Part II – Black-Box Composition Systems 10. Business Components in a Component-Based Development Process

1. Business component model of the Cheesman/ Daniels process
2. Identifying business components

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Literature

- J. Cheesman, J. Daniels. UML Components. Addison-Wesley.
- R. Prieto-Diaz. Implementing Faceted Classification for Software Reuse. CACM May 1991, vol 34(5). ACM. http://doi.acm.org/10.1145/103167.103176

10.1 Business Component Model of the Cheesman-Daniels Process

Goals of the Chessman-Daniels Process

- Bring together domain modelling with use case modelling (functional requirements)
- Find out business objects (large objects, subjects) of application
- Group business objects to components for change-oriented design and reuse
- Specify contracts for the components

Business Objects are Complex Object (Subjects)

- A **business object** is complex object (subject) with a coarse-grain, natural type of the domain model (business model)
  - which lives on its own (*natural type*)
  - exists independent of context and collaborators
  - which does not depend on other types (*independent type)*
    - Hotel vs. HotelRoom
    - Car vs. Screw or Motor
  - We call types that depend on others *dependent types.*
- Usually, business objects are large units
  - They can consist of thousands of smaller objects of dependent types (part-of relation)
  - They can play many *roles* with *context-based types*

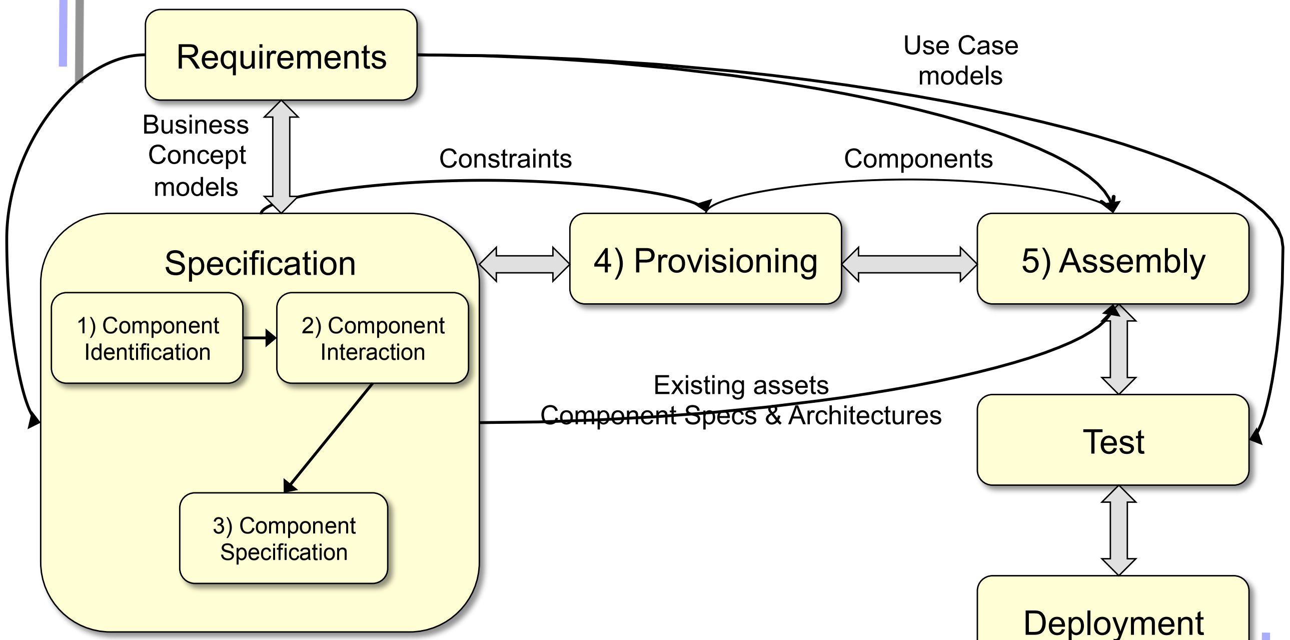
Business Component Model

- In the Cheesman-Daniels component model, a **business component** consists of a set of business objects and other business components (part-of relation)
- The smallest component is a *business object*
  - groups several interfaces together.
  - has several provided interfaces
  - has several requried interfaces
    - The business objects are the logical entities of an application
    - Their interfaces are re-grouped on system components for good information hiding and change-oriented design
  - Has a specification containing all interfaces and contracts
  - Has an implementation
  - UML-CD are used (UML profile with stereotypes)

10.2. Identifying Business Components

Identifying Business Components with the Cheesman-Daniels CBSE Process

Ooverall development process

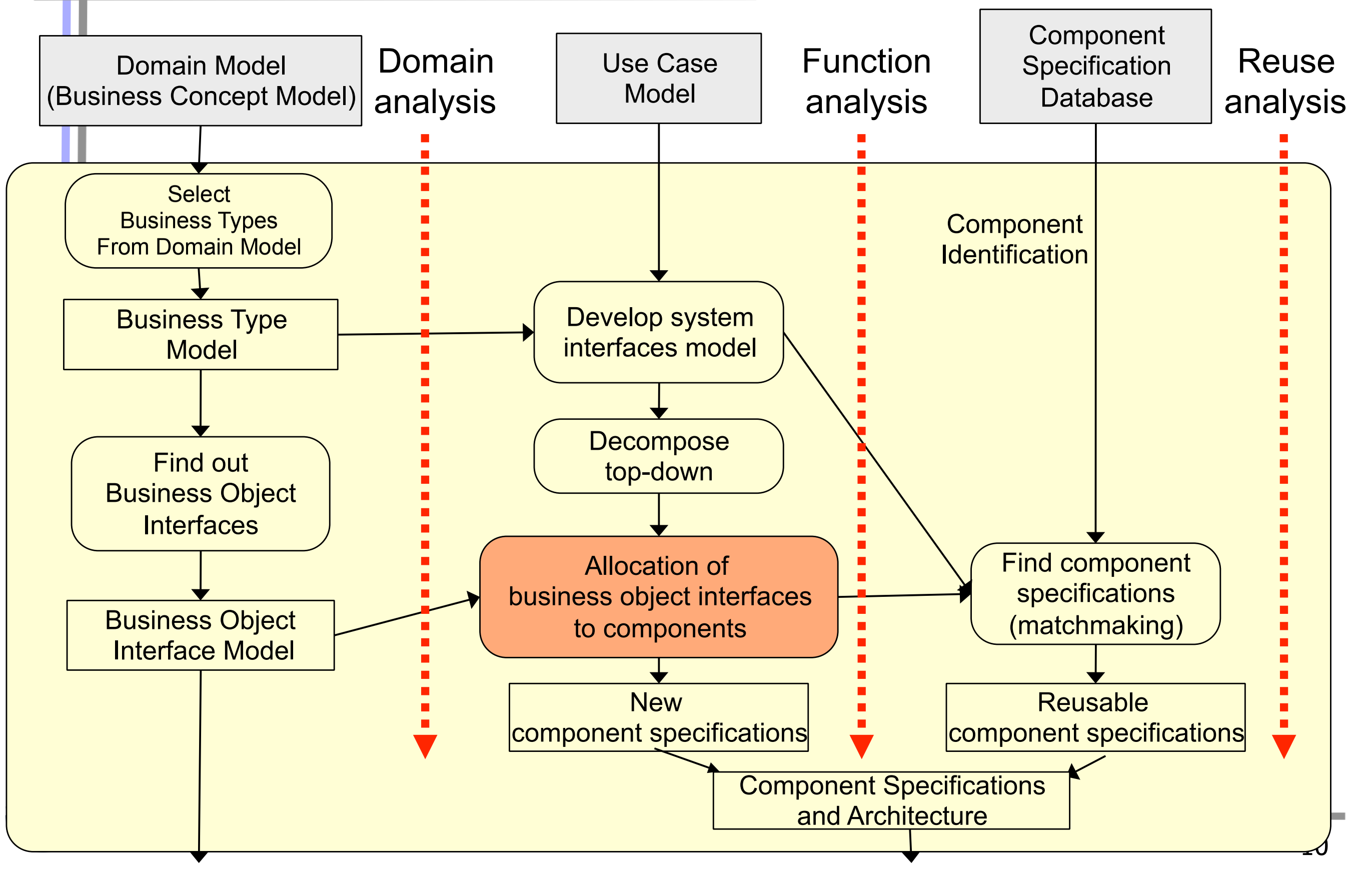


Simplified version of Fig. 2.1 from Cheesman/Daniels

Artifacts of the Cheesman/Daniels Process

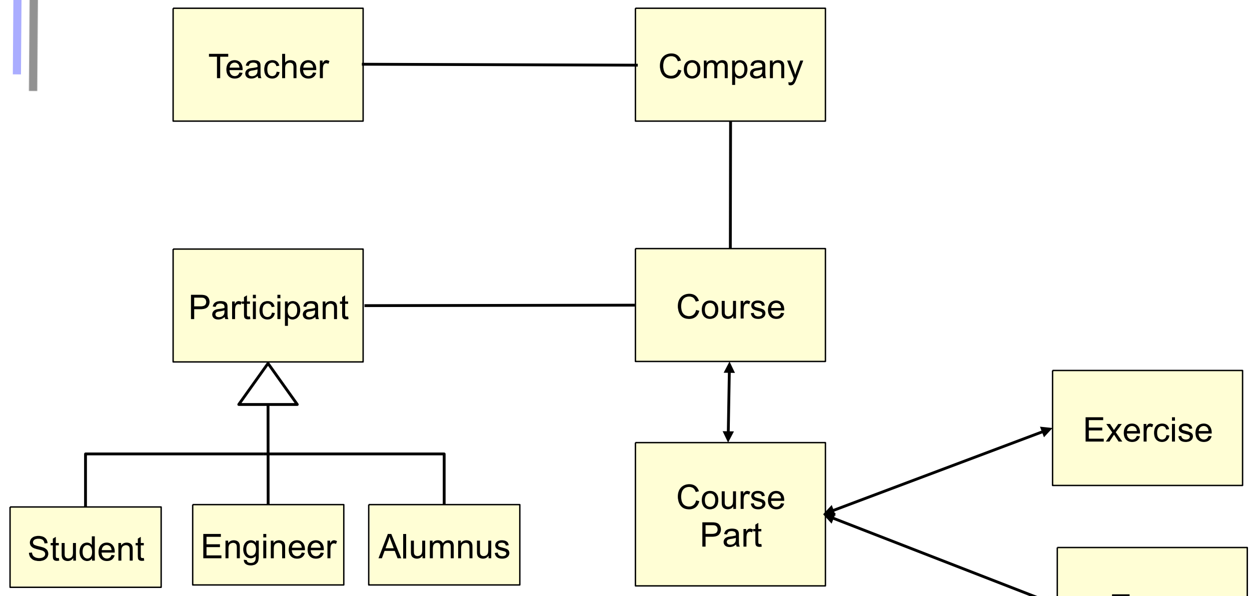
- Requirement artifacts:
  - *Business concept model (business model, domain model):* describes the business domain (application domain)
  - *Use case model* (requirements model)
- System artifacts, derived from the business concept model:
  - *Business type model*, derived from domain model.
    - Represents the system's perspective on the outer world (more attributes, refined class structures from the system's perspective)
  - *Business object interface model*, containing the business objects and all their interfaces
  - *Business object model*, derived from the business object interface model by adding operations
- System component artifacts
  - Component interface specifications: one contract with the client
  - Component interface information model (state-based model)
  - Component specifications: all interface specifications of a component plus constraints.
  - Component architecture: wiring (topology) of a component net.

10.2.1 Component Identification (Step 1)


Domain Model (Business Concept Model)
Domain analysis
Use Case Model
Function analysis
Component Specification Database
Reuse analysis
Select Business Types From Domain Model
Business Type Model
Find out Business Object Interfaces
Business Object Interface Model
Develop system interfaces model
Decompose top-down
Allocation of business object interfaces to components
New component specifications
Component Identification
Find component specifications (matchmaking)
Reusable component specifications
Component Specifications and Architecture

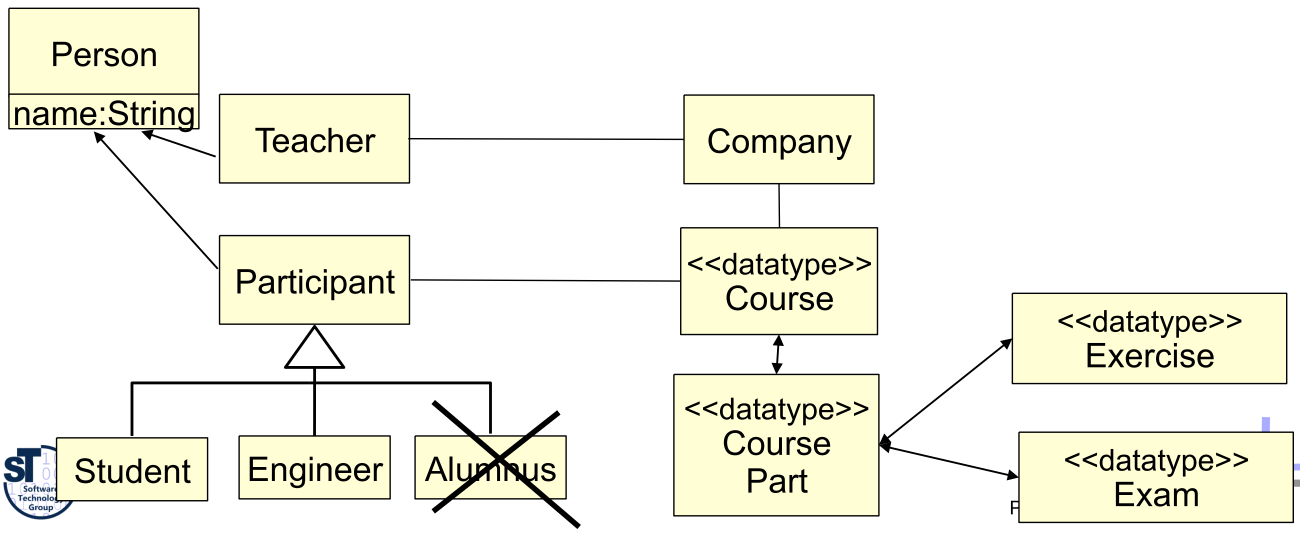
Ex.: Domain Model of a Course-Management System

- Collects all concepts of the domain (aka business concept model)



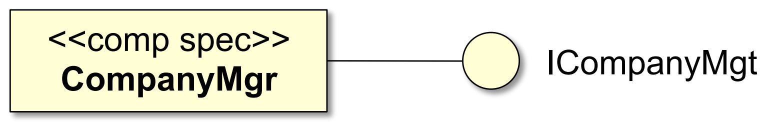
Business Type Model

- Defines system types from the domain model
  - Eliminates superfluous concepts
  - Adds more details
  - Distinguish datatypes (passive objects)

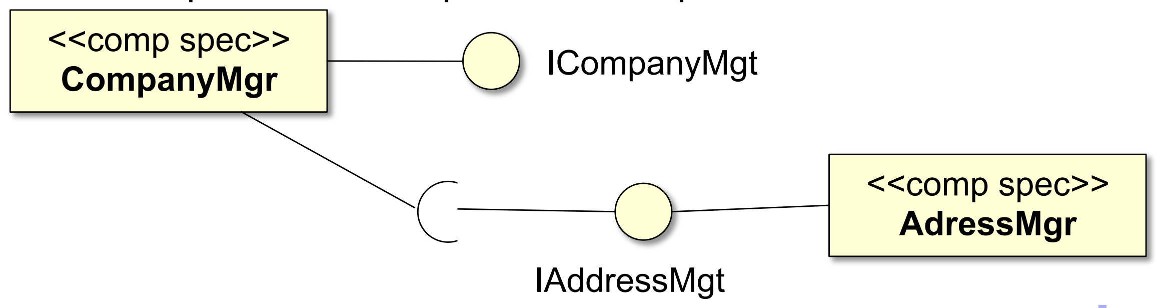


Component Specification with UML Components

- A UML component has *provided* and *required* interfaces
  - Provided interfaces are using „Lollipop“ notation
  - Required interfaces use „plug“ notation

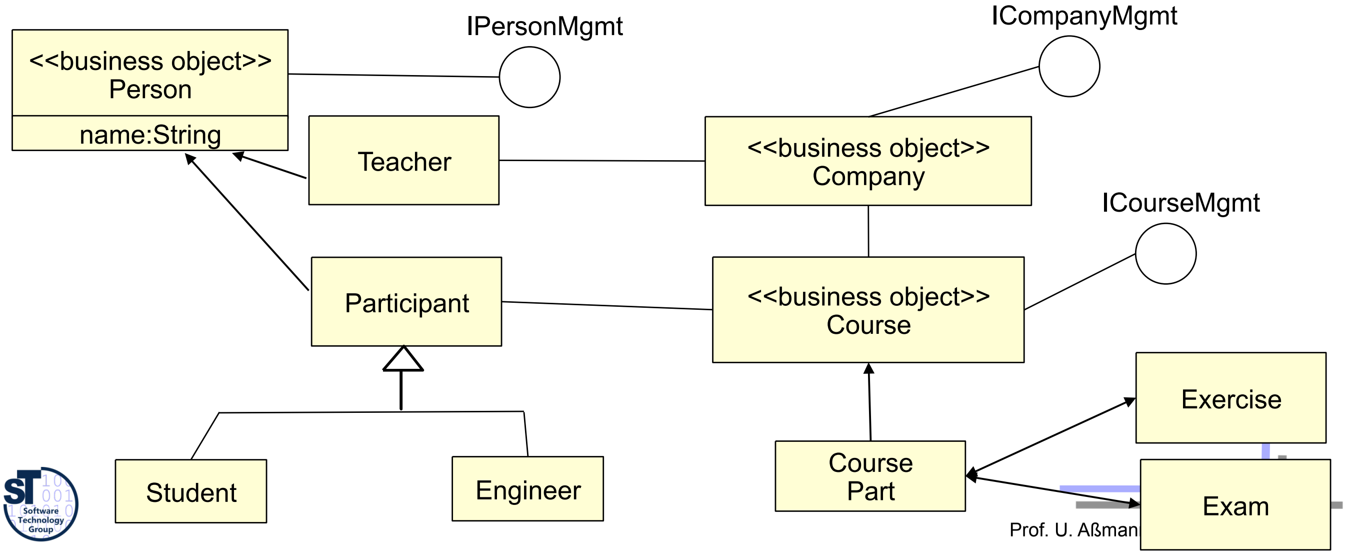


- Some components are required to use specific other interfaces



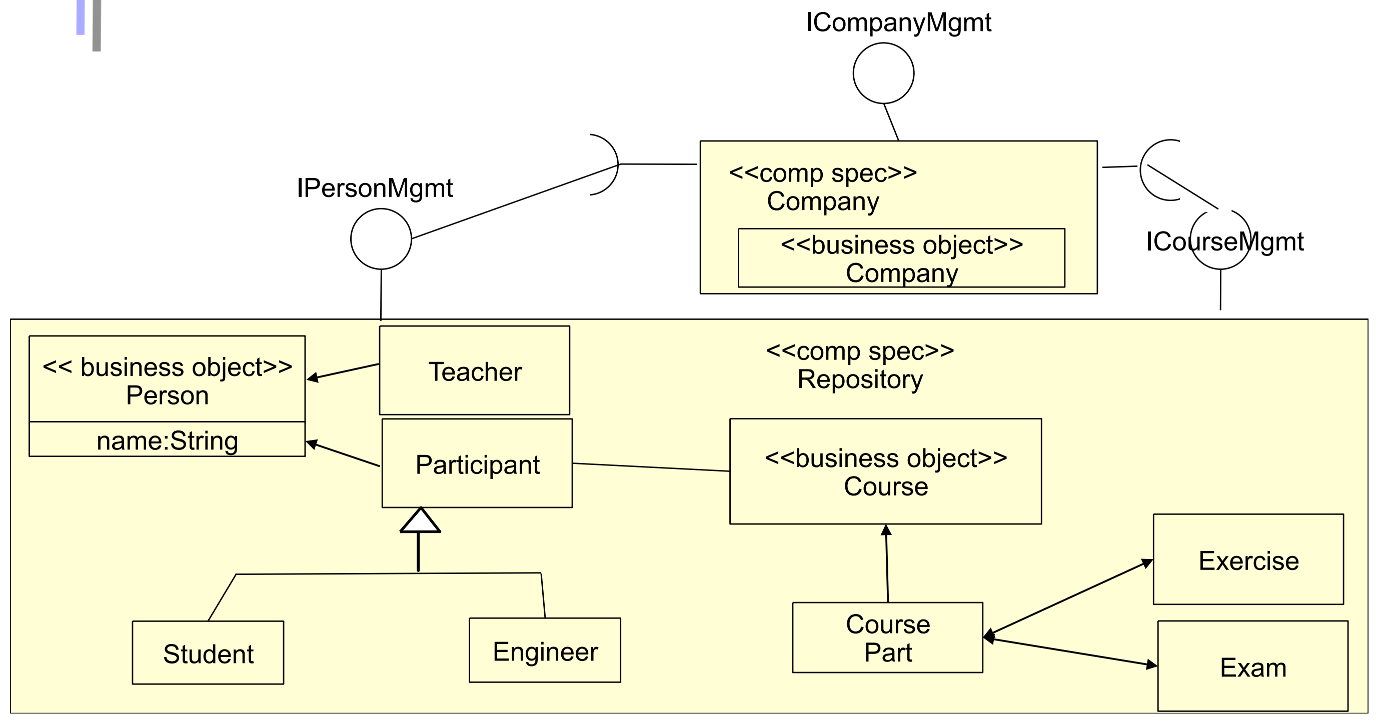
Business Object Interface Model

- Identifies business objects from the business type model
  - And defines *management interfaces* for them
  - Here, only Company, Course, Person are business objects, all others are dependent types



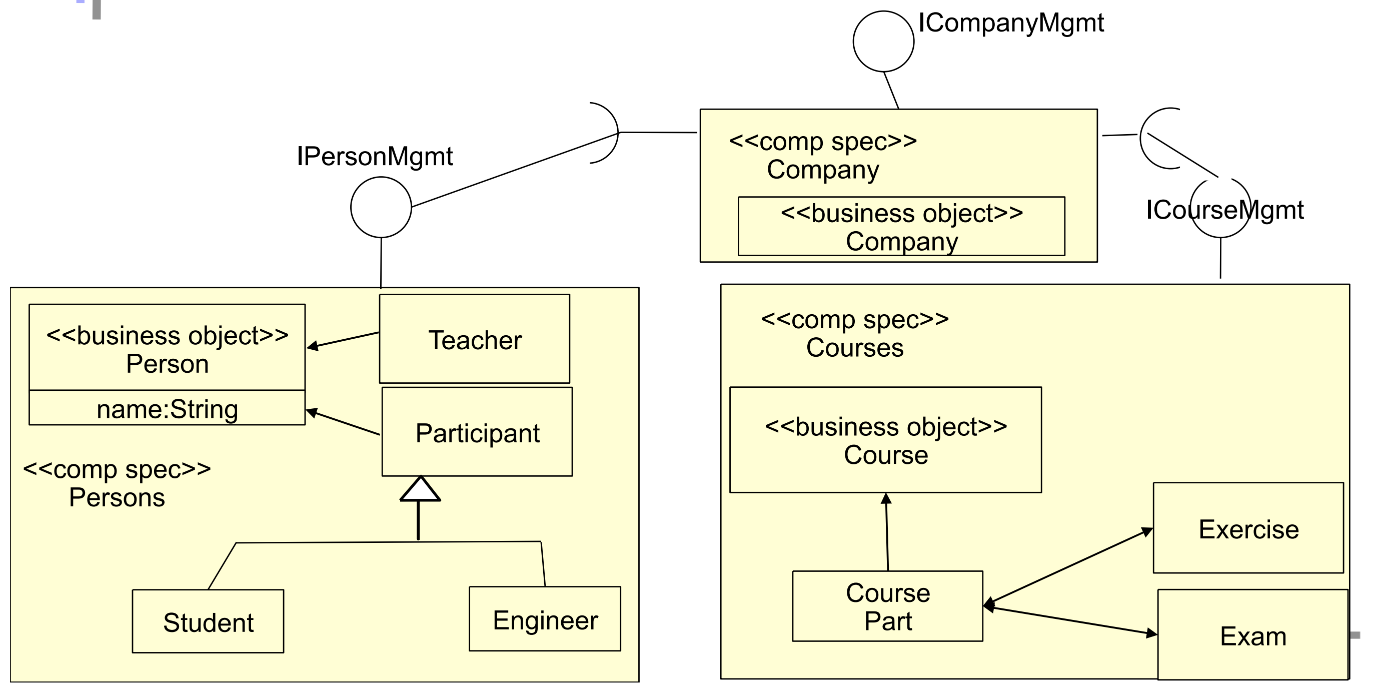
Component Identification (Version 0.1)

- Group classes and interfaces into reusable components



Alternative Component Identification (0.1)

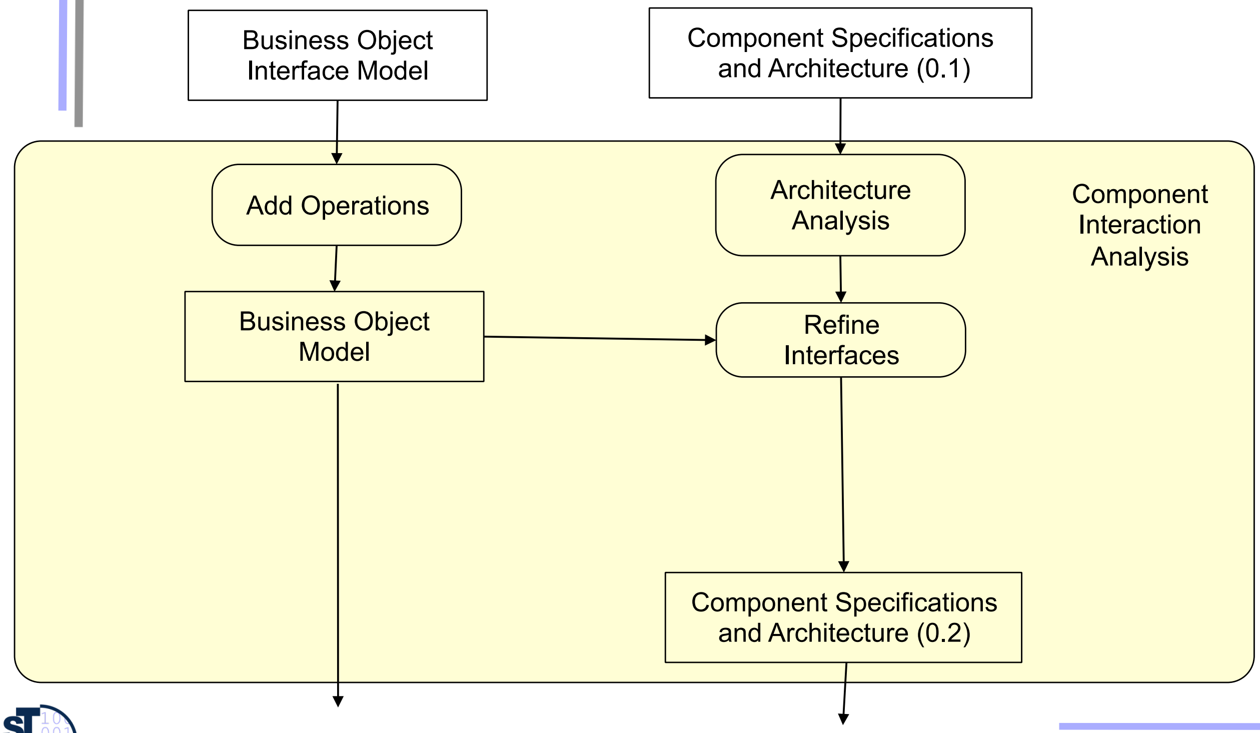
- Group classes and interfaces into components
- Person management might be reuseable



Component Identification

- The **component identification** subprocess attempts to
  - Create a business object interface model from the domain model (still without methods)
  - Attempts to group these interfaces to initial *system component specifications*
    - The grouping is done according to
      - *information hiding*: what should a component hide, so that it can easily be exchanged and the system can evolve?
      - *Reuse considerations:* which specifications of components are found in the component specification repository, so that they can be reused?
- There is a tension between business concepts, coming from the business domain (problem domain), and system components (solution domain). This gap should be bridged.

10.2.2 Component Interaction Analysis (Step 2)

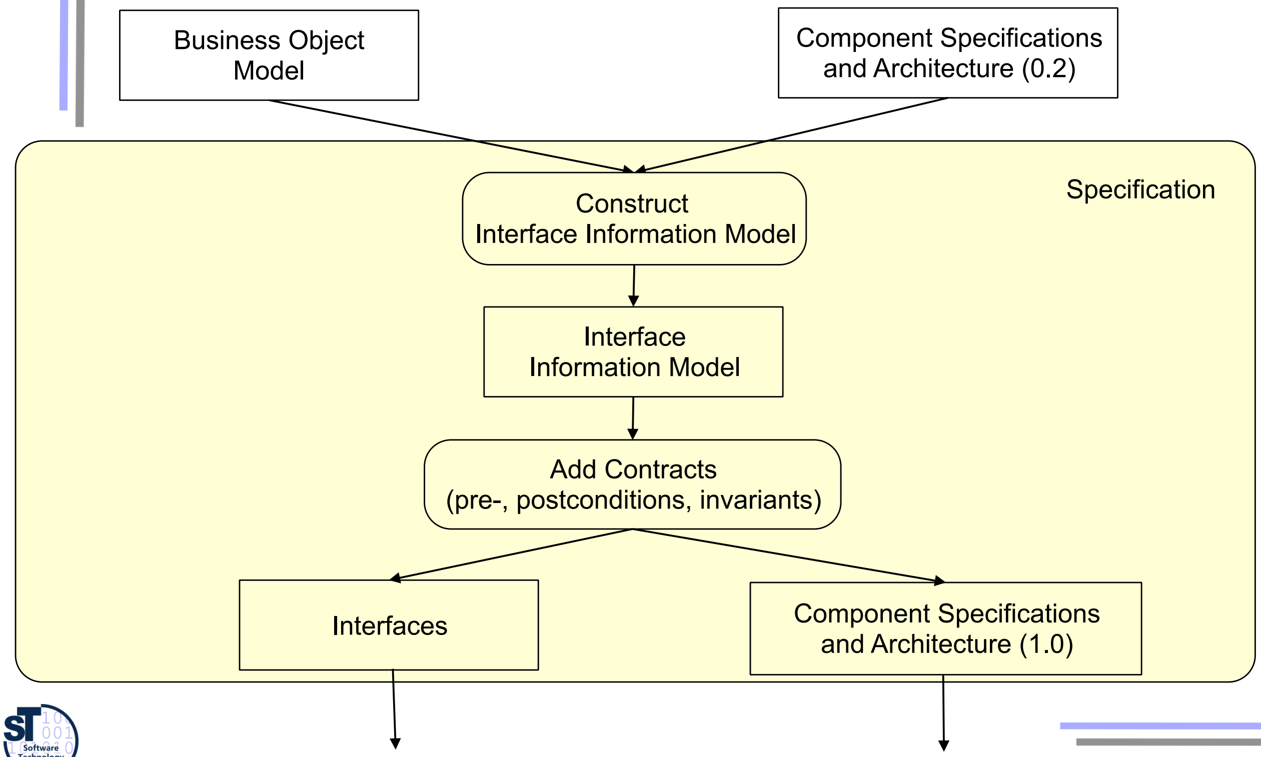


Business Object Interface Model
Component Specifications and Architecture (0.1)
Add Operations
Architecture Analysis
Component Interaction Analysis
Business Object Model
Refine Interfaces
Component Specifications and Architecture (0.2)

Component Interaction Analysis

- Is basically a refinement of the first stage
  - Removing,
  - Regrouping,
  - Augmenting,
  - Producing component specifications and wirings in a version 0.2
- Additionally, operations are added to business object interfaces
  - And mapped to internal types.

10.2.3 Component Specification (Step 3)


Business Object Model
Component Specifications and Architecture (0.2)
Specification
Construct Interface Information Model
Interface Information Model
Add Contracts (pre-, postconditions, invariants)
Interfaces
Component Specifications and Architecture (1.0)

Component Specification (Step 3)

- Specification of declarative contracts for UML components in OCL
- Invariant construction:
  - Evaluate business domain rules and integrity constraints
  - Example:

```
context r: Course
-- a course can only be booked if it has been allocated in
   the company
inv:  r.bookable = r.allocation->notEmpty
```

- Pre/Postconditions for operations
  - Can only be run on some state-based representation of the component
  - Hence, the component must be modeled in an *interface information model*
  - Or: be translated to implementation code (e.g. Java using an OCL2Java Compiler)

10.2.4. Provisioning (Realization, Implementation) (Step 4)

- Provisioning selects component implementations for the specifications
  - Choosing a concrete implementation platform (EJB, CORBA, COM+, ...)
  - Look up component implementations in implementation repositories
    - Write adapters if they don't fit exactly
  - Program missing components
  - Store component implementations and specifications in database for future reuse

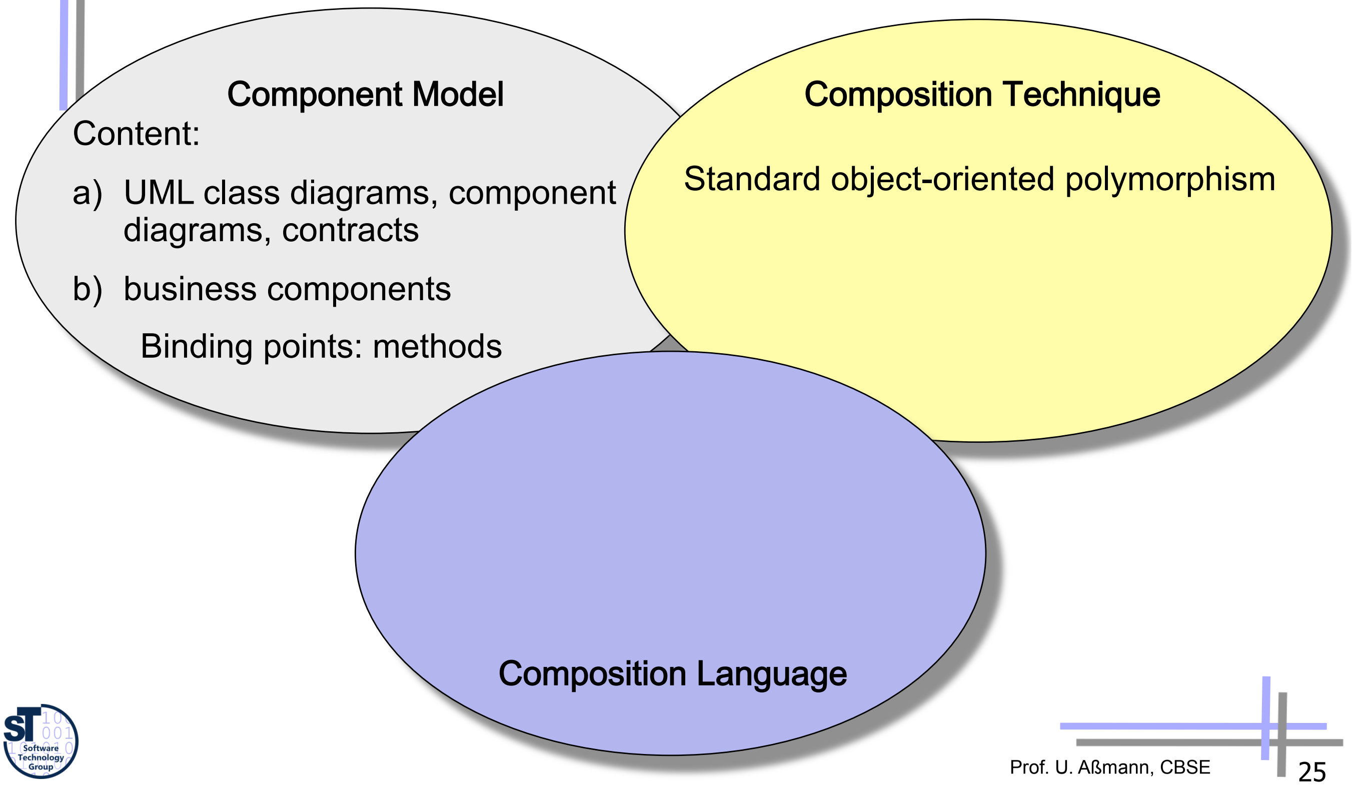
10.2.5 Assembly (Step 5)

- Puts together architecture, component specifications and implementations, existing components
  - We will see more in the next lectures

Weaknesses

- No top-down decomposition of components
  - part-of relationship is not really supported
- Reuse of components is attempted, but
  - Finding components is not supported (see companion lecture)
    - Metadata
    - Facet-based classification

Cheesman-Daniels’ Business Component Model as Composition System



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