

**Prosperity
Heights
Software**

Society for Software Quality

***Metrics for Managing a
Software Product Line***

June 13, 2002

Grady H. Campbell, Jr.

Copyright © 2002, Prosperity Heights Software. All Rights Reserved.

Questions to Consider

Product lines, what and why?

Why are metrics needed?

Which metrics are important?

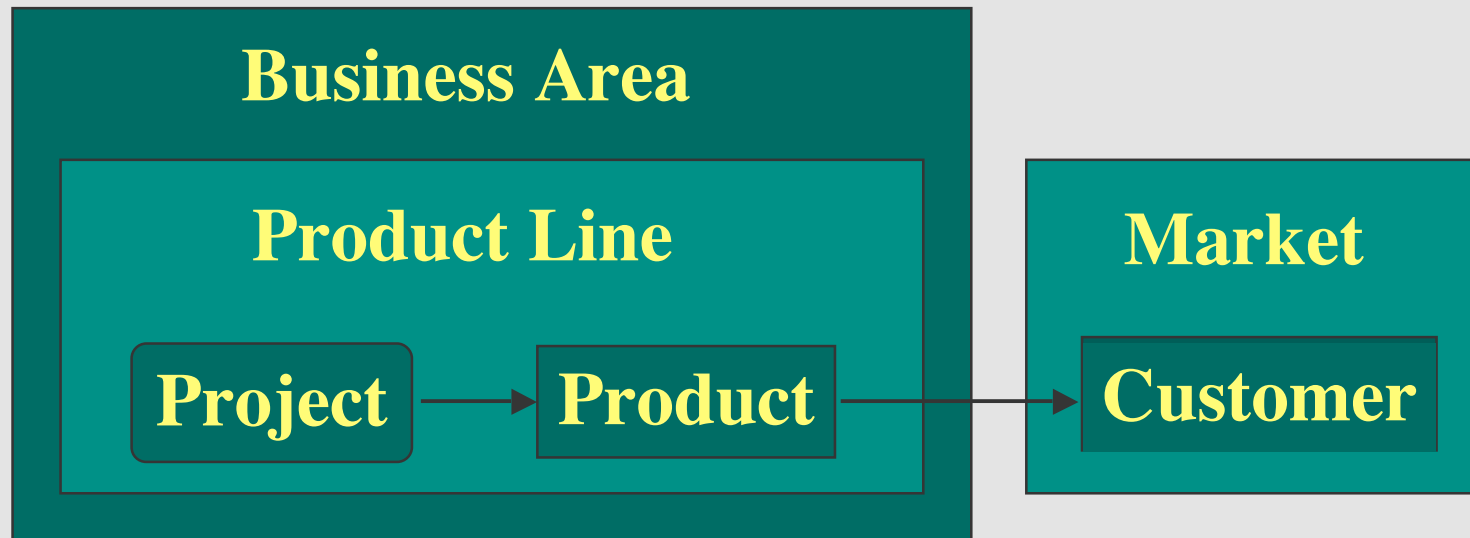
How do metrics differ for a product line?

Context for a Product Line

An organization that repeatedly builds similar products

- **Software**
 - **custom commercial**
 - **multi-version custom internal-use**
 - **embedded**
- **Systems**
- **Manufacturing (mass customization)**

An Organizational Perspective



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

Business Motivations for a PL

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

Improve productivity and product quality by focusing efforts on a set of similar products

Some Who Have Used PL Approach

- **Rockwell: global positioning receivers, helicopter avionics**
- **Lockheed-Martin: satellite avionics, test equipment**
- **Thomson-CSF: air traffic control, training simulators**
- **Lucent: telephone switching**
- **Cummins Engine: diesel engine controls**

PHS Product Line Approach

Domain-specific Engineering (DsE)

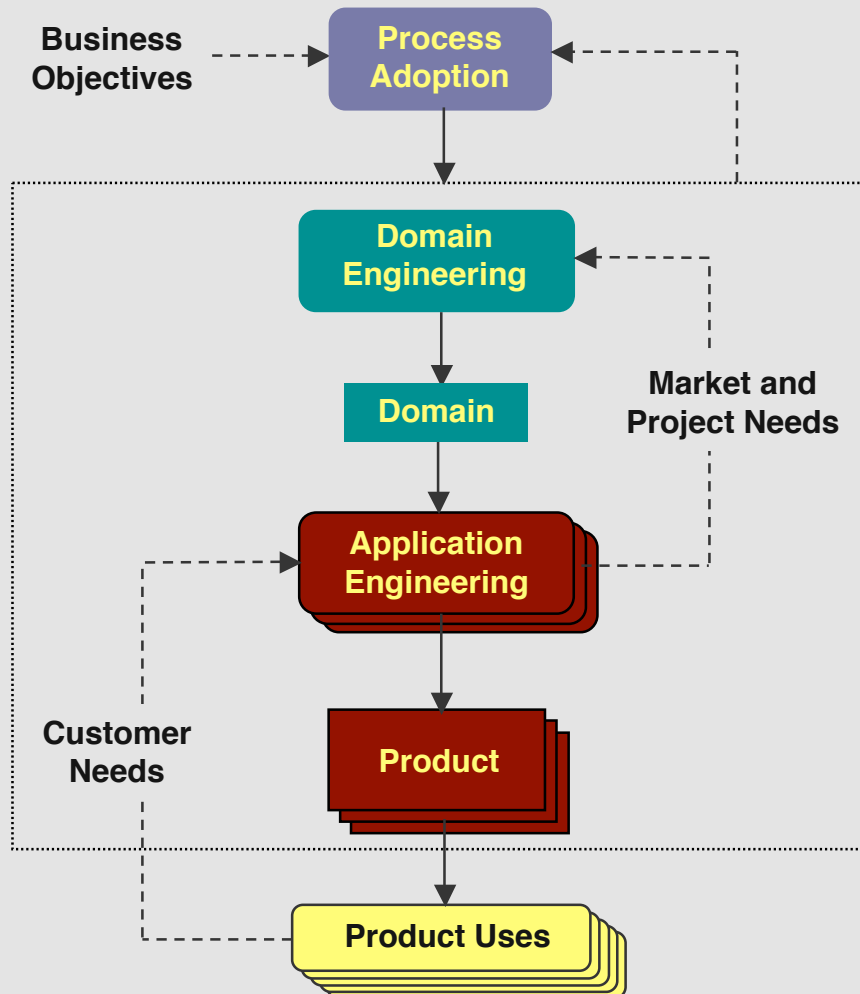
**A framework and discipline for the
engineering and manufacture
of similar products**

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

The DsE Process

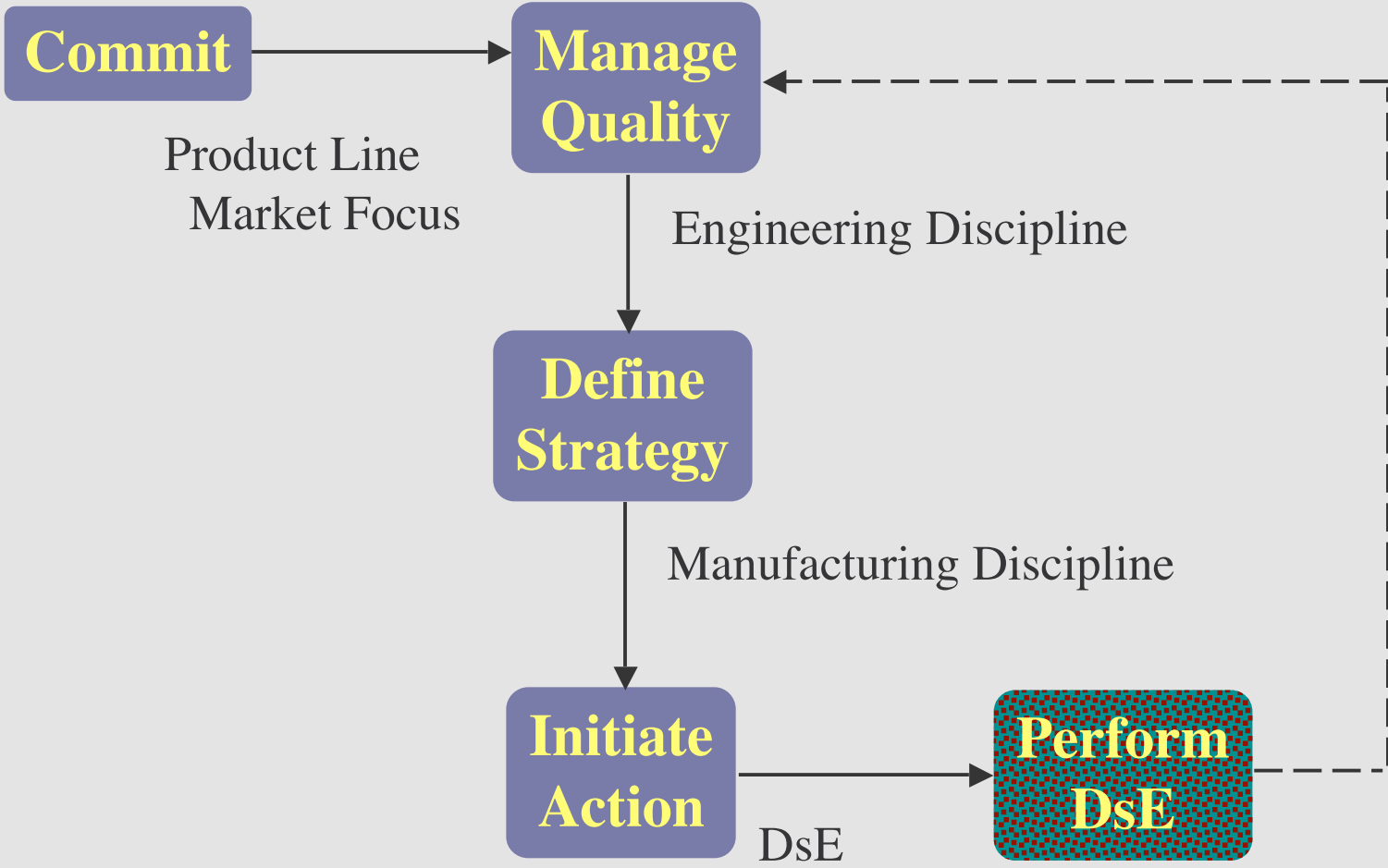


Institute & improve a product line business

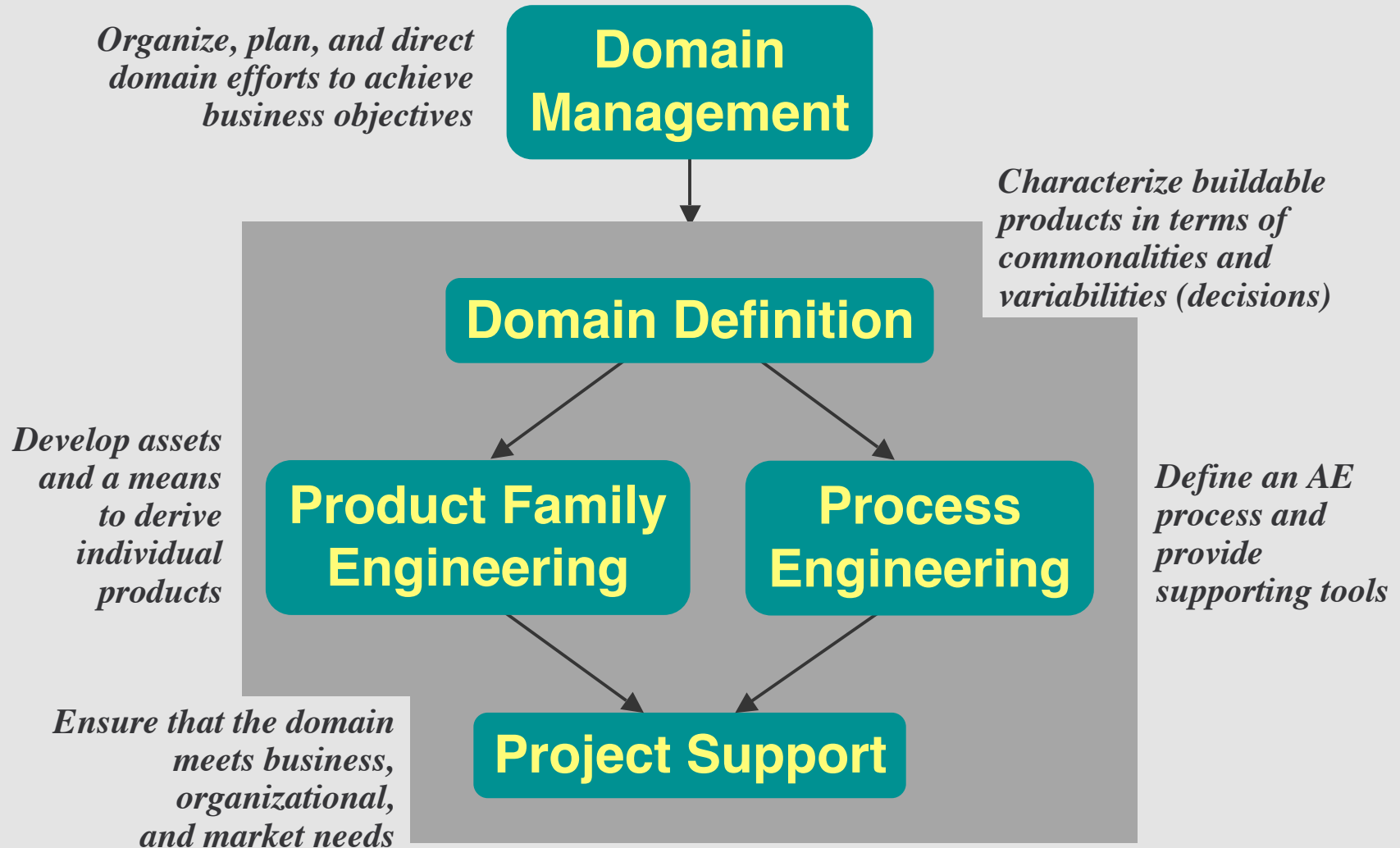
Create a domain (process, tools, and assets) for building similar products

Build tailored products for customers

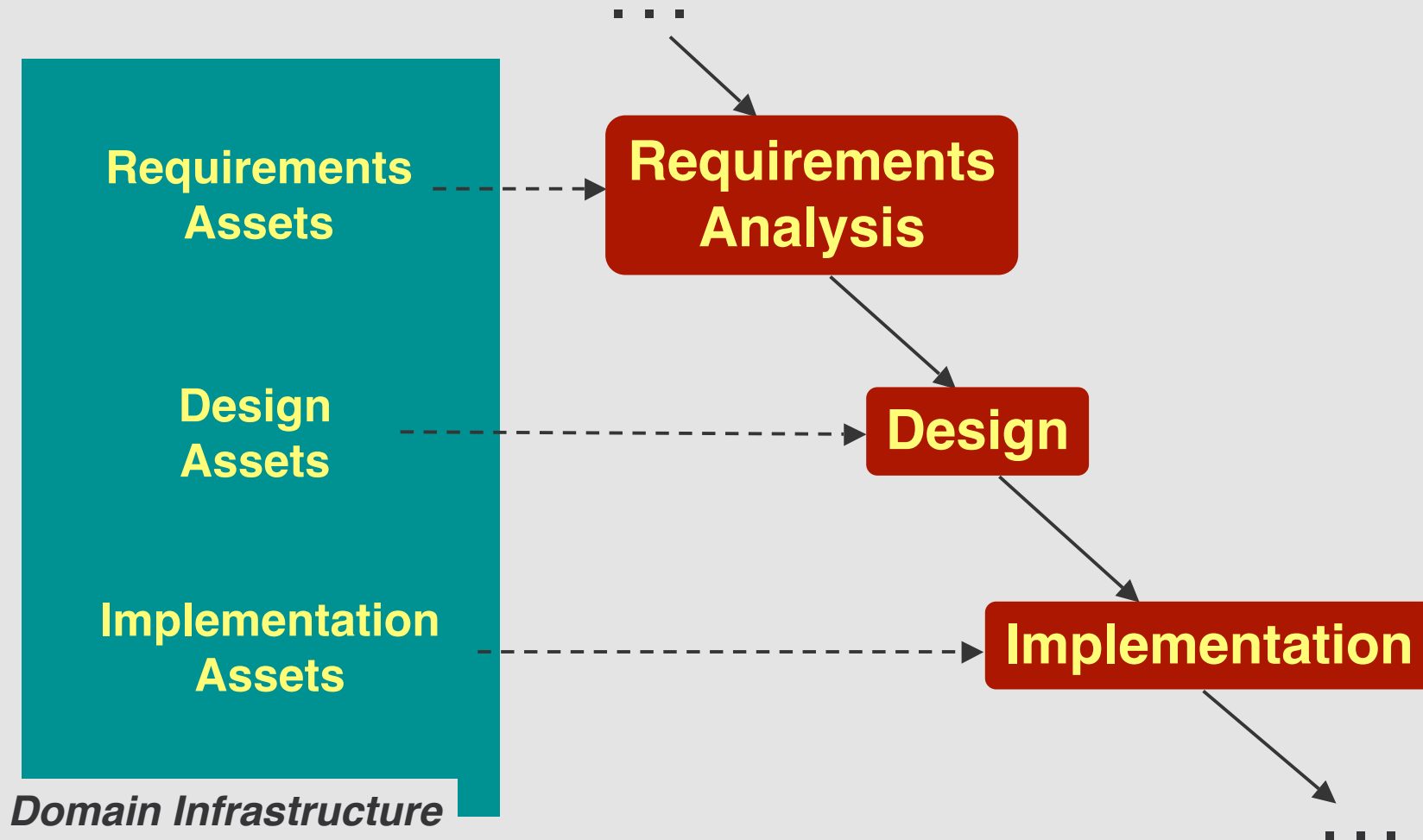
PI_r Process



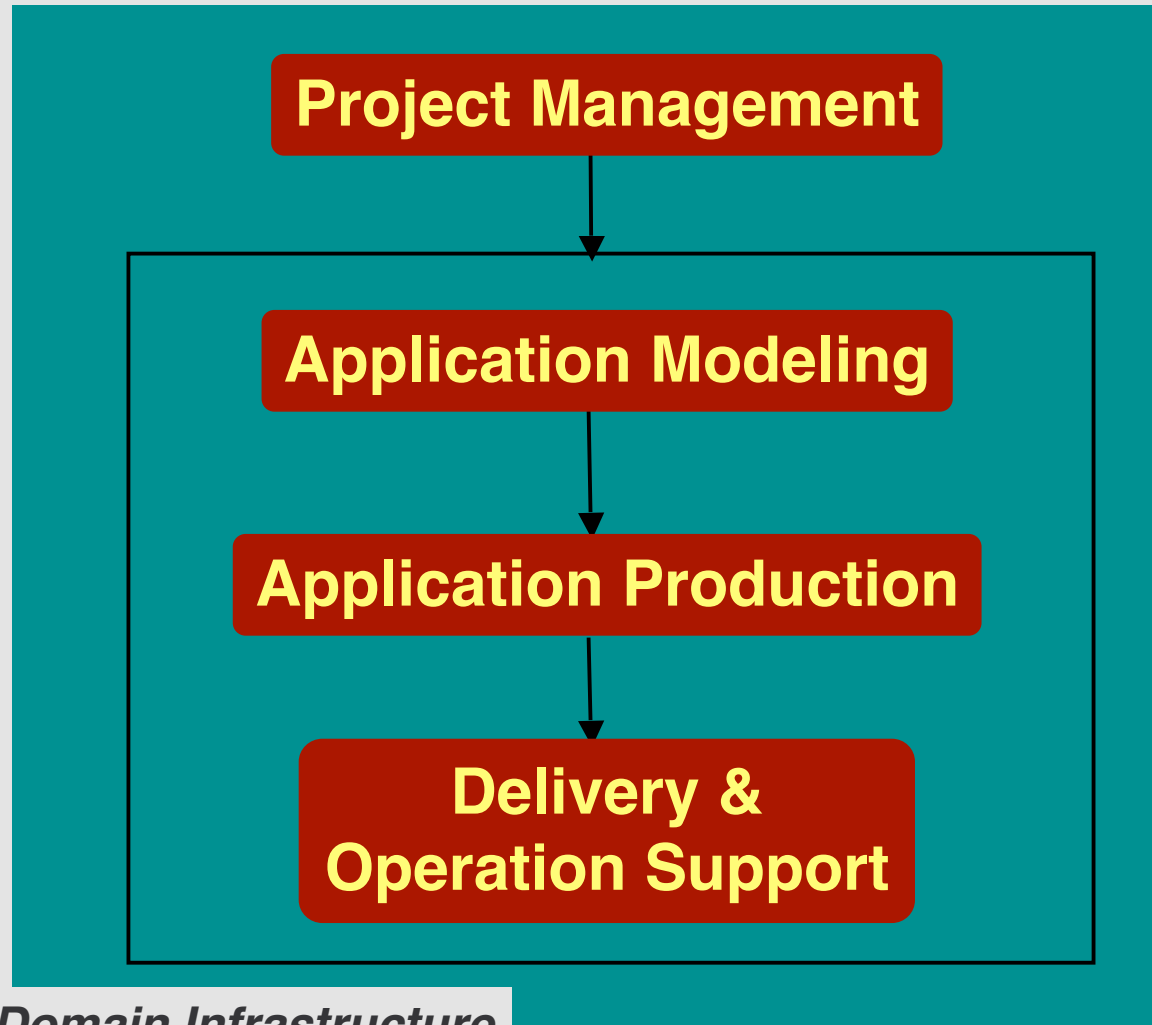
Domain Engineering Activities



An Augmented Application Engineering Process



A Streamlined Application Engineering Process



*Planning &
Coordination*

*Product
Specification
& Validation*

*Product
Generation
& Verification*

*Product
Distribution*

Domain Infrastructure

Potential Benefits

- **Problem knowledge and solution expertise become an organizational asset**
- **Customer needs are expressed in a standardized form and terminology**
- **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**

A Metrics Strategy for PLs

- **Minimize number of measures to be collected**
 - **Collecting adds to project cost; which are justified?**
 - **Beware “derived” data collected for other reasons**
 - **Focus on long-term trends, not short-term results**
- **Track to management scope of responsibility**
 - **Identify “levels” of management responsibility**
 - **Focus measures on key objectives at each level**
 - **Don’t collect a measurement without a management action as a possible consequence**
- **Apply Goal-Question-Metric method to focus & simplify**

Definitions

Capability

The range of expected results that can be achieved by following a process

Performance

The actual results achieved by following a process

Maturity

The predictability with which performance achieves a targeted level of capability

Understand Why Metrics are Needed

To guide management decision making

- 1. Monitor work progress against a plan (*performance*)**
 - Know when the plan needs to change
- 2. Compare performance against potential (*maturity*)**
 - Improve operational efficiency
- 3. Evaluate changes in organizational practices (*capability*)**
 - Improve productivity (build products with less effort)
 - Improve product quality (achieve fewer errors and better fit to customer's needs)

Why Product Lines are Justified

- **Capability (PL process) >> Capability (point-solution process)**
 - **leverages effort and expertise across similar products**
 - **responsive to diversity and change in customer and market needs**
- **A (necessary?) basis for statistical quality assurance**
 - **consistent (standardized) practices across projects**
 - **controls for process capability and performance variations traceable to product differences**
 - **leverages assurance efforts across projects**
 - **process streamlining reduces opportunities for special causes of variation**

Management Goals, Driving Metrics

- **Cost and schedule performance**
- **‘customer’ satisfaction**
- ***by management level***
 - **business area: financial results/mission success**
 - **program (product line): market viability**
 - **domain engineering: cost of production**
 - **application engineering: product fit-for-use**

Business Area Questions

- **Financial results (return on investment)**
- **Contribution to organizational mission success**
- **Compliance with laws, regulations, and obligations**

Program Questions

- **Market success**
- **Long-term profitability (growth or sustainment)**
- **Disciplined market focus**
- **Product life cycle cost**

Domain Engineering Questions

- **Development costs**
 - **product family**
 - **process infrastructure**
 - **conformance to organizational standards**
- **Alignment to AE project schedules**
- **Product family correlation to needed AE products**
- **AE production costs (level of effort required to build a product)**

Application Engineering Questions

- **Process measures**
 - **Compliance with organizational standards**
 - **Delivering product to planned schedule & budget**
- **Product measures**
 - **Fit to requirements**
 - » **Functional capabilities**
 - » **Performance-safety-reliability properties**
 - **Quality (usability, error density)**
 - **Customer satisfaction**

Unique PL Metrics Issues

- **New management area of responsibility (DE) focuses on enhancing AE project capabilities**
 - **Cross-project cooperation and coordination**
 - **Need for software adaptable to diverse market and changing customer needs**
 - **Focused investment in effort-leveraging infrastructure**
- **Program focus on organizational market success counters AE project focus on customer satisfaction**
- **Program focus on life cycle cost counters AE project focus on development cost**

***For More Information on
Product Lines***

Prosperity Heights Software

www.domain-specific.com

GradyCampbell@domain-specific.com