Software Product Line

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Introduction to Software Product Line

Software Development

- Development from scratch

- Development via reuse
    - Methods and functions
    - Classes and libraries
    - Components
    - Subsystems

Development via Reuse

- We want to reuse anything (code, documentation, tests, …) as long as it is useful in building the new product
- Our goal is not reuse; our goal is to produce products quickly and economically
- We can focus more on innovations

Development via Reuse

- The components of Boeing 757 and 767 are 60% in common

- The components in different models of M. Benz E class may be over 70% in common

- The components of Tencent QQ for PC and cell phone may be over 90% in common

Definition of Software Product Line

- A software product line is 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 set of core assets in a prescribed way

Analysis of the Definition

- Core asset is anything reusable for producing multiple products
  - Source code
  - Software architecture
  - Test infrastructure, test cases, and test data
  - Production plans
  - ….
- Core asset is attached with a process about how to use it

Analysis of the Definition

- Product line is a set of products built from core assets addressing a particular objective
  - A frequent misconception is that the product line is the core assets

- Product line is economic and efficient in building products
  - Most work is about integration instead of creation

Analysis of the Definition

- Software product line uses software engineering technique to meet the purpose of software product management

  - Software product management needs to plan a series of products with shared features
  - Software engineering technique makes use of core assets for the shared features

Benefit of Software Product Line

Payoff

- Initiating a software product line strategy requires some amount of up-front investment
- Payoff can happen after a small number of products
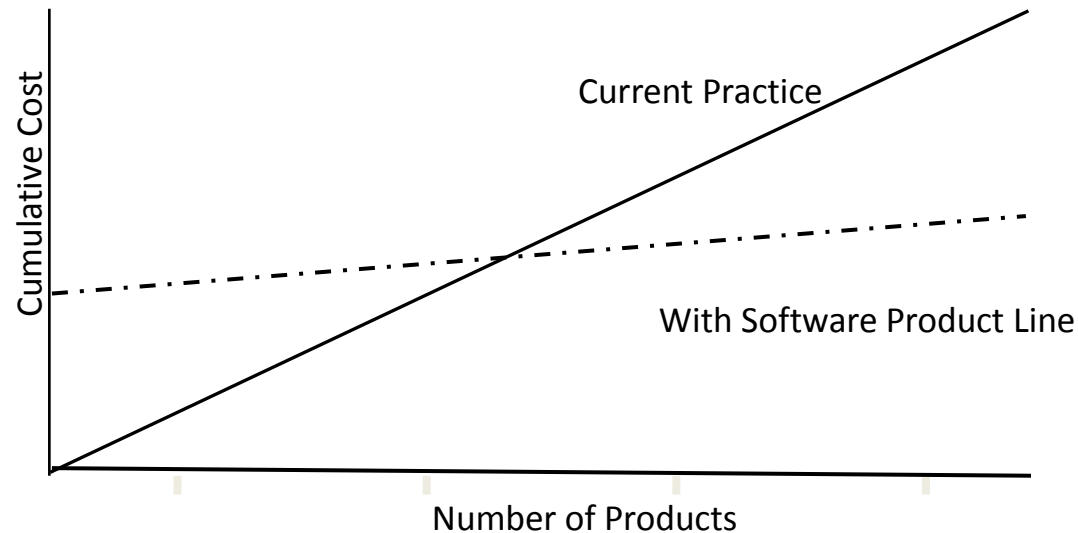
Some Real Numbers

- Improved productivity
  - By as much as 10x
- 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
  - By as much as 98%

Scalability for Modifications

- When a core asset is modified, all the systems in the software product line are modified

Development with Software Product Line

Key Activities

- Core asset development
- Product development
- Management

Core Asset Development

- ## What can we profitably reuse?
  - How many products will use it?
  - How much extra cost will be taken to make it reusable?
- ## We reuse anything that makes sense (money)
  - Source code – obviously – but non-software assets too
    - For example, we decompose a test suite into individual test cases, then compose as needed by a product

Core Asset Development

- A team is devoted to providing these assets
  - This team has a vision of all products that would use its assets
- An "attached process" accompanies each core asset to facilitate reuse of the asset

Product Development

- Product development is combining core assets with product-specific artifacts to produce products
- Product development moves faster than in traditional development because of the assets and the small percentage of product-specific artifacts

Product Development

- To produce a product, the product line works in two steps

  - Selection: needed core assets are selected
  - Extension: additional artifacts are added (possibly created from scratch)

Management

- A manager oversees the software product line
  - Coordinating the production of core assets and the assembly of products
  - Ensuring that resources are available at the right time to optimize operations of the software product line

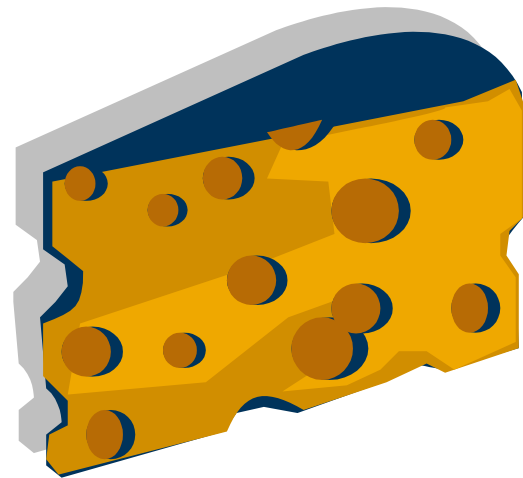# Software Product Line Ecosystem
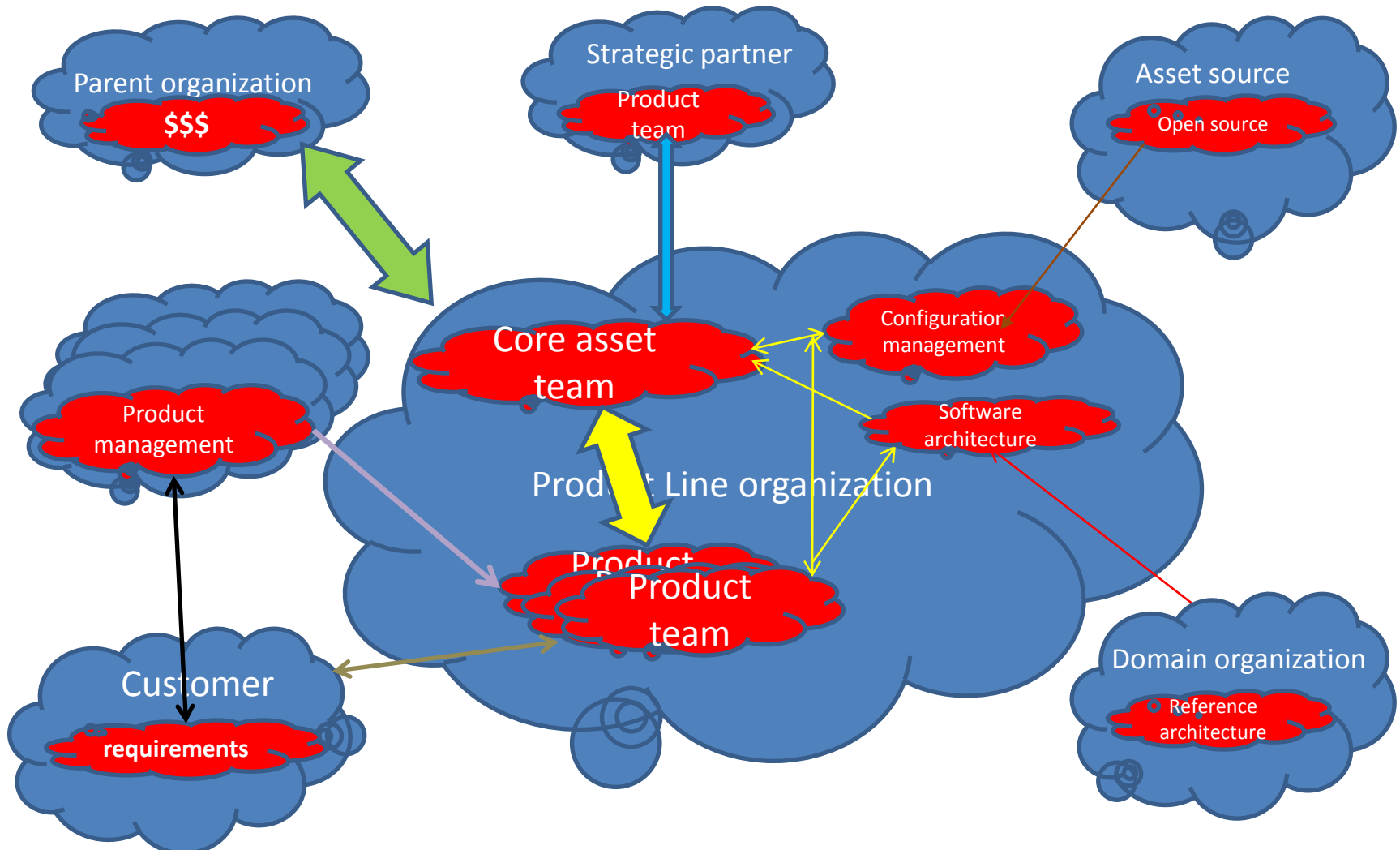
Software Product Line Architecture

Software Product Line Architecture

- Software architecture as key core asset
  - Captures early decisions about solving the problem
  - Communication vehicle among the stakeholders
  - Explicitly addresses the quality attributes
- More abstract than normal software architecture
  - Without everything completely defined

Software Product Line Architecture

- There are holes in its specification, but the architecture constrains how the holes can be filled
  - Strategic variations at the business unit level
  - Tactical variations at the technical manager's level
  - Variation points at the implementation level

Software Product Line Architecture

- Each hole is plugged by an artifact for a specific feature