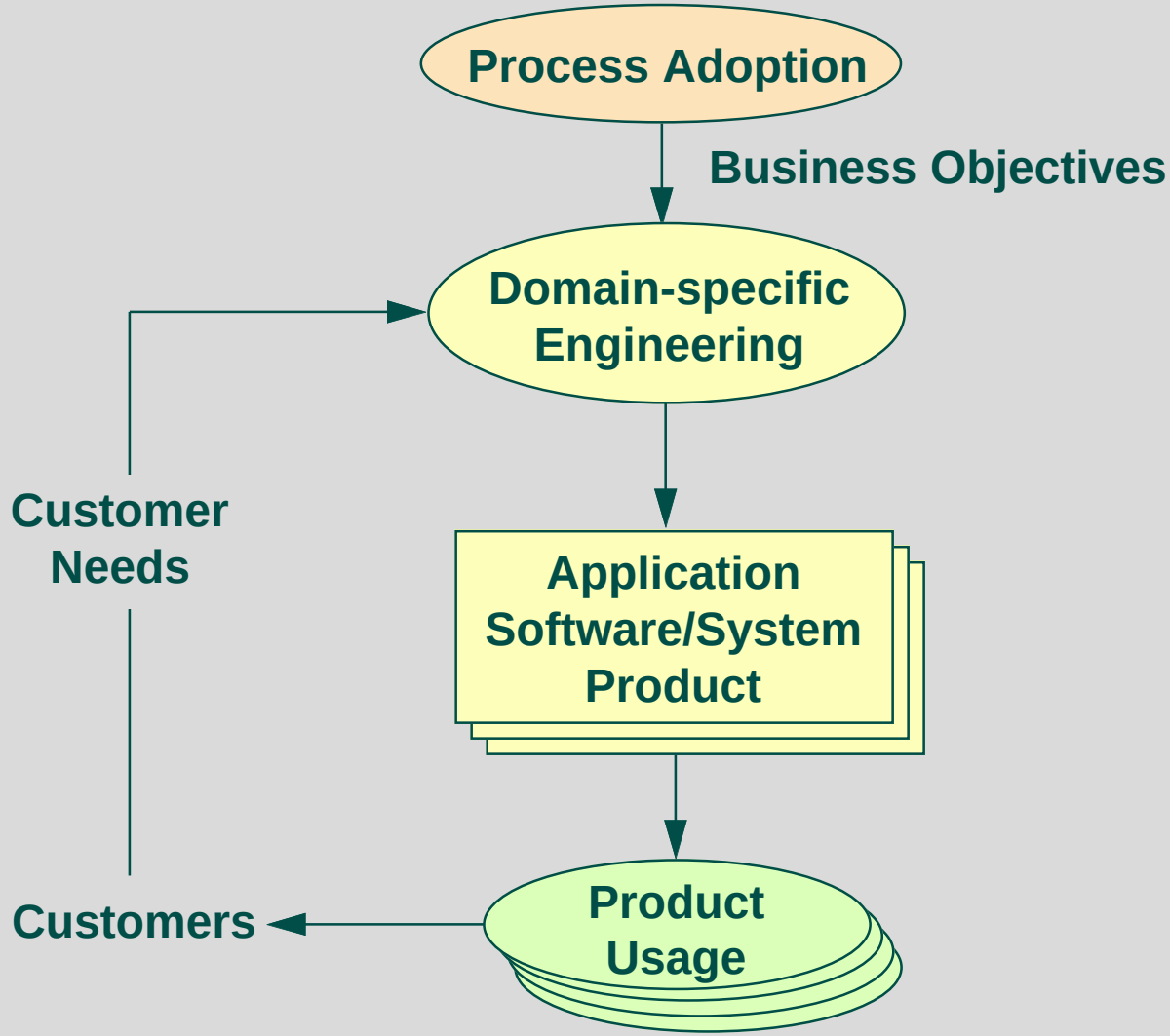
Domain-specific Engineering



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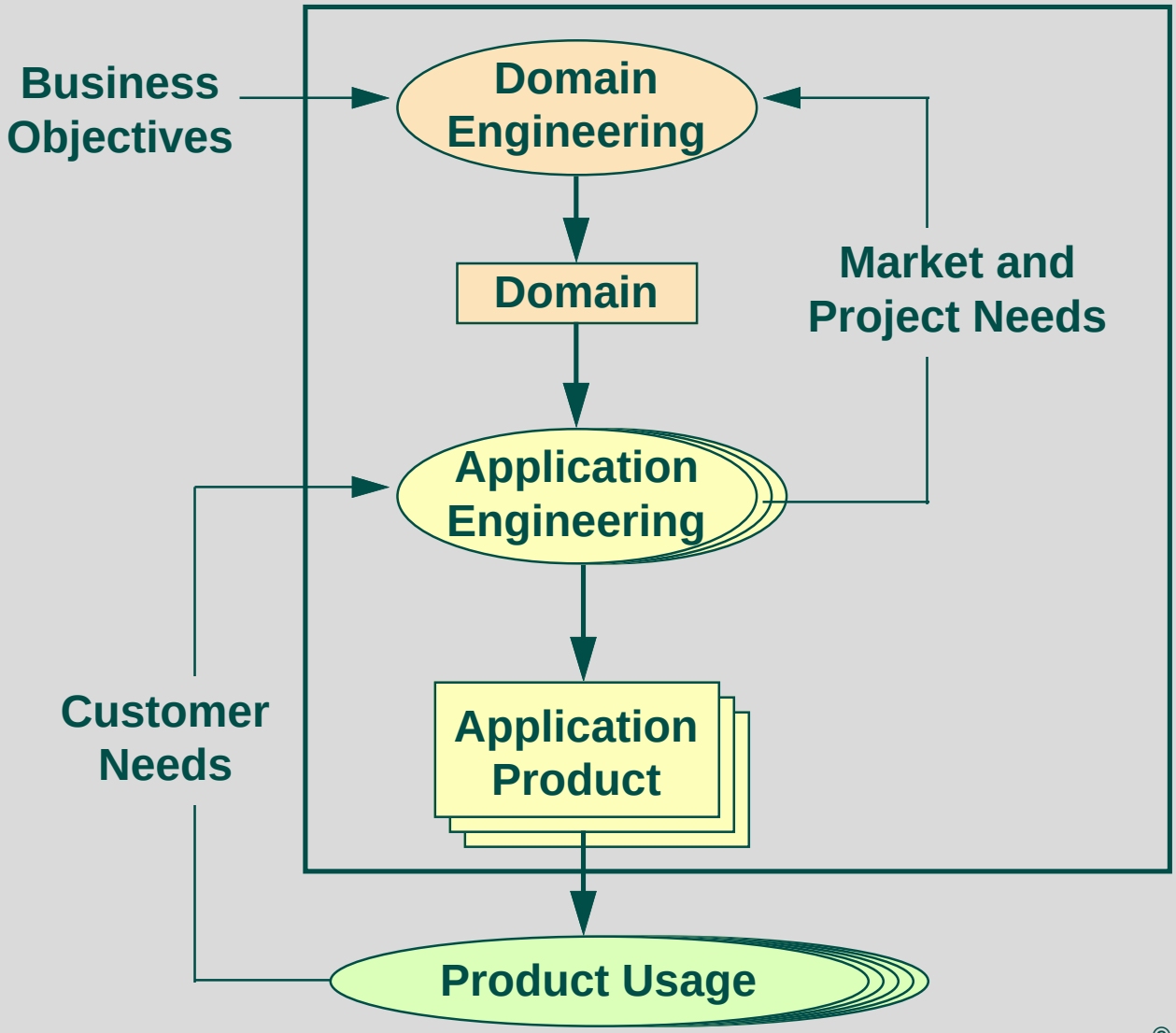
The DsE Process



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Activities

- **Domain Engineering:**
  - **Standardize a product family, adaptable to deferred requirement and engineering decisions.**
  - **Establish a standard process for resolving deferred decisions.**
- **Application Engineering:**
  - **Resolve deferred decisions to match customer needs.**
  - **Mechanically produce a product, adapted to resolved decisions.**

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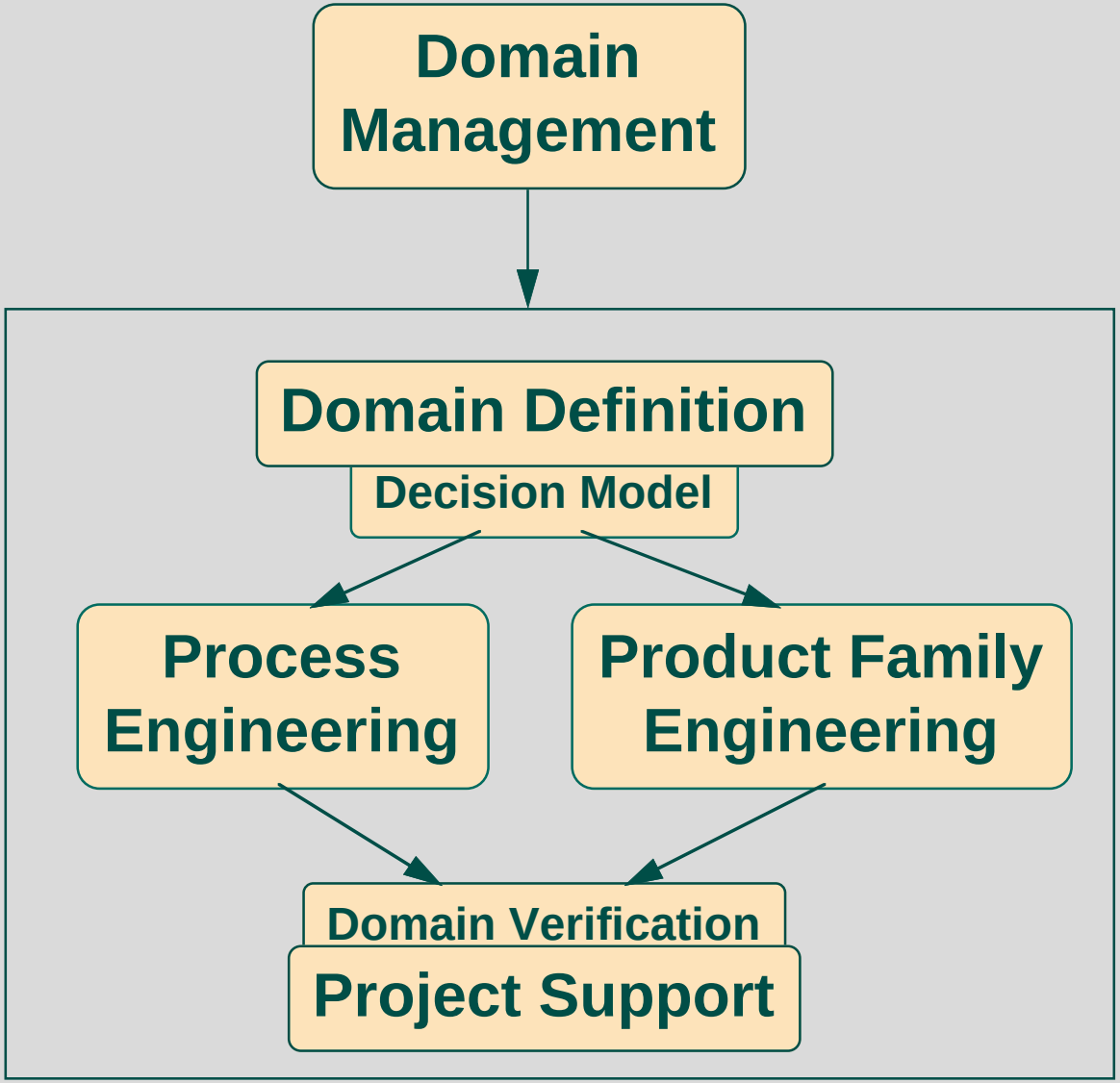
A Domain Engineering Process



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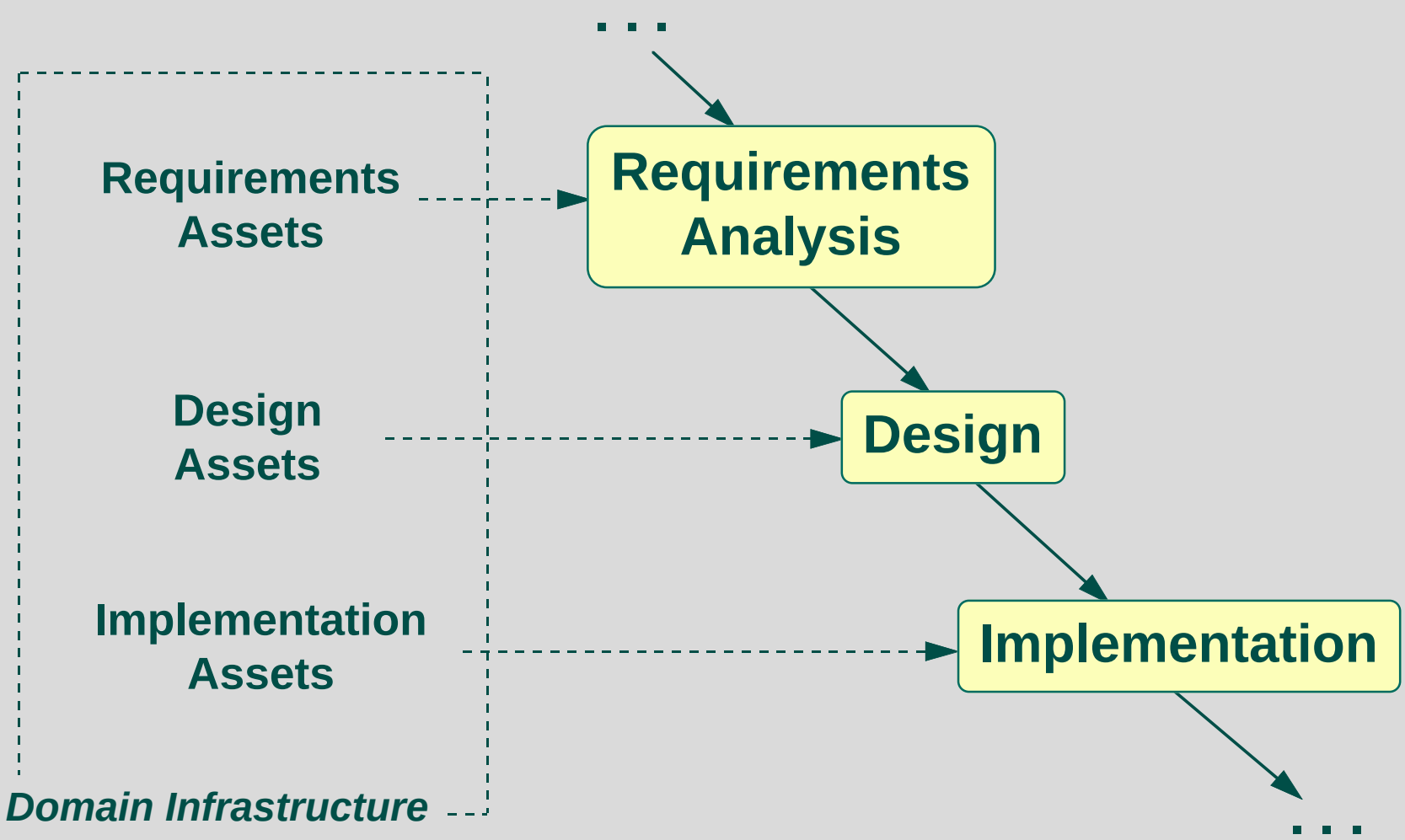
A Conventional Application Engineering Process



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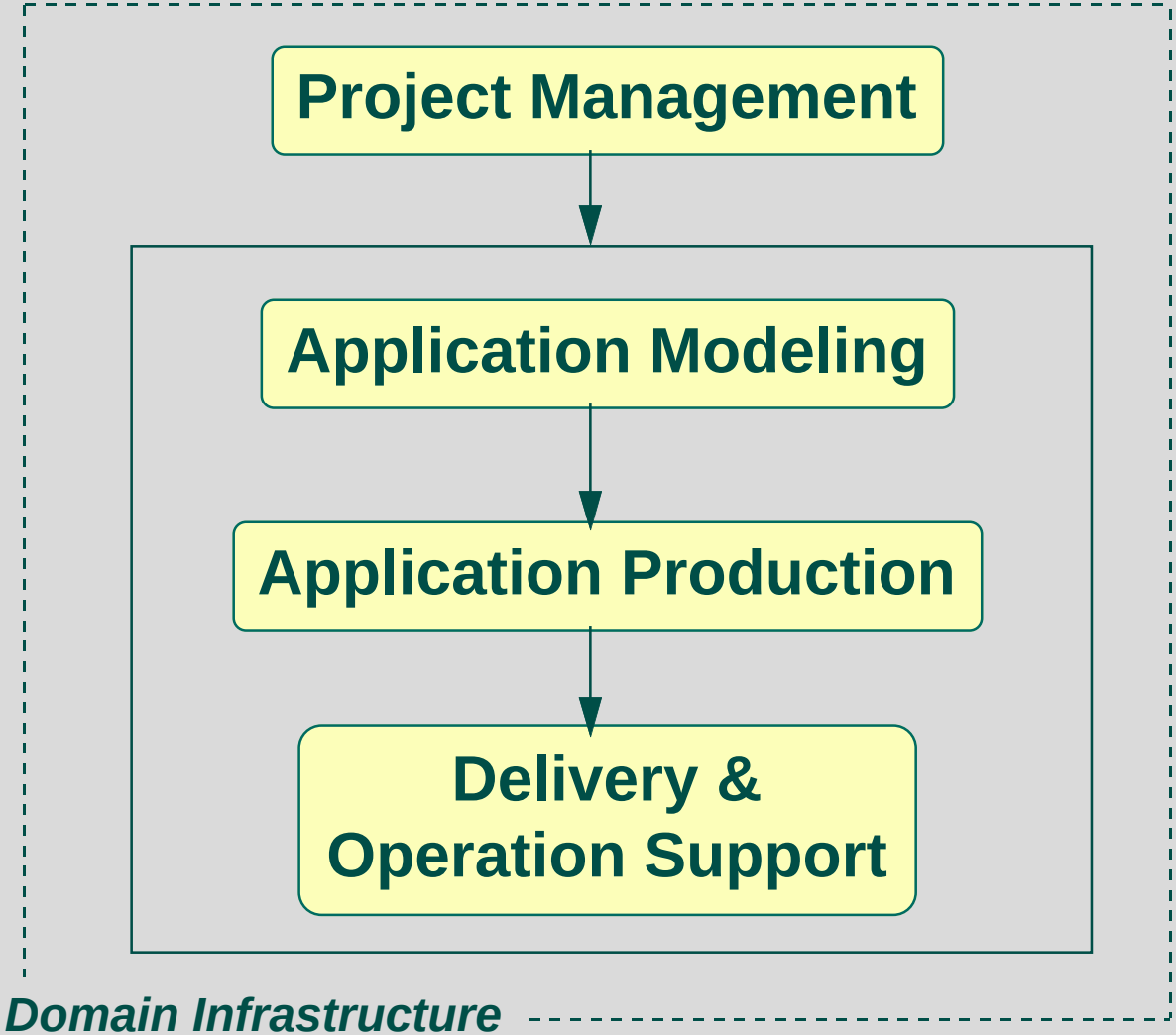
A Streamlined Application Engineering Process



Product Specification & Validation

Product Generation & Verification

Product Distribution

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Results of DsE

- **Customer needs expressed in a standardized, abbreviated form and terminology ensures clearer communication and earlier discovery of unsupported needs.**
- **Quality improvements in the product family improve the quality of all products.**
- **Process standardization fosters more predictable schedules and cost estimates.**
- **Process streamlining, based on a product family, reduces time and effort to deliver similar products.**
- **Problem and solution knowledge and expertise are more easily shared and extended.**

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Is Domain-specific Engineering Right for You?

- **There is a viable future market for a line of similar products:**
  - **– Multiple customers with differing needs**
  - **– A single customer who needs multiple versions**
  - **– Customer needs or supporting technologies that are likely to change**
- **Appropriate management and engineering expertise is available (and, optionally, a legacy of prior products)**
- **Management is committed to the product line market as a cohesive business area.**

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Process Adoption

- **Strategic business process improvement undertaken to institute an organizational capability**
- **For Reuse-driven Process Improvement (PI_r):**
  - **Scope is 1 product line business area derived using a domain viability model.**
  - **Process improvement is guided by integrated process maturity and reuse maturity models.**
  - **Process tailoring is based on an organizational reuse capability model.**
  - **Effort is integrated with other process improvement actions (BPR, CMM, technology insertion, etc.).**

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Risk Reduction

- **Tailor domain capabilities to particular organizational needs and capabilities**
  - **Opportunistic *(enhanced project-level reuse)***
  - **Integrated *(collaborative domain/projects operations)***
  - **Leveraged *(domain-specific streamlined processes)***
  - **Anticipating *(domain-market coevolution)***
- **Develop and use domain capabilities in short increments**
- **Institute continuous improvement**

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Key Goals

- **Organizational commitment**
  - **– Create organizational expertise in Domain-specific Engineering**
  - **– Charter a domain wherever a product line business case exists**
- **Domain engineering**
  - **– Standardize shared understanding of product line problems and solutions in a product family**
  - **– Create an infrastructure for “manufacturing” standardized products**

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For Additional Information on Domain-specific Engineering

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