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)
• 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

- **Commit**
- **Define Strategy**
- **Initiate Action**
- **Manage Quality**

Product Line
Market Focus

Engineering Discipline

Manufacturing Discipline

DsE

- **Perform DsE**
Domain Engineering Activities

Domain Management

Organize, plan, and direct domain efforts to achieve business objectives

Domain Definition

Characterize buildable products in terms of commonalities and variabilities (decisions)

Product Family Engineering

Develop assets and a means to derive individual products

Process Engineering

Define an AE process and provide supporting tools

Project Support

Ensure that the domain meets business, organizational, and market needs
An Augmented Application Engineering Process

Requirements
Assets

Design
Assets

Implementation
Assets

Domain Infrastructure

Requirements Analysis

Design

Implementation
A Streamlined Application Engineering Process

Domain Infrastructure

- Project Management
  - Application Modeling
  - Application Production
    - Delivery & Operation Support

Planning & Coordination
- Product Specification & Validation
- Product Generation & Verification
- Product Distribution

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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

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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

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