A Connector Model for Object-Oriented Component Integration

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Integrated Object Systems (IOS)

Component integration

- Software development as long-term endeavor, combined forward and reverse engineering
- Composition of diverse, previously isolated applications in distributed, heterogeneous environments

Integration technologies

- Principle of software bus
  - Plug-in mechanism for component integration
  - Services for component interoperation
- exemplified by *Object Request Brokers*

Integrated Object Systems

Software systems that are continuously built using object-oriented integration technology

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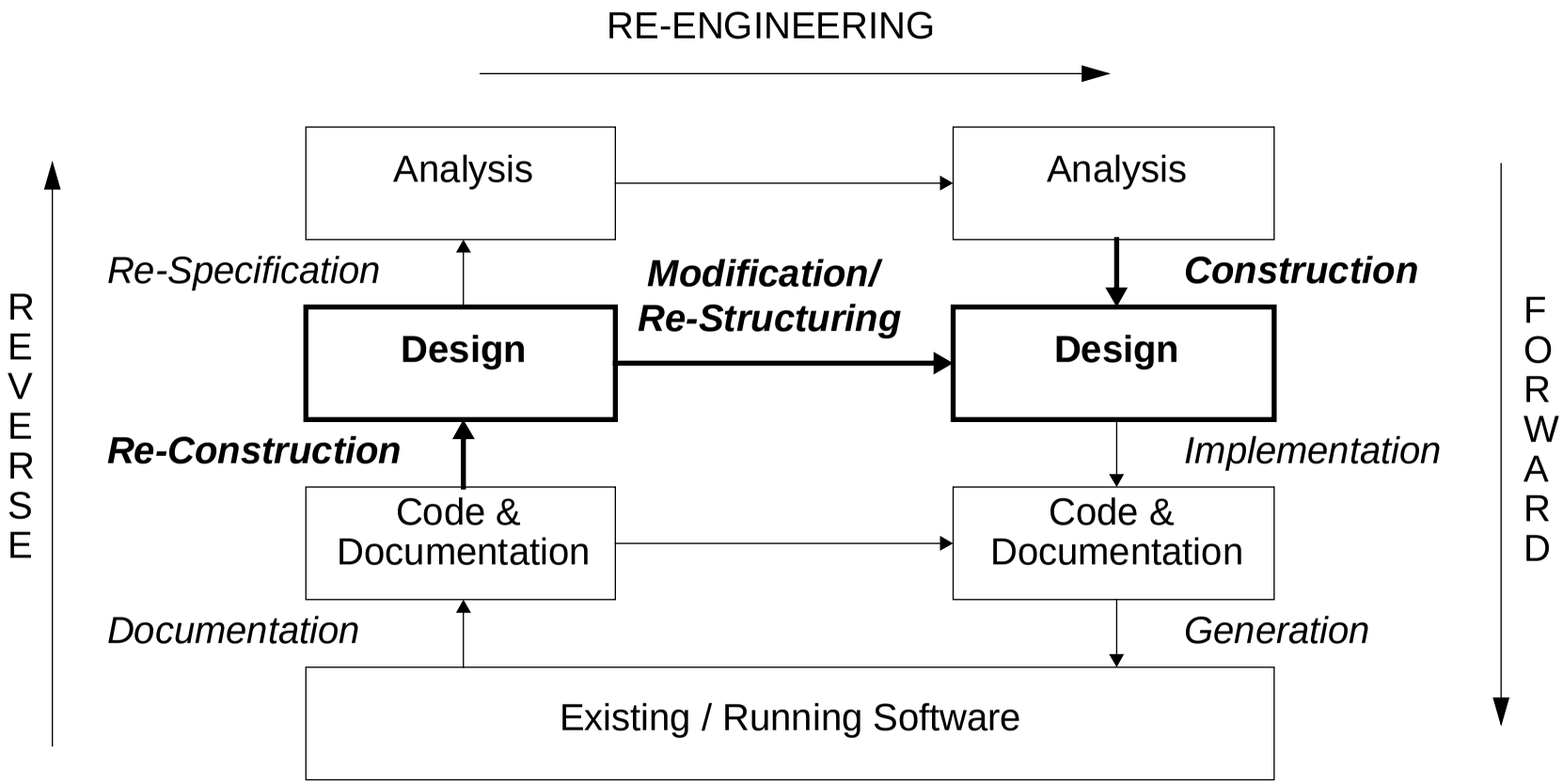
Software Design in Continuous Software Engineering



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Software Architecture

General Definition

"The description of elements from which systems are built, interconnections among those elements, patterns that guide their composition, and constraints on these patterns" [Shaw & Garlan 96]

Objectives

- Specification
- (Re-)Documentation
- Identification & Provision of transferable, reusable software solutions

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Creating Software Architectures

Techniques toward an architecture

- Reference models
- Architectural styles/archetypes
- Design patterns

Languages to express an architecture

- Architecture Description Languages
  - Universal *component* and *connector* model
- Object-Oriented Modeling Languages
  - Class-based object model

Architecting IOS

What are suitable techniques and languages to meet the diverse objectives?

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Software Architecture for Integrated Object Systems

Observations

- Mutual influence between IOS architecture and enabling technology used to build IOS
- Conventional architectural description distant from IOS technical realization

- Impact of technology on architecture should be made explicit
- Improving documentation practices by dedicated abstraction concepts for modeling IOS

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Describing Component Collaborations

Connectors of ADLs	• First-class language constructs symmetrical to components • Def. of *roles* as types, of *interaction protocols* • Universal model
Object collaborations	• Separate modeling languages/notations, rather weakly integrated with object type/class modeling languages • Def. of *sequences of method invocations* among a group of objects • Object-oriented model

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Issues of Using Connectors/Object collaborations for Modeling IOS

Connectors

- Object-oriented interpretation of connectors
- Technical realization of connectors
- Connector abstractions of
  - technology (engineering viewpoint)
  - business problem domain (enterprise viewpoint)
  - existing software infrastructures

Object collaborations

- Programming level vs. architecture level of description
  - Object/component granularity
  - Intensional and extensional relationships between 'architectural objects'

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Description of Components and Connectors – A Specialized Perspective –

Description of	Transferable Abstraction	Particular System
Component	Isolated component	Integrated, adapted /wrapped component
Connector	Pattern of component collaboration	Composition of specific integrated components

Def. *Component*:
System of programming objects (incl. technical infrastructure objects), encapsulated by ORB-level interfaces

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Connectors as Pattern-like Transferable Abstractions

	Structured template/recording schema
Roles	• Collaboration participants marking responsibilities
Role Interfaces	• Role behavior expressed in terms of provided and/or required services
Interactions	• Sequences of requests wrt. role interfaces
Modeling Example	• Use and impact of applying a connector to *specific* components
Abstract Architecture	• Component composition using connectors: Distribution of role responsibilities to specific components
Concrete Architecture	• Component composition using component abstractions only: Exhibiting individual component customizations and adaptations of collaboration rationale

Connector Examples

- an Event Notification connector, Relationship connectors

  S. Tai, S. Busse. *Connectors for Modeling Object Relations in CORBA-based Systems.* Proc. TOOLS-24, 1997.

- an OTS connector

  S. Busse, S. Tai. *Software Architectural Modeling of the CORBA Object Transaction Service.* Proc. COMPSAC-22, 1998. *to appear.*

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Summarizing Position

Integrated Object Systems

- A class of component-based systems characterized by distribution, heterogeneity, continuity of development

Software Architecture for IOS

- Describing transferable abstractions vs describing particular systems, Making impacts of technology on architecture explicit

Specialized connector model

- Documentation template combining concepts of software architectural connectors and object-oriented modeling
  - to exhibit (enterprise or engineering) patterns and assumed contexts guiding component composition
  - can be related to a more technical, implementation-oriented system representation
  - existing, standard modeling languages can be used