

15 Jahre Software-Produktlinien: Einführung und aktueller Stand

Mini-Tutorial

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25. Mai 2009

PIK '09
Produktlinien im Kontext

Agenda

What is a Software Product Line (SPL)?

History of the SPL discipline

Concepts & approaches to SPL development

SPL case study

Key questions of SPL research & practice

Terminology: Product Family

We consider a set of programs to constitute a **family**, whenever it is worthwhile to study programs from the set by ...

first studying the common properties of the set and

then determining the special properties of the individual family members.

(David L. Parnas, 1976)

Terminology: Product Line

A **software product line (SPL)** is ...

a set of software-intensive systems

that share a common, managed set of features

satisfying 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 and Northrop, SEI, 2002)

Terminology: Product Line

Marketed (Software) Product Line:

A set of products that are marketed together as sharing a common set of concepts or features.

Engineered (Software) Product Line:

A set of products that are engineered together so as to share major parts of their implementation.

Reuse

Build something
from existing or pre-produced items

Advantages of Reuse

Quality

Productivity

Time

Reuse Items

Test Cases

Architecture

Estimates

Models

Code

Requirements

Subsystems

Documentation

Rules

But...

..most traditional software reuse approaches actually failed?

So what is new?

opportunistic
vs.
systematic

explicit differentiation in:

- development **for reuse**
- development **with reuse**

Agenda

What is a Software Product Line (SPL)?

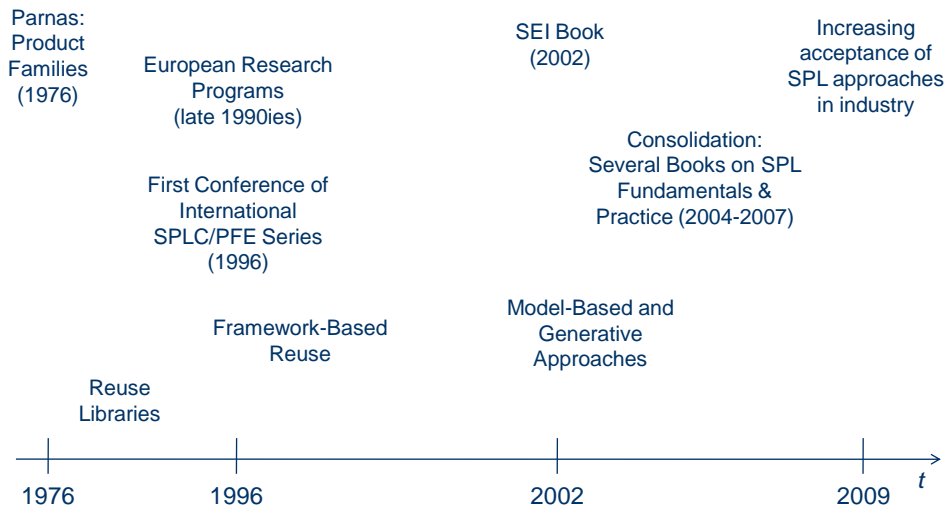
History of the SPL discipline

Concepts & approaches to SPL development

SPL case study

Key questions of SPL research & practice

History of the SPL discipline



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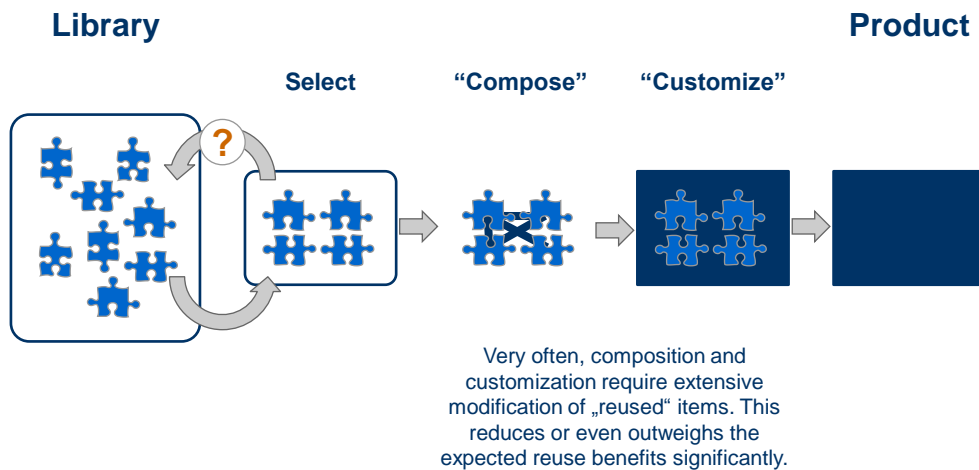
Key questions of SPL research & practice

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Reuse: The Old Way



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Reuse, the Old Way: Shortcomings

Library did not contain needed items

Selection tedious

Mostly adaptation is needed

Too little composition

Too much customization

People tend to build from scratch

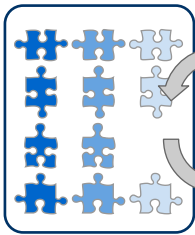
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Reuse: Product Lines

Platform /
Core Assets



Select & Compose



Customize

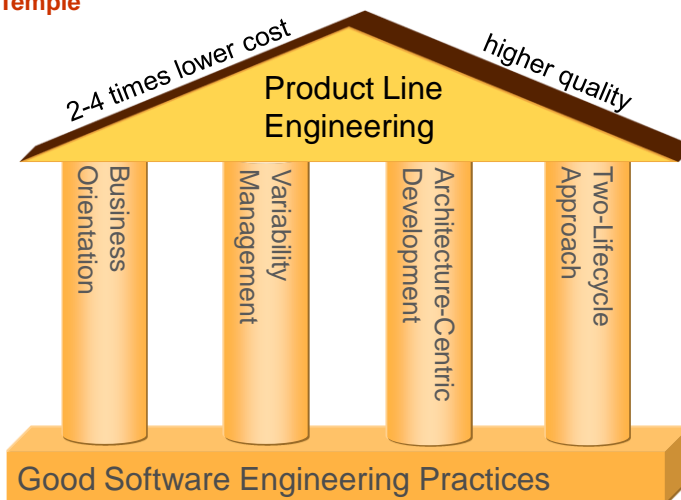


Product



Product Lines: Technical Challenges

PLE Temple



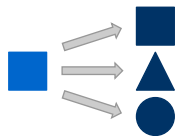
SPL Type: Business Rationale

Product Suites



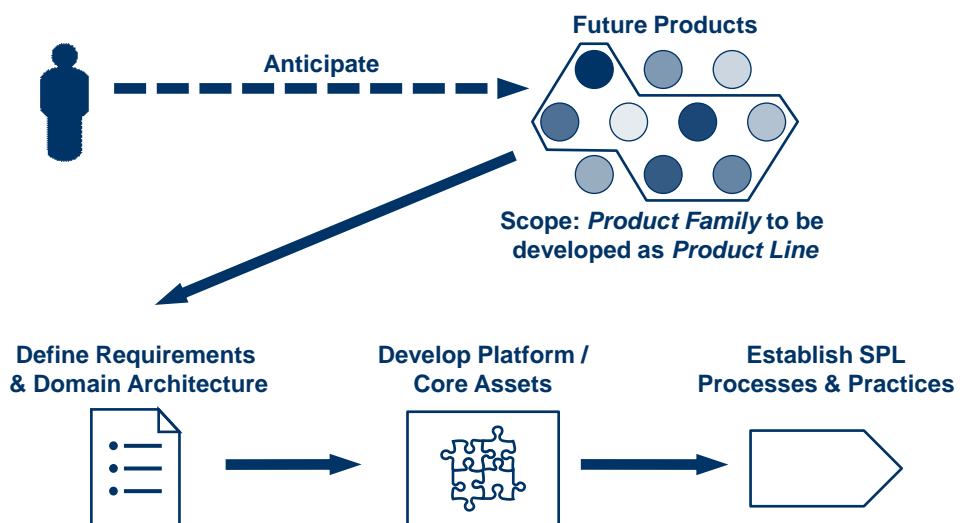
- Existing applications are integrated over time
- Customer uses more than one product from SPL
- **SPL motivation: Reduced cost of ownership**
- Example: Microsoft Office

Customized Products

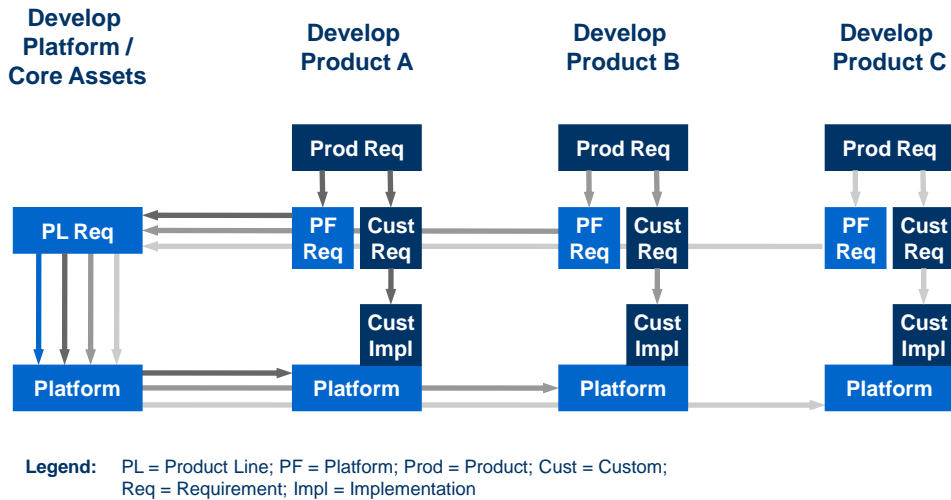


- New applications are instantiated from the framework
- Customer uses only one product from SPL
- **SPL motivation: Delivery efficiency**
- Examples: Cummins, Bosch, Danfoss

Setting up a Product Line



Operating a Product Line



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Challenges of SPL: Requirements

Anticipate Requirements

Describe Commonality & Variability

Maintain large requirements base over very long lifetime

Split requirements into platform and variant

Derive variant- & version-specific requirements views

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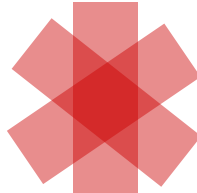
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Variability Management

Core Idea of Product Line Engineering

- Product 1
- Product 2
- Product 3



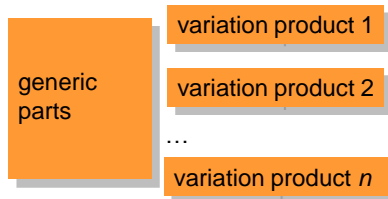
Core idea: Similarity of Products =
 Commonality + (reg.) Variability + Product-specific parts

↓ ↓ ↓

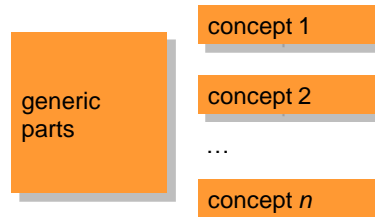
develop once make selectable single development

Variability Management

product-oriented variation



concept-based variation

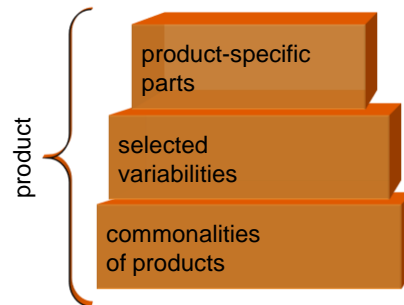


Product Definition
 product 1: concept 1,2, ,4,5, ,...
 product 2: concept 1, ,3,4, ,6,...

Variability Management

Definitions:

- **Product-specific:**
an artifact (or characteristic) that is specific to a product
- **Variability:**
an artifact (or characteristic) that exists in some, but not all, products of the product line
- **Commonality:**
an artifact (or characteristic) that exists in all products of the product line



SPL Types: Product Instantiation

Constructive



- Customization based on framework, library, or shared components

Compositional



- Fixed building blocks with parametrization
- Parametrization during build process or during installation; never exposed to end user

Generative



- Model-driven development with artefact generation

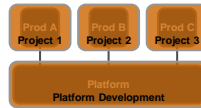
Combination



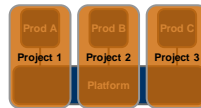
- For instance, generation of shared components with subsequent customization

Mapping Organization and Architecture

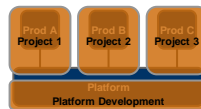
Separate platform team



Platform under control of product engineering projects



Mixed



Phased combination



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Product Lines: Technical Challenges

Anticipate scope & requirements

Define & maintain domain architecture

Develop & maintain platform / core assets

Establish mature software engineering practices

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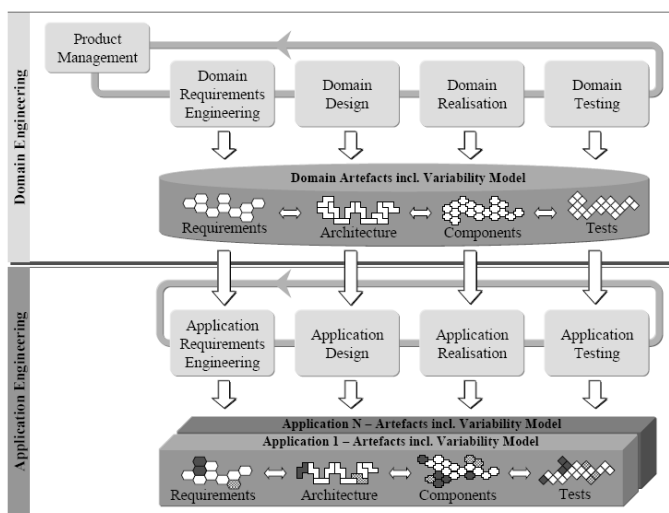
Challenges of SPL: Organization

Very many stakeholders

Diverging interests

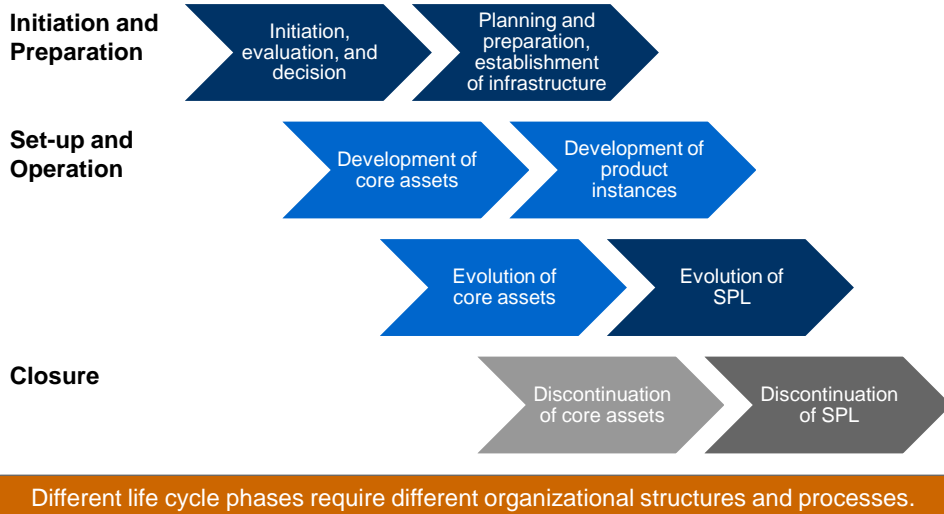
Changes of requirements & products

Product Line Framework



Source: Pohl, K., Böckle, G., van der Linden, F.: Software product line engineering: Foundations, principles, and techniques. Springer-Verlag, Berlin (2005).

Process: Overall SPL Lifecycle



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Case Study: Small

Market Maker Software AG

Small organization (< 25 developers total; ~50 people total)

Company started in 1984 with a focus on developing stock market software

Since then development of various products (product line)

- Desktop / PC-based systems
- Delphi-/C++-based development

Large range of customers (from consumer-market to large banks)

New product line (i* product line) started in 1999

- Web-based products
- Java-development
- Development started from scratch



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Case Study: Small

Market Maker: Product Line Engineering Results

New product line highly successful

- Running for more ~ten years now
- Large number of products
- + Reduction of Time-to-Market: 2-4
- + Break-Even: after about five products
- + Reduction of maintenance cost: ~60%
- + Reduced cost of quality (reliability in the field)
- Increase of issue resolution time

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Case Study: Large

Philips Medical Systems

- Large organization (> 1000 developers)
- Focus on medical imaging systems, e.g.,
 - Acquisition: X-Ray, Magnetic Resonance Imaging (MRI)
...
 - Image processing, viewing & storing
- World-wide development
- Development structured around product groups
 - cross product group reuse
 - core functionality: imaging products (storing, retrieving, processing)



Case Study: Large

Product Line Engineering Results

- Successful transition
- Integration of additional companies
- + Reduction of Effort: 2-4
- + Time-to-Market reduction: ~50%
- + Product defect density: <50%
- + Reduction of maintenance cost: ~60%
- + Common look and Feel
- + Better product planning and use of roadmaps

Some Literature

Further Material

- Product line engineering from a practitioner perspective
- Families Evaluation Framework
- Many industrial case studies!

<http://www.spl-book.net>

*Linden, Schmid, Rommes
Product Lines in Action
Springer, 2007*



Gleichheit in Vielfalt –
Produktlinien die Zukunft der industriellen
Softwareentwicklung



iX-Archiv, 5/2008, Seite 110

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Key Questions of SPL Research & Practice

How to model complex real-world variability?

How to integrate SPL with other methodologies?

How to create awareness of SPL demands?

How to switch over from non-SPL development to SPL development?

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