Prosperity Heights Software

Process Improvement for Software Product Lines

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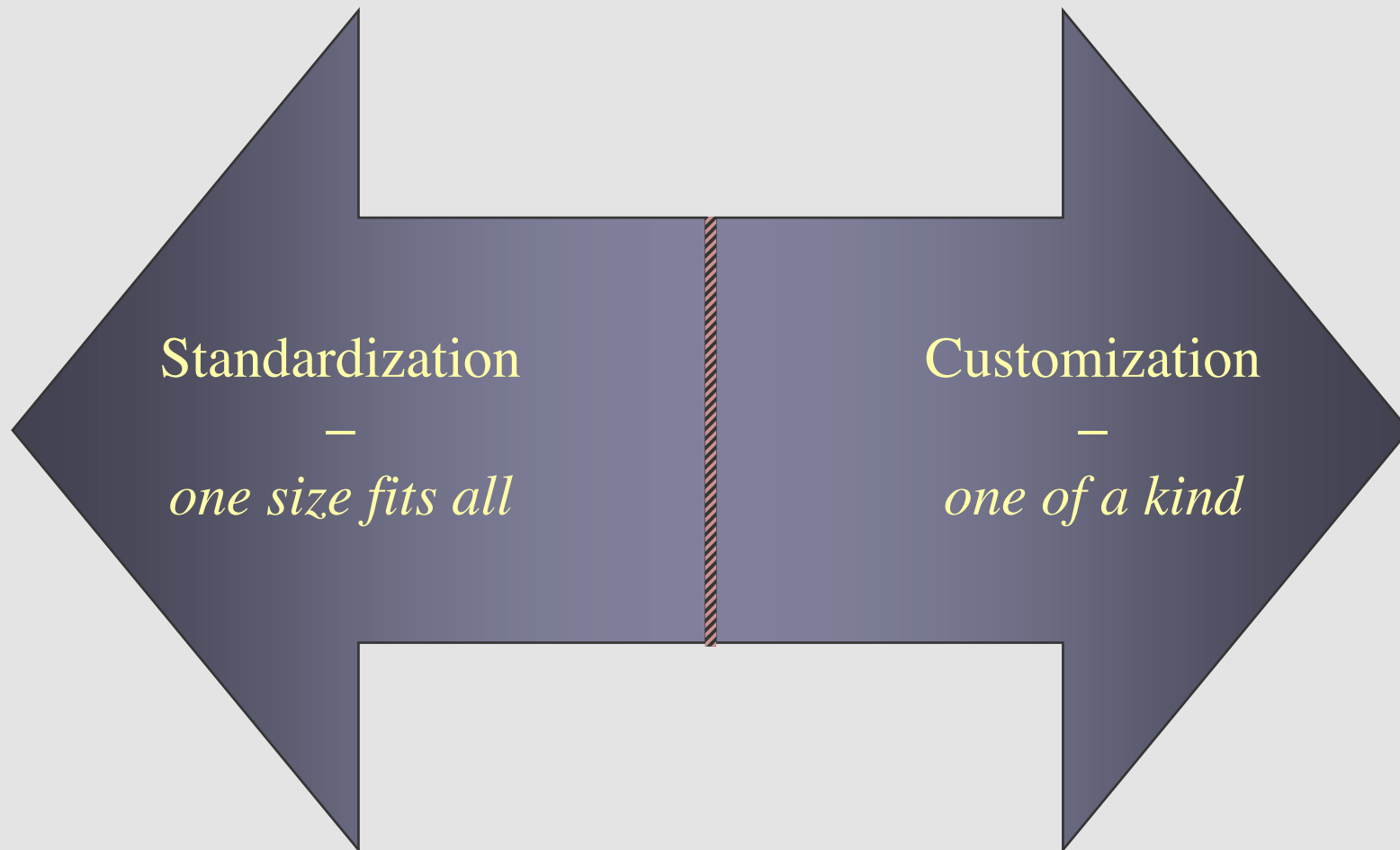
Consider These Questions

What is a product line?
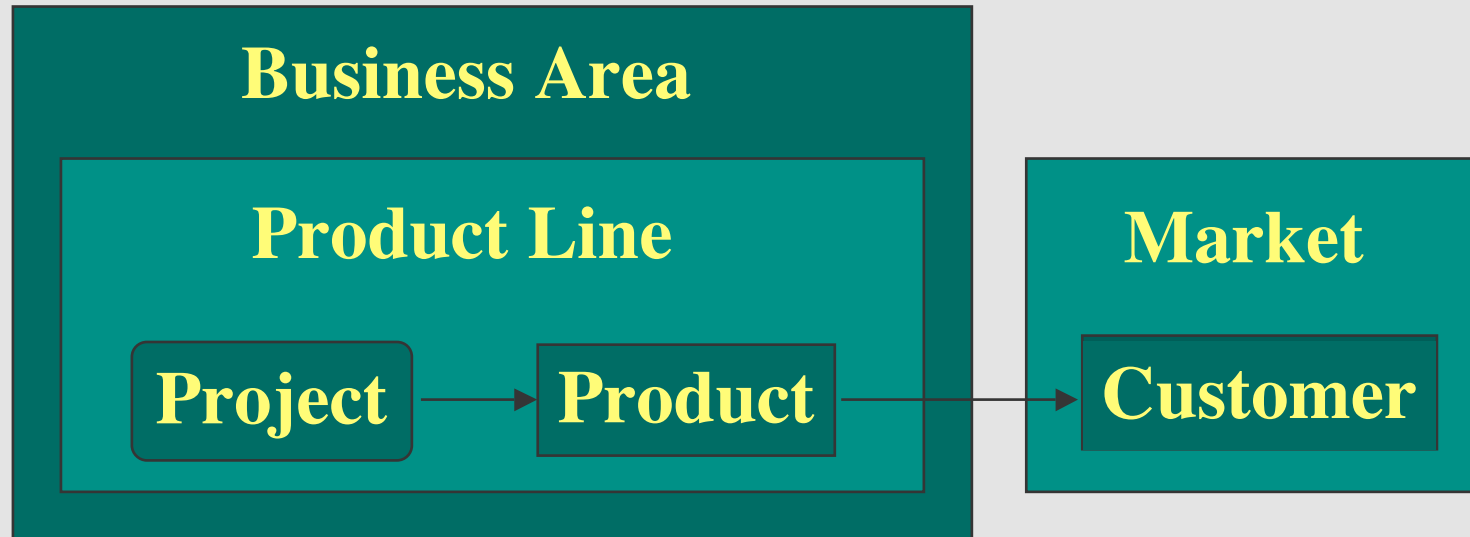
Why do organizations adopt a product line approach?

What is different about a product line process?

How does process improvement differ for a product line?

An Artificial Dichotomy

Standardization

—

one size fits all

Customization
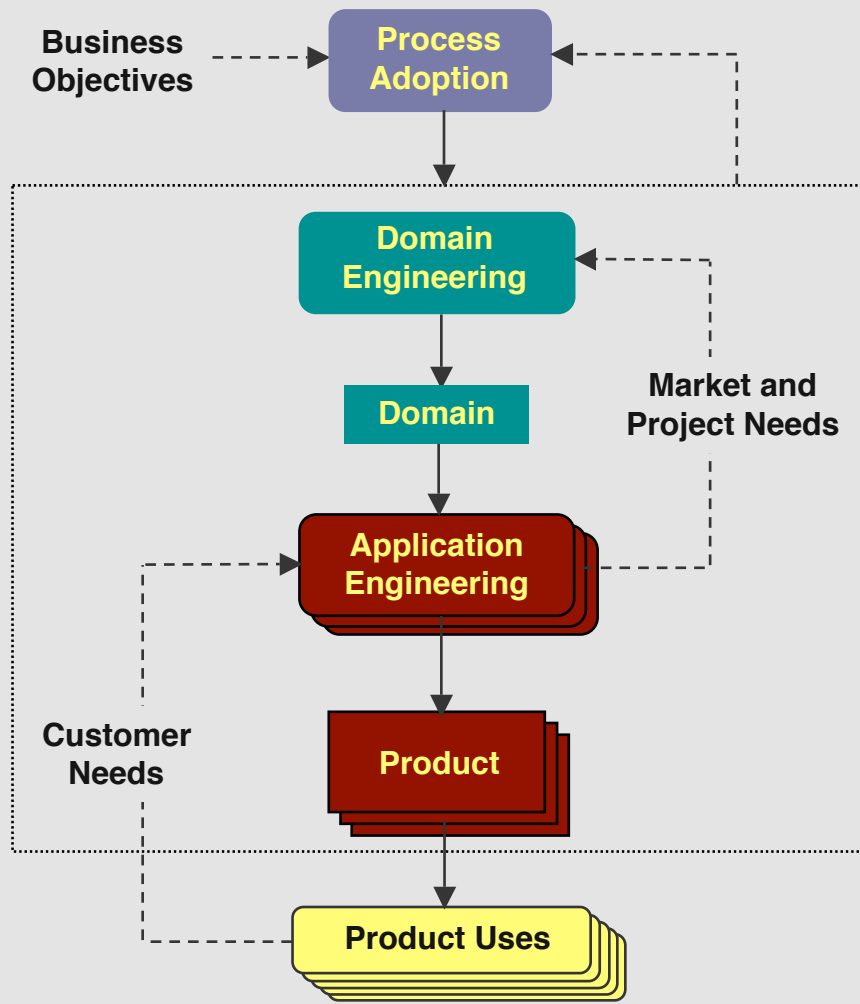
—

one of a kind

An Organizational Context

- **Market: A set of customers having similar needs**

- **Product line (PL): A set of similar products (to be) created by an organization for a market**

A Product Line Approach

Domain-specific Engineering™ (DsE)

A framework and discipline for the engineering and manufacture of similar products

The DsE Process

Institute & improve a product line business

Create a domain (process, tools, and assets) for building similar products

Build tailored products for customers

Diagram labels:
- Business Objectives
- Process Adoption
- Domain Engineering
- Domain
- Market and Project Needs
- Application Engineering
- Customer Needs
- Product
- Product Uses

What Makes DsE Different?

*Standardizing on the most effective solutions
to a class of similar problems*

- **Focusing exclusively on a market with customers who have similar needs**

- **Achieving an informed consensus on how and why customers' needs differ and change**

- **Developing a product family and process for building similar customized products rapidly**

Reported PL Experiences

- **Rockwell: global positioning receivers, helicoptor avionics**

- **Lockheed-Martin: satellite avionics, test equipment**

- **Thales: air traffic control, training simulators**

- **Lucent: telephone switching**

- **Cummins Engine: diesel engine controls**

- **U.S. Army Stricom: training systems**

- **Technology Concept: realty services**

PL Business Motivations

Gain competitive advantage by being more responsive to diversity and change in customer and market needs

Increase "process capability" (achievable productivity and product quality) by focusing improvement efforts on a set of similar products

Instituting a Product Line Approach

Reuse-driven Process Improvement™ (PI$_r$)

A method
for the adoption and improvement
of a product line approach
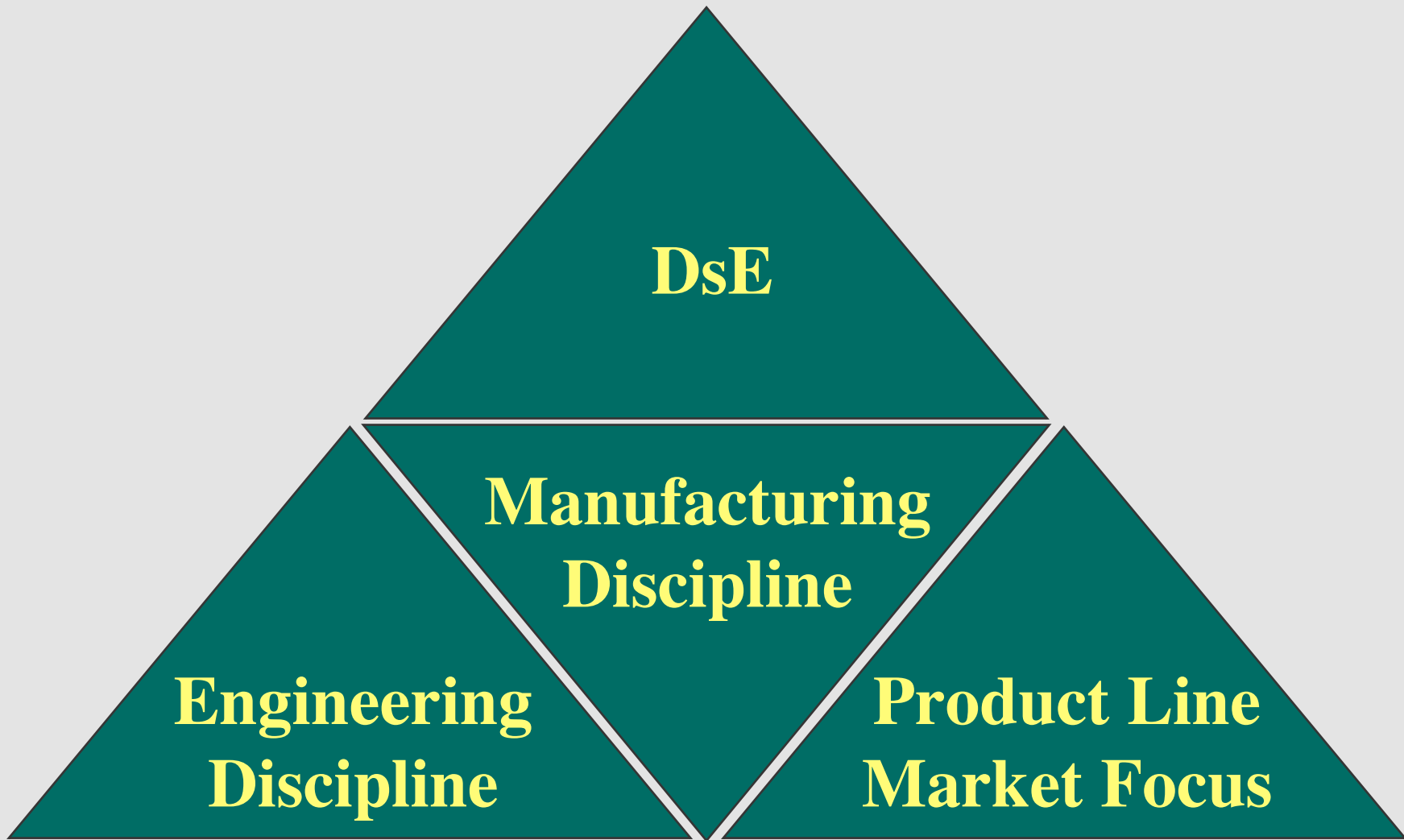
(DsE in particular)

Precursors to PI$_r$

- **Software Engineering Institute**

  – *Capability Maturity Model® for Software* **(1993)**

- **Software Productivity Consortium**

  – *Reuse Adoption Guidebook* **(1993)**
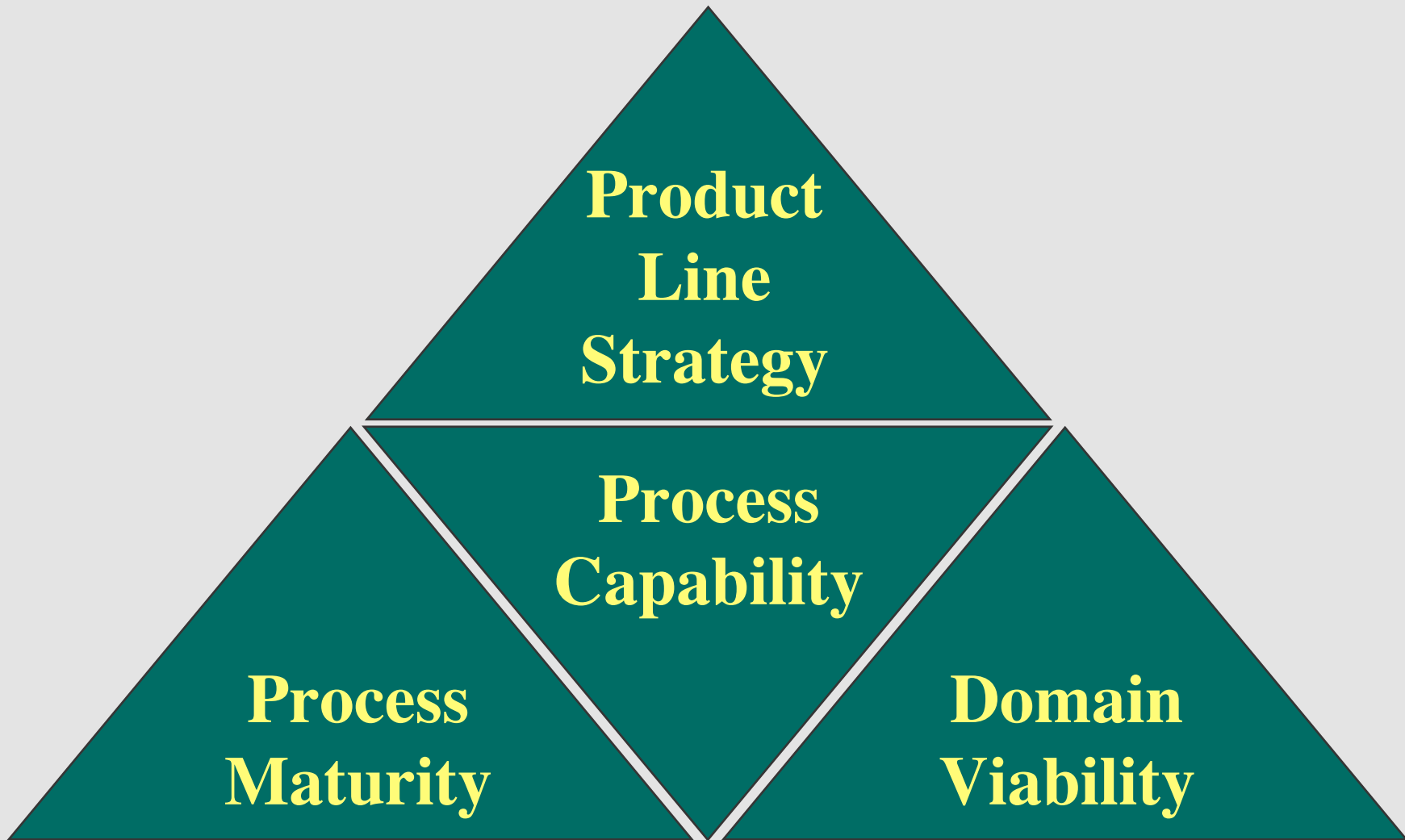
- **PHS work with Thales (1996-8)**

PI$_r$ Refinements

- **Limit improvement scope to a product line business (not organization-wide or generic reuse)**

- **Integrate process improvement and reuse adoption efforts**
  - **Extend maturity models to address product line practices**
  - **add a capability model to aid process reconception**
  - **add a model for evaluating product line viability**

- **Emphasize fast start-up & rapid iteration**

- **Defer PL technical questions (scoping, phasing, ...) to DsE**

PI$_r$ Objectives

DsE

Manufacturing Discipline

Engineering Discipline

Product Line Market Focus

PI$_r$ Tools

Product Line Strategy

Process Capability

Process Maturity

Domain Viability

PI_r Process

Commit → **Manage Quality**

Domain Viability
↓
Product Line Market Focus

Process Maturity
↓
Engineering Discipline

Define Strategy

Reuse Capability
↓
Manufacturing Discipline

Initiate Action → **Perform DsE**

Product Line Strategy →*DsE*

PI*r* Activity : Commit

Objective: Establish a product line market focus

- **Characterize the product line opportunity:**
  products, customers, business challenges

- **Evaluate viability:**
  subjective factors, financial analysis

- **Define business objectives**

- **Allocate resources to institute a product line approach**

- **Monitor progress and revise commitment as circumstances change**

Domain Viability Model

Market opportunity

Are there customers for a line of similar products?

Technical expertise

Does the organization have the expertise to build envisioned products?

Business commitment

Is there a credible case for investing in this business?

PI$_r$ Activity : Manage Quality

Objective: Establish engineering discipline

- **Assess process maturity**
  - **Conventional criteria**
  - **Product line criteria**

- **Identify needed improvements**

- **Initiate improvement actions**
  - **Define action plans**
  - **Implement actions**
  - **Evaluate effects**

Process Maturity Model
Conventional Factors

Organizational infrastructure *Establish effective support for common (cross-PL) needs*

Project management *Work within budget and schedule constraints*

Engineering methods *Perform technical activities properly*

Product quality and integrity *Achieve product quality goals*

Customer/supplier relationships *Manage external interactions effectively*

Process predictability *Reduce variation in results experienced across projects*

Process Maturity Model
Product Line Factors

Product line strategy and management
How effectively do strategy and management actions support a product line approach?

Raw materials and assets
How effectively do available raw materials and assets contribute to product line needs?

Organizational and technical infrastructure
How well do infrastructure capabilities support a product line effort?

PI_r Activity : Define Strategy

Objective: Establish manufacturing discipline

- **Target an appropriate level of process capability**
  - **Business objectives**
  - **Risks**
  - **Financial projections**

- **Create a product line strategy**

Process Capability Model

Management Integration

Will projects have coordinated or independent planning?

Needs Orientation

Should efforts focus more on immediate or long-term payoff?
Should views of customer needs be unified or stay unique?
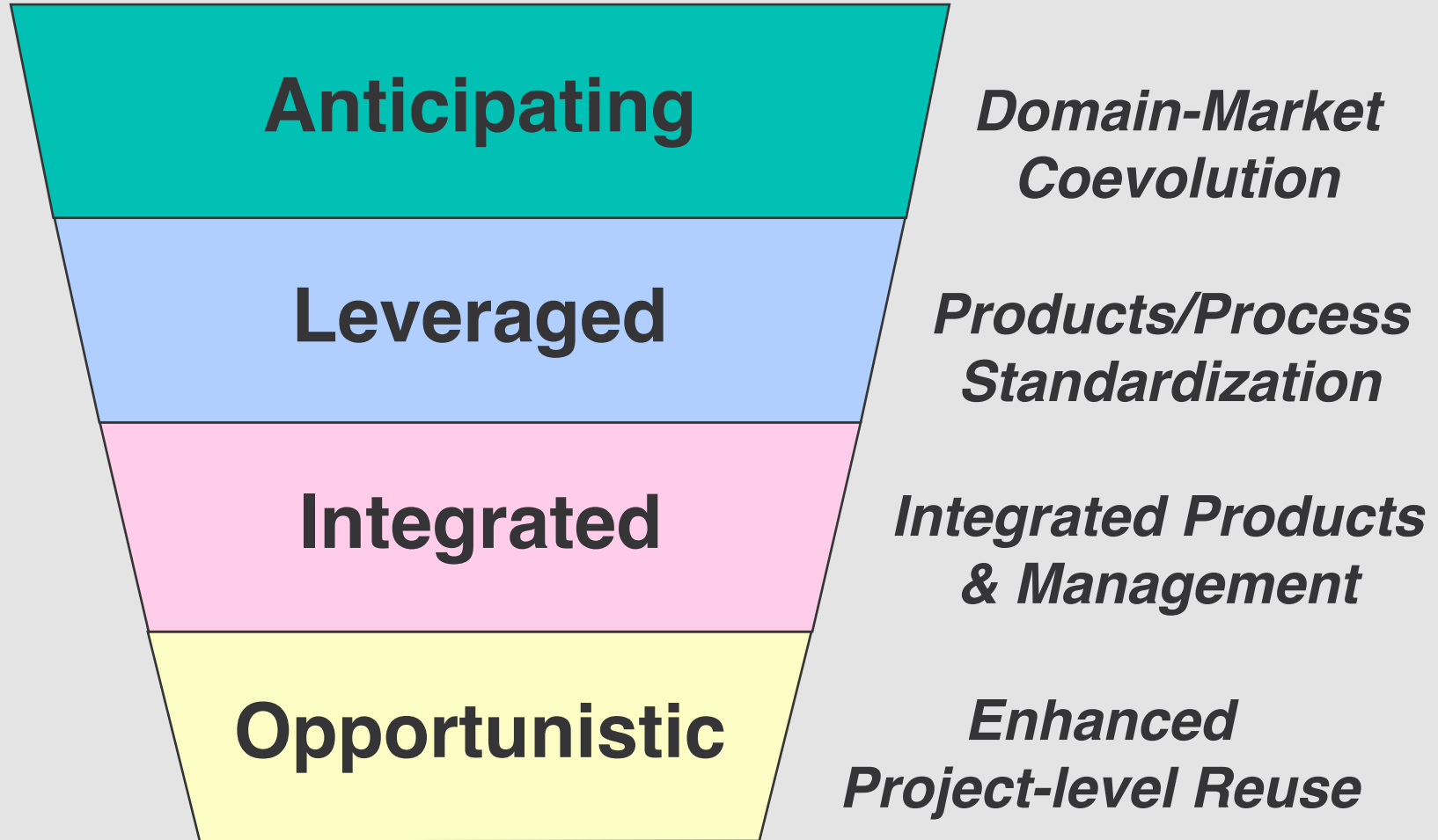
Product Integration

To what degree must projects focus on form and content
of work products versus whole-product representations?

Stability–Optimization

To what degree can cultural stability be disturbed
to achieve a streamlined process?

DsE Capability Levels

Anticipating	*Domain-Market Coevolution*
Leveraged	*Products/Process Standardization*
Integrated	*Integrated Products & Management*
Opportunistic	*Enhanced Project-level Reuse*

Product Line Strategy

Market/products focus

Business model

**Tailored process
(DsE + methods)**

Organization

Support environment

Transition strategy

A DsE Process

Product Line Strategy → Domain Engineering → Domain → Application Engineering ← Market and Project Needs

Application Engineering → Application Product → Product Uses

Customer Needs
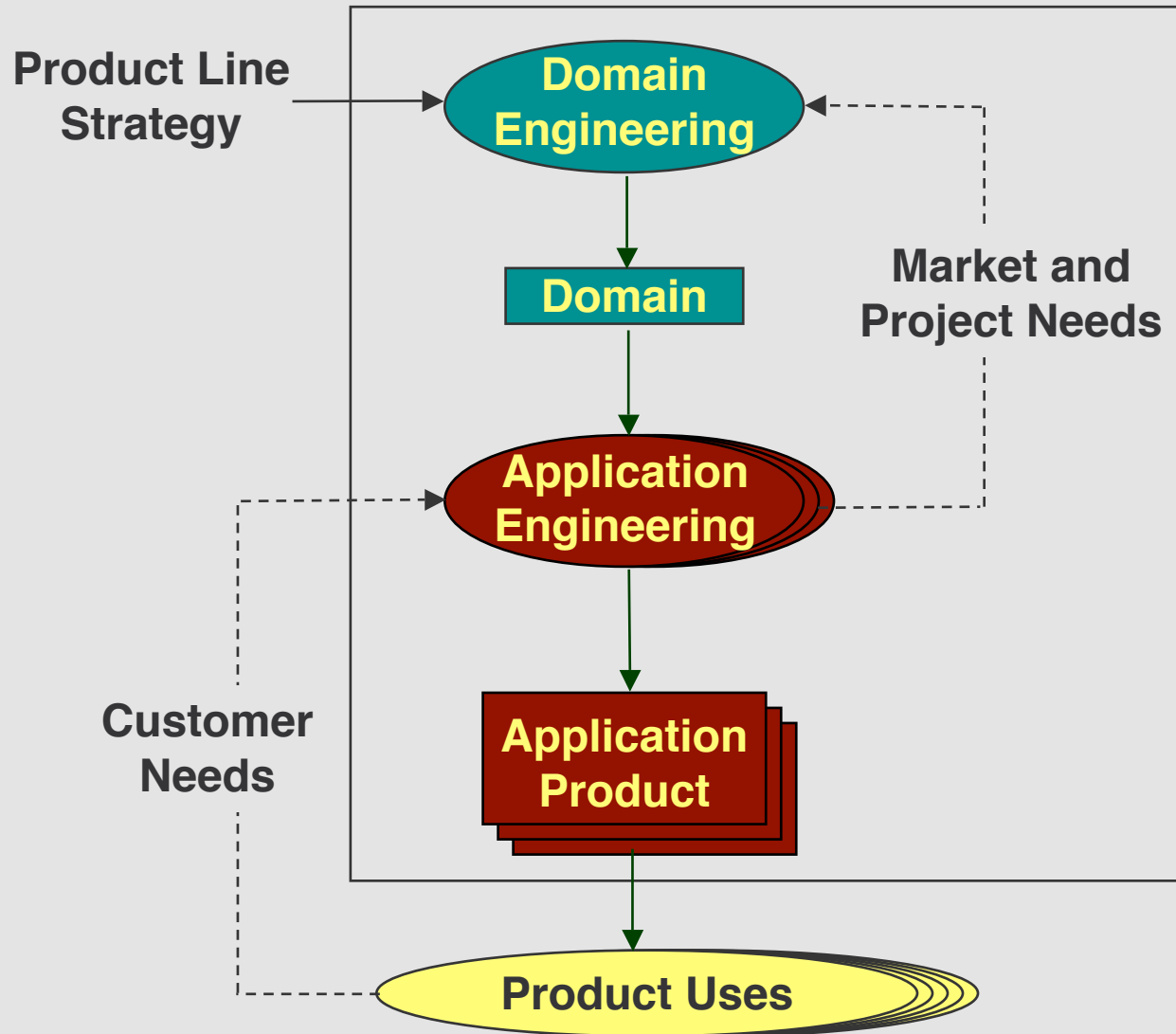
Create an infrastructure for building similar products

Build products using the infrastructure

PL Strategy
PL Organizational Functions

Management

Customer Relationships (Marketing & Sales)

Domain

- **Management**

- **Engineering**
  - **Product Family**
  - **Appl. Process**

- **Project support**

Application

- **Management**

- **Engineering**
  - **Requirements**
  - **Production**

- **Customer support**

PL Strategy
Organizational Structures

Opportunistic

AE_1 AE_2 ... AE_n

DE

Integrated

AE_1
AE_2
$\vdots$
AE_n

DE

Leveraged/ Anticipating

DE

AE_1 AE_2 ... AE_n
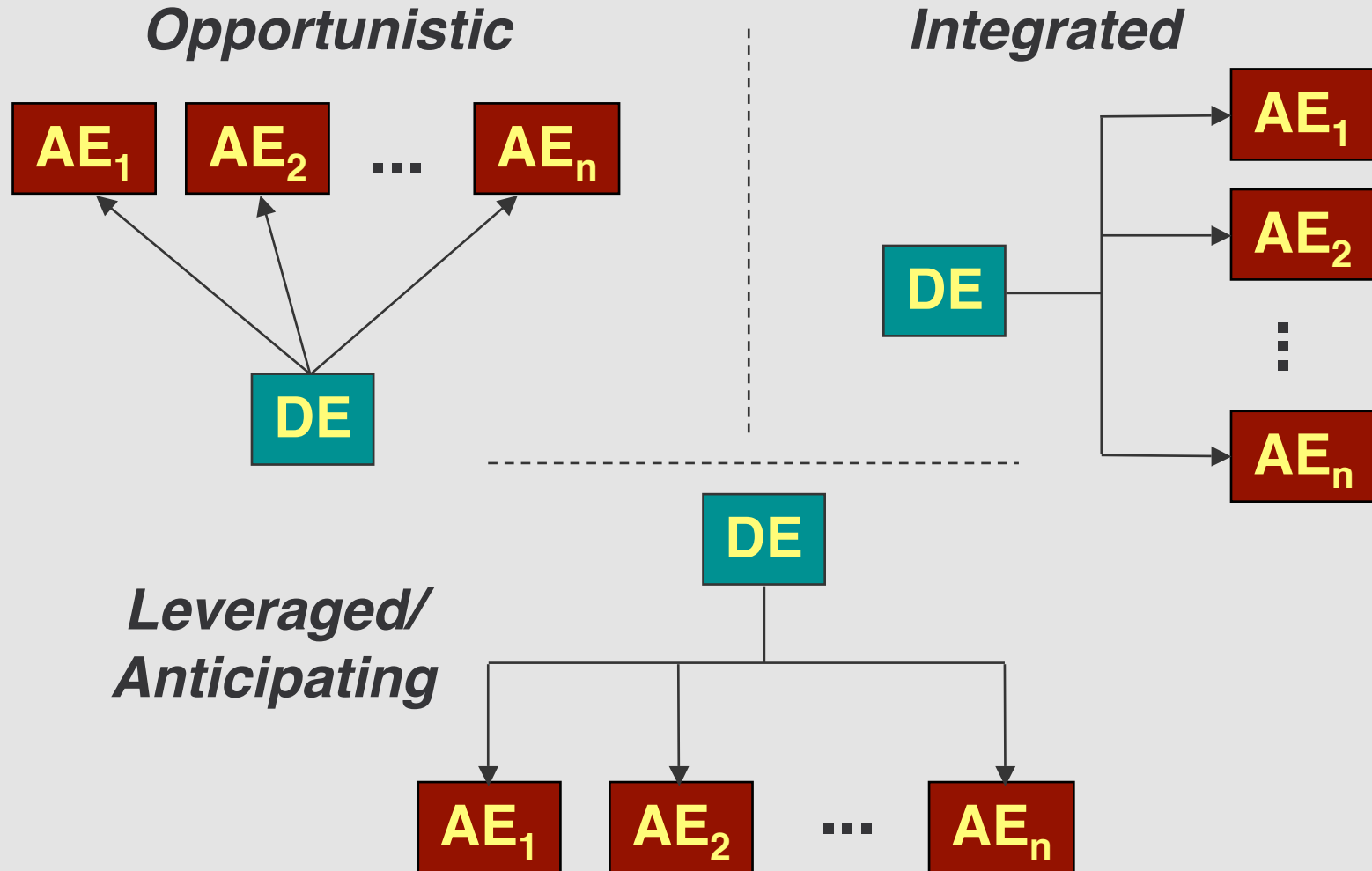
Alternative Transition Strategies

Anticipating

Leveraged

productivity & risk

?

Integrated

?

?

Opportunistic

?

start
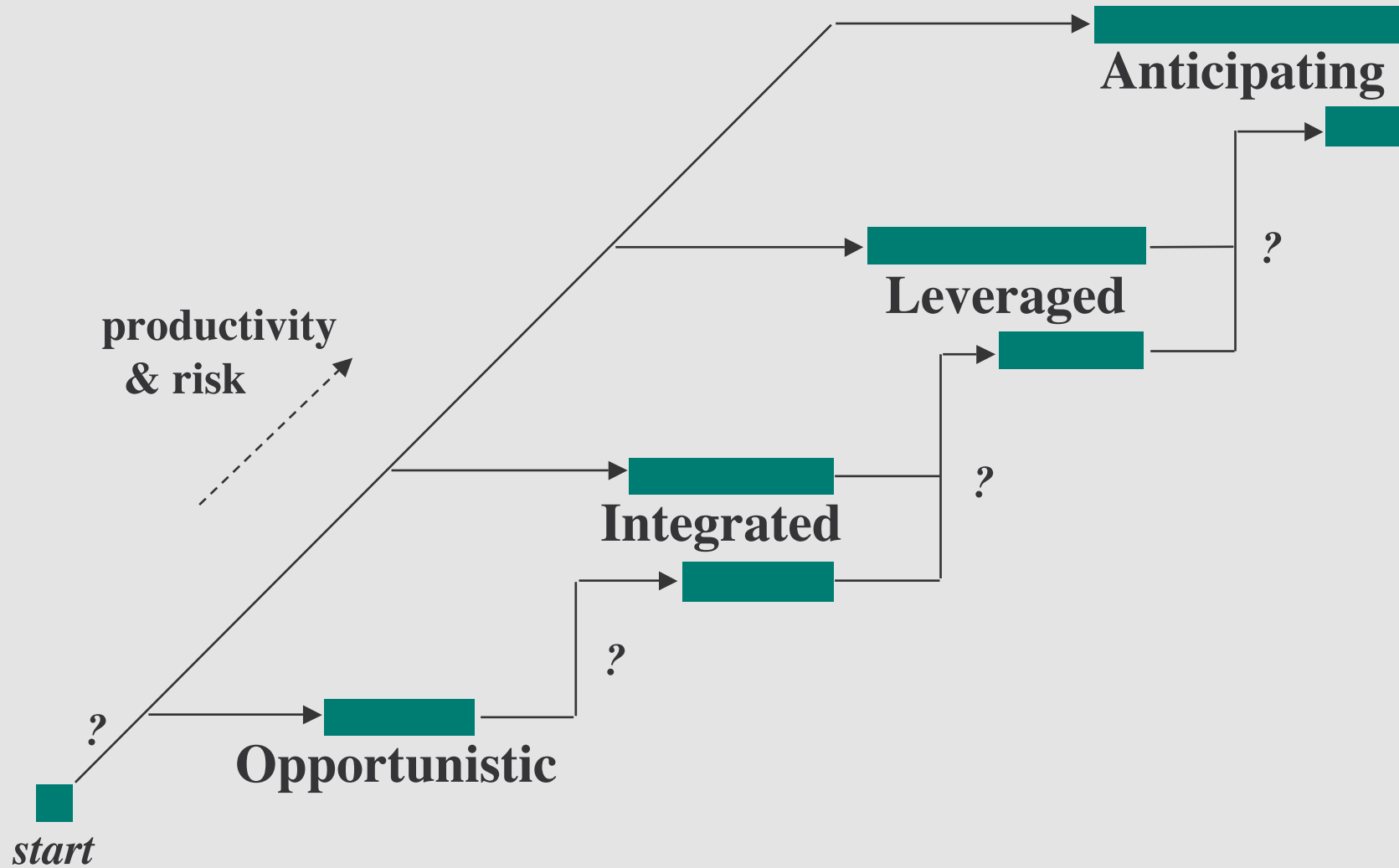
PI$_r$ Activity : Initiate Action

Objective: Establish a DsE capability for building similar products, based on a Product Line Strategy

- **Obtain funding and organizational support**

- **Augment staffing**

- **Provide documentation and training**

- **Deploy infrastructure**

- **Resolve organizational/cultural and legal/contractual issues**

For More Information on PI$_r$ or DsE

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