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**Synergies between
Service-Oriented Architecture
and
Software Product Lines**

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- **Motivation**

- Introduction to software product lines

- Comparing SOA and product lines

- Benefits of product line techniques in SOA

- Conclusion

Motivation

- Service-oriented architecture supports requirements of businesses processes and software users
- Fosters loose coupling, interoperability and reuse of legacy investment
- Therefore, promotes business agility

However:

- Services and applications are often built for specific needs and requirements
- Interfaces and data types will change
- Much redundant development is done

- ☞ **Techniques from software product lines can help addressing many of these issues**

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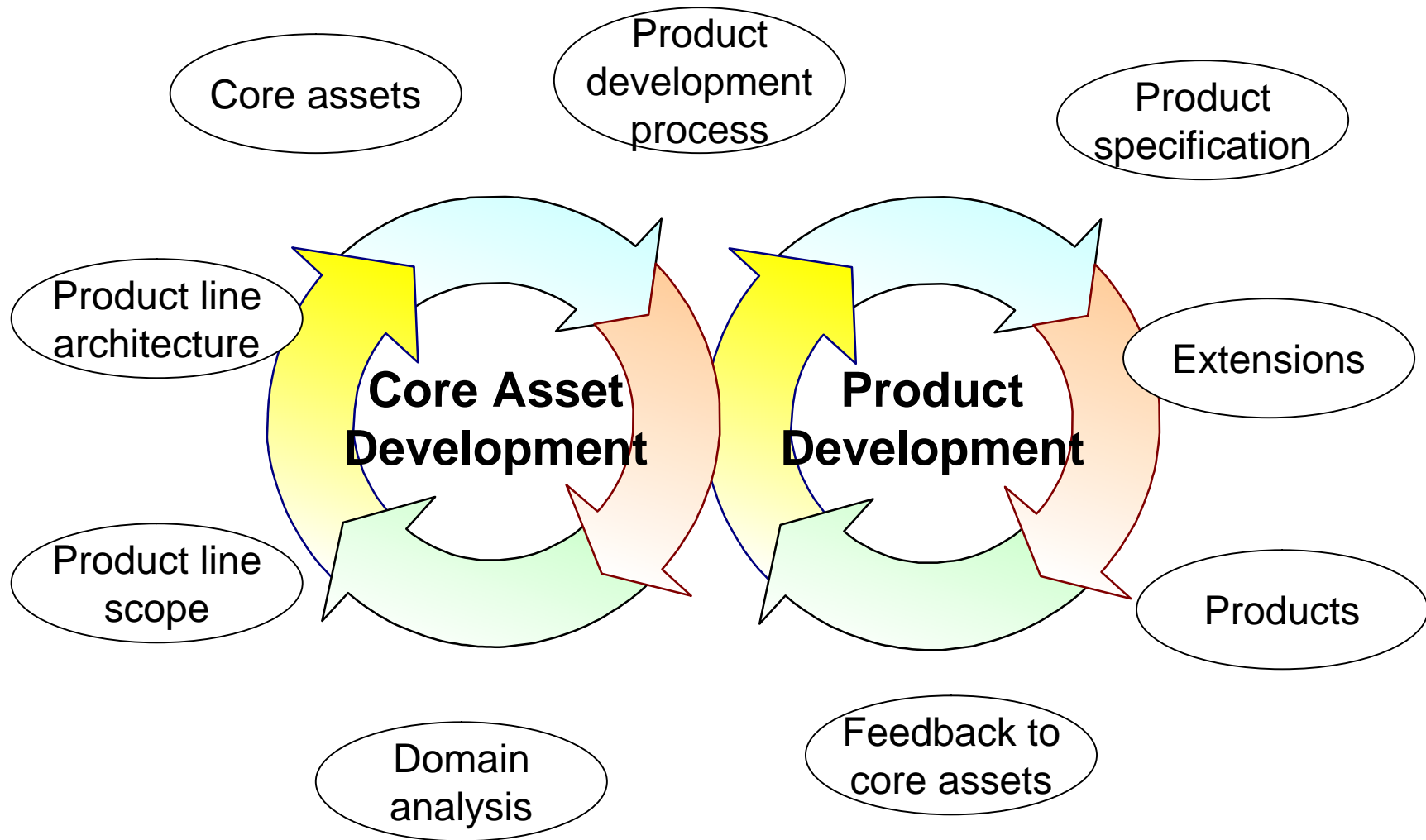- Conclusion

Introduction to Software Product Lines

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 common set of **core assets** in a prescribed way.

Paul Clements and Linda Northrop, 2002

Key Benefits of Software Product Lines

- Achieve productivity gains

- Improve time to market

- Exploit economies of scope through reuse of common assets

- Enhance the predictability of software development processes

- Improve software quality

- Focus on the unique aspects

Software Product Line Development

Core assets

Product development process

Product specification

Product line architecture

Core Asset Development

Product Development

Extensions

Product line scope

Products

Domain analysis

Feedback to core assets

Software Product Lines

Concepts:

- **Scope:** What products/solutions can be built (without extensions)

- **Commonality/Variability:** Identifies the common and variable (optional) features of product line members

- **Extensibility:** Well-defined extension points allow to add customer-specific features outside of the scope

Product Features

Product Line Features/ Scope

custom features

variable features

common features
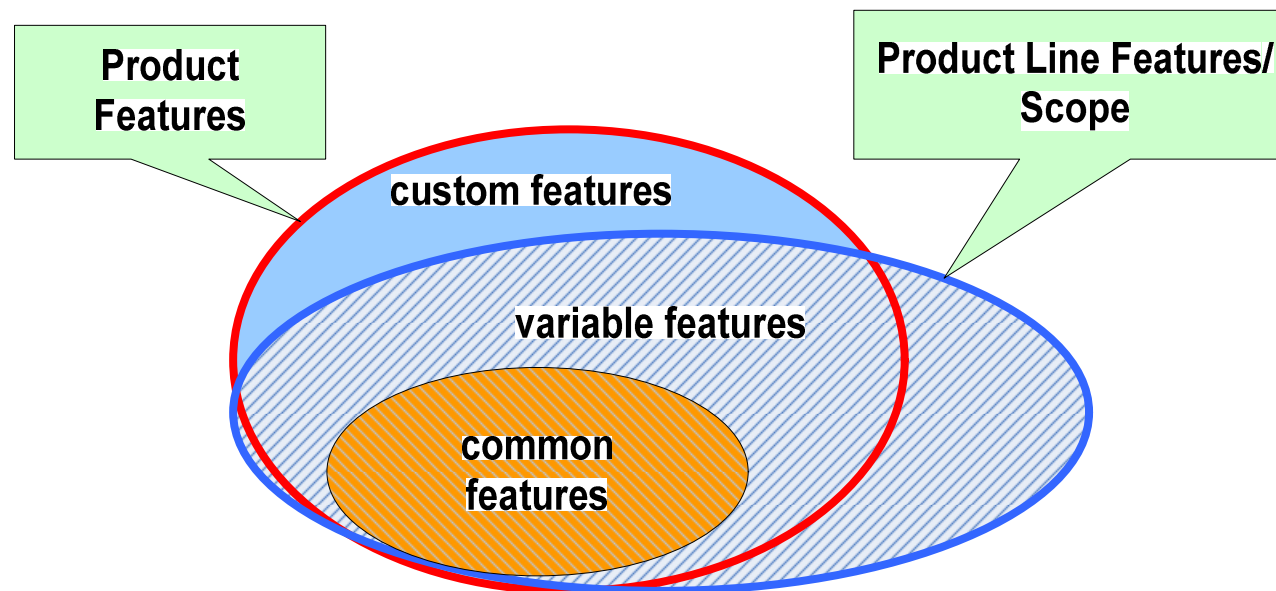
Feature-Oriented Domain Analysis
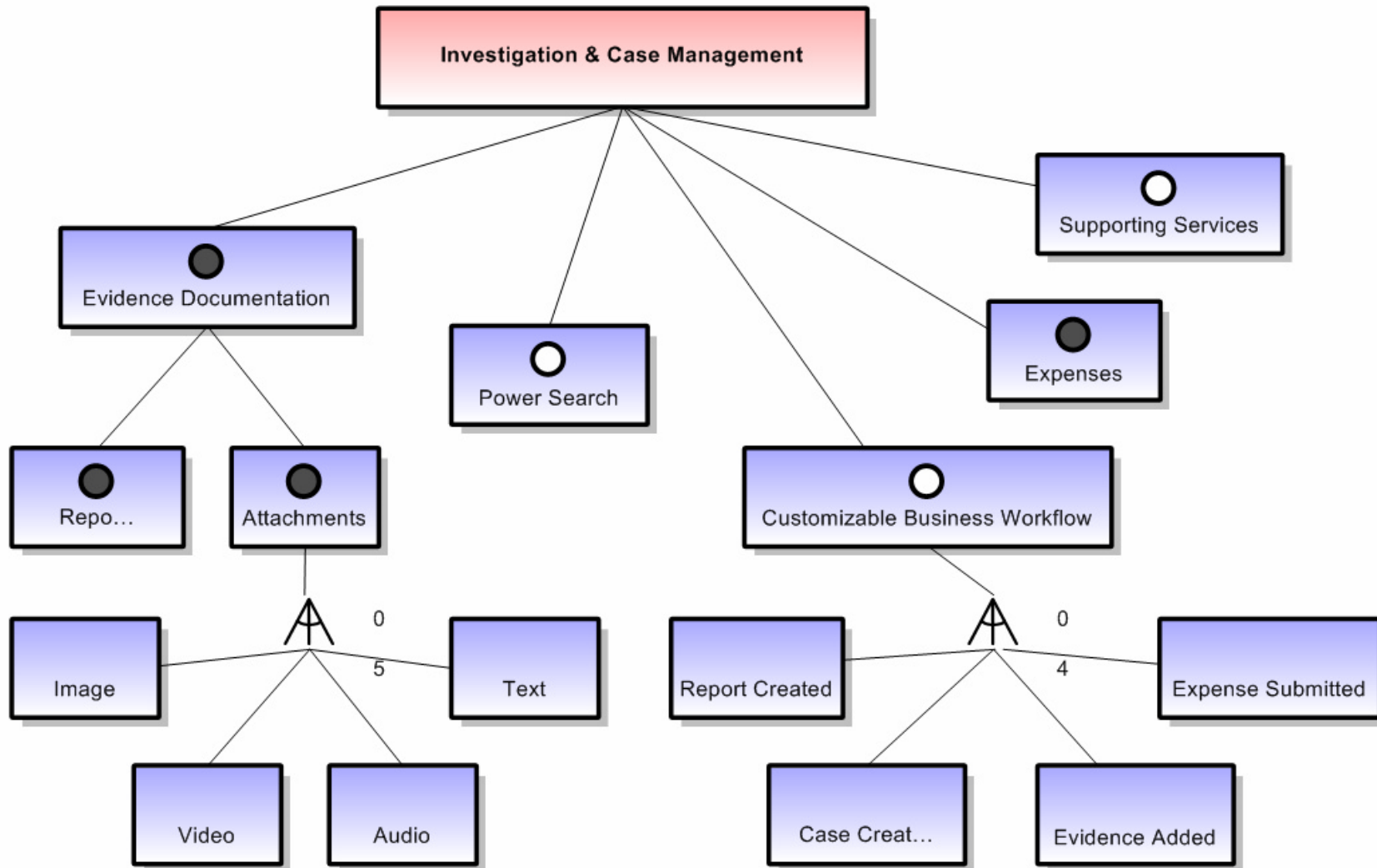
How Software Product Lines address problems in today's software development

- **One-off development**
  - ? Planned and systematic reuse

- **Monolithic systems and increasing system complexity**
  - ? Reusable components and a common product line architecture

- **Working at low levels of abstraction**
  - ? Use of specialized domain-specific languages, editors and code generators

- **Development process immaturity**
  - ? Mandates a strict product line development process with organization-wide dedication

- **Increasing demand for software and IT services**
  - ? Allows for rapidly building customized product line members

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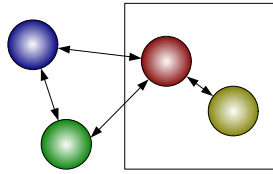
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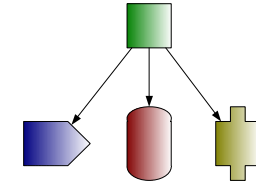
Someone familiar with concepts from service-oriented architectures will quickly become familiar with product line concepts.

Service Orientation　　　　　~　Software Product Lines

Service-Oriented Analysis　~　Domain Analysis

Service-Oriented　　　　　　~　Product Line Architecture
Architecture

Common Goals

Service-Oriented Architecture

- **Reusability**

- **Composability**

- Loose coupling

- Service contract

- Autonomy

- Abstraction

- Statelessness

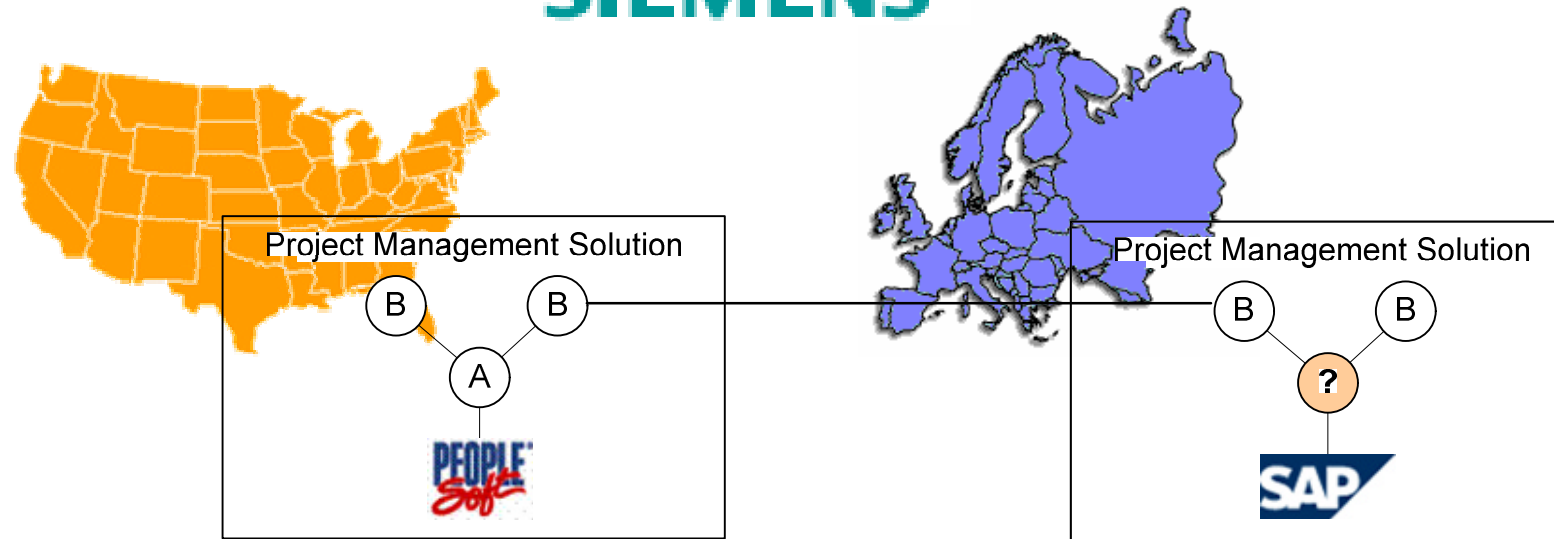- Discoverability

Product Line Architecture

- **Reusability**

- **Composability**

- Extensibility

- Scalability

- Portability

- Maintainability

- Interoperability

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Example 1: Variability within Services

- Solution originally incepted for one market
- "Same" solution requested for another market
- Problems
  - Different underlying "legacy" systems
  - Differences in ontologies
  - Slightly different service logic

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Project Management Solution

B   B

A

PEOPLE Soft

Project Management Solution

B   B

?

SAP

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Example 2: Variability in between Services

Company A

Company B

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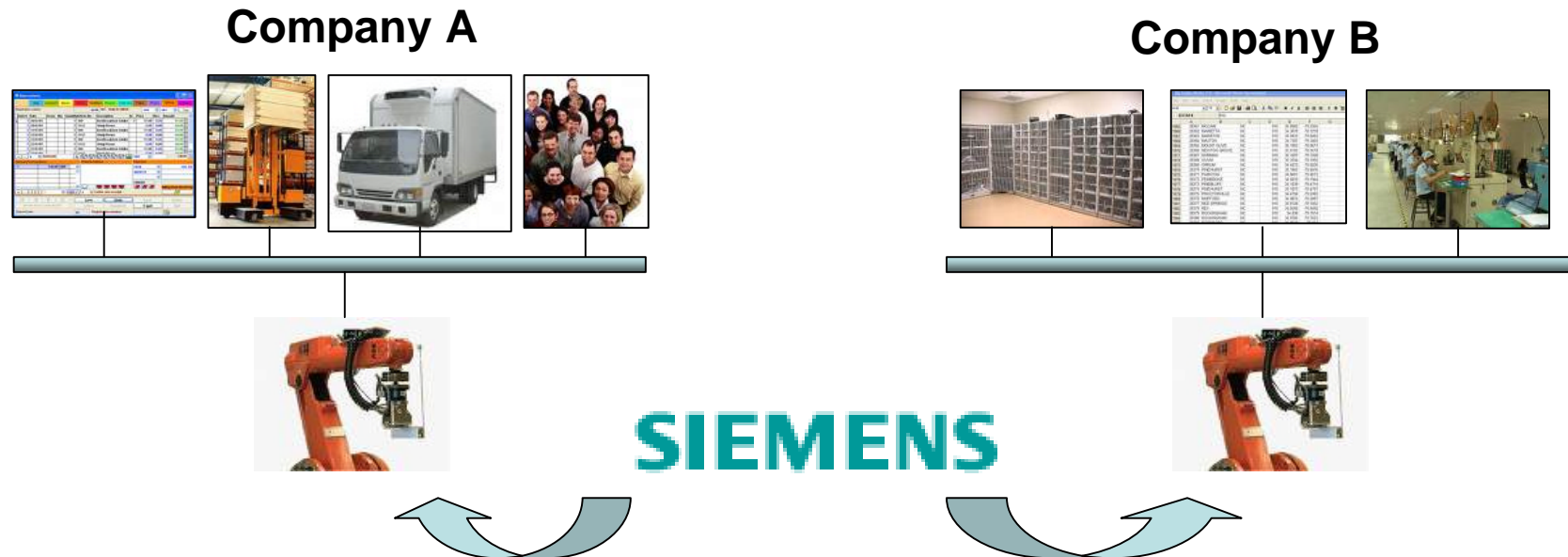
- Problems:
  - Ontologies and data models are NOT the same across different companies
  - Data models do NOT remain stable
  - Middleware platforms, policy frameworks differ greatly
  - How build generally reusable services

How Product Line Techniques support Service-Oriented Architecture

- Product line concepts facilitate communication

- Commonality/variability analysis provide formal means to make services and service-oriented architecture more future-proof

- Just as service-orientation, product lines need to be embraced throughout an organization

- Product line architecture provides concepts, patterns and practices that go beyond and complement service-oriented architecture

Supporting variability through architecture

Intra-Service Variability

- Installation wizards and configuration files
- Rules and workflow engines

Inter-Service Variability

- Orchestration
- Service discovery
- Service versioning
- Extensible protocols and data types
- WS* extensions

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Conclusion

- Both paradigms effectively address many of today's problems in software development.

- Together, SOA and Product Lines form a very potent combination.

- SOA provides an excellent foundation for product line architectures.

- Product line principles help thinking broader and more general.

Questions

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