Exploring Acquisition Strategies for a Software Product Line

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Exploring Acquisition Strategies for a Software Product Line

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Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213

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Presentation Topics

Software Product Line Basics

Software Product Line Acquisition Challenges

Product Line Acquisition Strategies

An Enterprise View of a Product Line Acquisition

• Organizing a product line production capability

• Product development using the product line production capability

Summary
What Is A Software Product Line?

Software Product Lines:

“A set of software-intensive systems sharing a common, managed set of features that satisfy the specific needs of a particular market segment or mission and that are developed from a common set of core assets in a prescribed way.”

[Clements 2002]

In an Acquisition Context?

Acquisition:

“The process of obtaining products and services through contracting. Contracting includes purchasing, buying, commissioning, licensing, leasing, and procuring of designated supplies and services via a formal written agreement.”

[Bergey and Fisher 1999]
The Key Concepts

Use of a core asset base in production of a related set of products
Three Essential Activities

All three activities are interrelated and highly iterative.

There is no “first” activity.
- In some contexts, existing products are mined for core assets.
- In others, core assets may be developed or acquired for future use.

There is a strong feedback loop between the core assets and the products.

Strong management at multiple levels is needed throughout. Management oversees core asset and product development. Management orchestrates all activities and processes needed to make the three essential activities work together.
Software Product Lines Value Proposition

The systematic use of software product line practices results in significant organizational benefits including

• increased quality
  – by as much as 10x

• decreased cost
  – by as much as 60%

• decreased labor needs
  – by as much as 87%

• decreased time to market (to field, to launch...)
  – by as much as 98%

• ability to move into new markets
  – in months, not years
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Summary
Traditional Contracting vs. Product Line Acquisition

**Traditional contracting** is most suited to efforts that

- are well understood and have no unprecedented aspects
- are based on prior experience and well understood cost history data
- are based on predetermined quantity, schedule, and funding
- are well bounded – i.e., involve a fixed set of tasks and traditional deliverables in a well defined context
- have fixed and well understood requirements
- involve familiar practices and processes
- are likely to involve minimal changes or redirection

Product line acquisitions may present challenges to traditional contracting.
Traditional Contracting vs. Product Line Acquisition

Traditional contracting is most suited to efforts that

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Product line acquisitions may present challenges to traditional contracting

While these factors may prove troublesome for any acquisition, none of these are showstoppers.
Specific Product Line Acquisition Challenges

Product lines focus on meeting the needs of multiple programs and target systems that transcend multiple platforms and developers.

These aspects may exacerbate product line acquisition because

- DoD’s **acquisition policies and infrastructure** are still largely predicated on acquiring ‘**one-of-a-kind**’ stovepiped systems.
- **Planning** a family of software products that rely on a common development effort is not a traditional DoD acquisition paradigm.
- No institutionalized means exist for **funding** the development and sustainment of a product line **across multiple programs**.
- **Program offices** are not appropriately incentivized to adopt a product line approach.
- **Contractors** are not suitably incentivized to participate in **collaborative** product line development and sustainment efforts.
- Adopting a product line approach may force the government to assume **system integration responsibility**.
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- Planning a family of software products that rely on a common development effort is not a traditional DoD paradigm.
- No institutionalized means exists for funding the development and sustainment of a product line across multiple programs.
- Program offices are not appropriately incentivized to adopt a product line approach.
- Contractors are not suitably incentivized to participate in collaborative product line development and sustainment efforts.
- Adopting a product line approach may force the government to assume system integration responsibility.

The “takeaway” is that programmatic issues – not technical issues – are the impediments to widespread adoption of product line practices in the DoD.

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Summary
Two Fundamental Ways for a DoD Program to Initiate a Product Line Acquisition

Reactive

Desired product line initiative/activities/tasks are conducted opportunistically and performed in situ under an existing contract.

Proactive

Desired product line initiative/activities/tasks are preplanned and integrated up front in a request for proposal (RFP) for a system (or software) acquisition.
Three Basic Acquisition Strategies for Acquiring Products via a Product Line Approach

1. Commission a supplier to develop a specific product (or products) using its own proprietary product line. This strategy involves acquiring products directly from a supplier who has an existing product line and a demonstrated capability to build products in the domain of interest.

2. Commission a government organization to develop a product line production capability and build specific products. This strategy involves acquiring a completely government-owned product line using the in-house capabilities of a designated government acquisition organization.

3. Commission a supplier to develop a product line production capability and build specific products. This strategy involves acquiring a complete product line production capability and developing derivative products through contracting with one or more suppliers.
Overview: Software Product Line Acquisition

Three Major Contractual Tasks

1. DEVELOPMENT of a product line
   PRODUCTION CAPABILITY

2. PRODUCT DEVELOPMENT
   using the PRODUCTION CAPABILITY

3. MANAGEMENT and OPERATION of Product Line

Is it that simple?

Legend:
- Contractual Task
- Contract Deliverable

Family of Software Products

Incremental Delivery

Interaction
Overview: Software Product Line Acquisition

Reality: Five Major Contractual Tasks to Provide Support

1. DEVELOPMENT of PRODUCTION CAPABILITY and SUSTAINMENT of PRODUCTION CAPABILITY

2. PRODUCT DEVELOPMENT and PRODUCT SUSTAINMENT using the PRODUCTION CAPABILITY

3. MANAGEMENT and OPERATION of Product Line

4. Interaction

Incremental Delivery

for operational deployment

Family of Software Products

Legend:
- Contractual Task
- Contract Deliverable
Overview: Software Product Line Acquisition

Reality: Five Major Contractual Tasks to Provide Support

1. DEVELOPMENT of PRODUCTION CAPABILITY
   and
   SUSTAINMENT of PRODUCTION CAPABILITY

2. PRODUCT DEVELOPMENT and PRODUCT SUSTAINMENT
   using the PRODUCTION CAPABILITY

3. MANAGEMENT and OPERATION of Product Line

4. Incremental Delivery

5. Interaction

Enables Clone-and-Own AVOIDANCE

for operational deployment

Family of Software Products

Legend:
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Summary
Establishing the Product Line Context

The government acquisition organization has the responsibility for establishing the product-related context for the product line.

• What are we buying?
• What is the scope of the product line?
• What are the funding and schedule constraints?

The government acquisition organization has the responsibility for establishing the organization-related context for the product line.

• What other organizations will be involved?
• What will be their roles and responsibilities?
• How do we plan, organize and operate the product line effort from an enterprise perspective? For example,
  – How will customer interface management be handled?
  – How can external product developers be accommodated?
Enterprise View of a Product Line Acquisition

Prime Contractor’s Product Line Organization

Product Line Management Team

Software Core Asset Development Team

Product Line Operations Team

Product Development Team

Coordinated Transactions

* Core assets that are specific to product development

EXAMPLE

Parent Government Organization

Prime Contractor’s Product Line Organization

PL Contract

Coordinated Transactions

Product Line Artifact

Typical Acquisition Artifact

Organizational Entity

Governmental Entity

Governmental Contract

Governmental Development

Acquisition Strategy #3

Governmental Ownership

Contractor Development

Acquisition Program Office

Capability Description Document

Product Line Business Case

Initial Product Line Scope

RFP and SOW

Acquisition Strategy

Teaming

Legend

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Enterprise View of a Product Line Acquisition

Prime Contractor’s Product Line Organization

Building a Product Line Production Capability

EXAMPLE

PL Contract

Product Line Management Team

Software Core Asset Development Team

Product Line Operations Team

Coordinated Transactions

Product Development Teams

Parent Government Organization

Acquisition Organization

Product Line Program Office

Teaming

Acquisition Strategy

RFP and SOW

Capability Description Document

Product Line Business Case

Initial Product Line Scope

Product Line Program Office

Acquisition Organization

RFP and SOW

Capability Description Document

Product Line Business Case

Initial Product Line Scope

Legend

Organizational Entity

Typical Acquisition Artifact

Product Line Artifact

* Core assets that are specific to product development

Typical Acquisition Artifact

Product Line Artifact

Organizational Entity
Enterprise View of a Product Line Acquisition

-- from the perspective of Key Product-Specific Deliverables --

Prime Contractor’s Product Line Organization

Using the Product Line Production Capability

Legend:
- Denotes a PL Unique Asset

Product Line Management Team
Product Line Operations Team
Software Core Asset Development Team
Product Development Team

Coordinated Transactions

Parent Government Organization

Acquisition Organization
RFP and SOW
Product Line Business Case
Capability Description Document

PL Contract

Software Product

Delivery

Product Line Unique Component(s)
Product Test Plan
Product Requirements Specification
Product Unique Component(s)
Product Production Plan

Acquisition Strategy

Teaming

Software Product Line Organization

Software Core Asset

Product Line Business Case

Initial Product Line Scope

Product Requirements Specification

Enterprise View of a Product Line Acquisition

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Summary
Summary

Carefully choosing an appropriate product line acquisition strategy is essential to ensure the selected approach is:

- consistent with stakeholders’ expectations
- a good fit with the acquirer’s resources and technical skills

Considering product line acquisition from an enterprise point of view is useful for:

- identifying and understanding how stakeholder involvement is managed
- understanding stakeholder interactions and interdependencies and defining specific roles and responsibilities
- stimulating discussion, analyzing different “acquisition threads” (i.e., scenarios), and answering pertinent questions such as:
  - How is the product line effort being organized and managed?
  - How do requirements flow from the customer to the core asset team?
  - How does an external developer use the core assets to develop a product?
  - What is the information flow for sustaining products that are already fielded?
Questions
Contact Information

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Backup Slides
Customer View of a Product Line Acquisition

Program Office is the Customer

Customer Interaction: Simplest Case

Prime Contractor’s Product Line Organization

This is an Example of Product Line Acquisition Strategy #3

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Customer View of a Product Line Acquisition

Program Office is the Customer

Capability Description Document

Product Line Business Case

Delivery

Product Line Scope

Requirements

Requirements Negotiations

PL Agreement

System Prime Contractor’s Organization

XYZ Product Integration

Target platforms under the jurisdiction of the Product Line Program Office

Expanded Customer Environment

Parent Organization

Teaming

Product Line Program Office

XYZ SW Product

Contract

Contractor A

Contractor B

Contractor C

Contractor Z

Contractor X

Army

Another SEC or SED

Product Line Developer -- Government Organization --

How does this example relate to Product Line Acquisition Strategy #2?

Government Ownership

Government Development

Contractor Development

Customer View of a Product Line Acquisition

Customer Interaction: Simplest Case

Program Office is the Customer

Prime Contractor’s Product Line Organization

Target Platform

Product Line Program Office

Initial Product Line Scope

Initial Product Line Requirements

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