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A Dynamic Software Product Line Approach using Aspect Models at Runtime

Tom Dinkelaker, Ralf Mitschke, Karin Fetzer*, Mira Mezini

Technische Universität Darmstadt, Germany

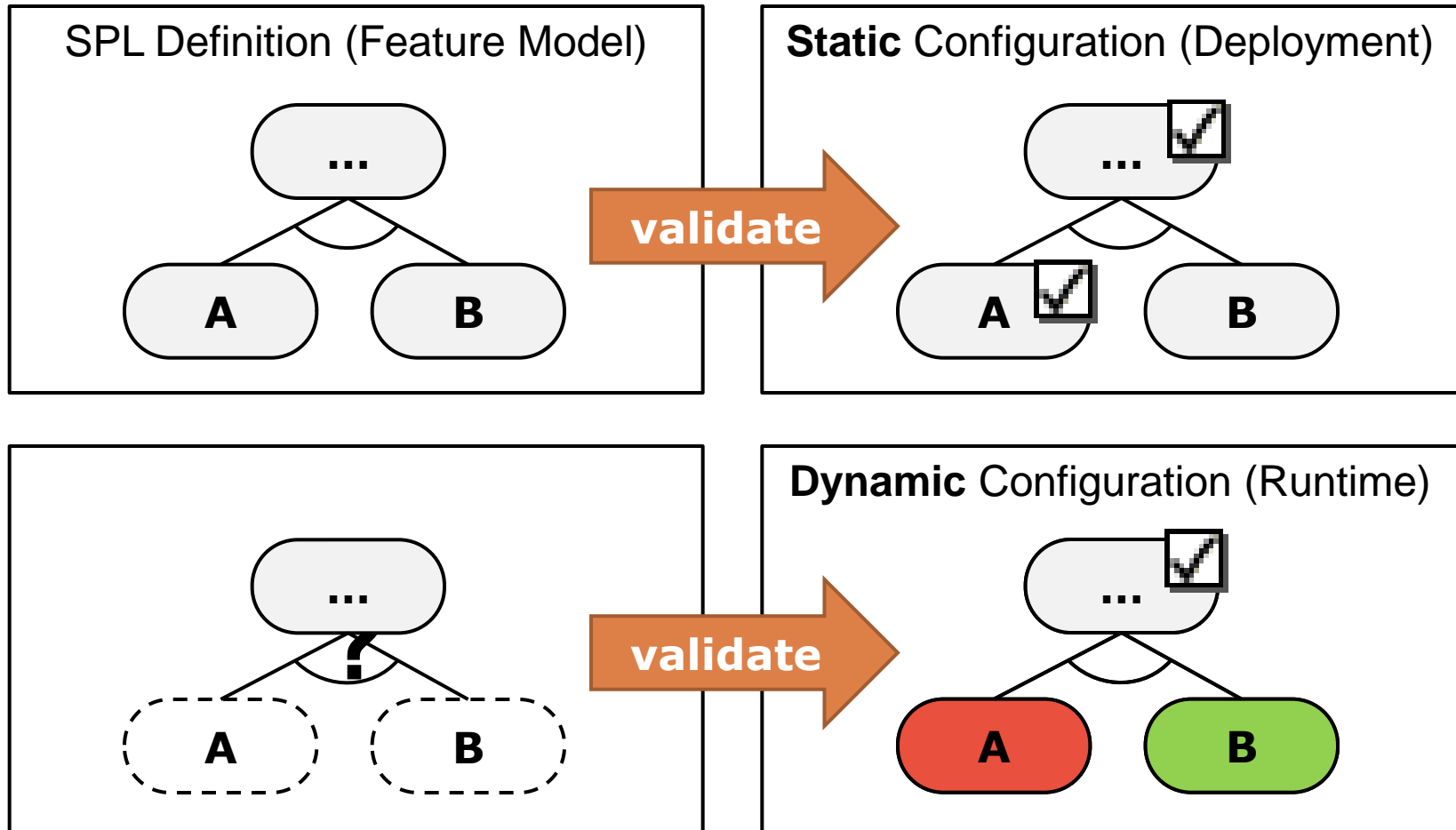
*** SAP Research Dresden, Germany**

Talk in a nutshell

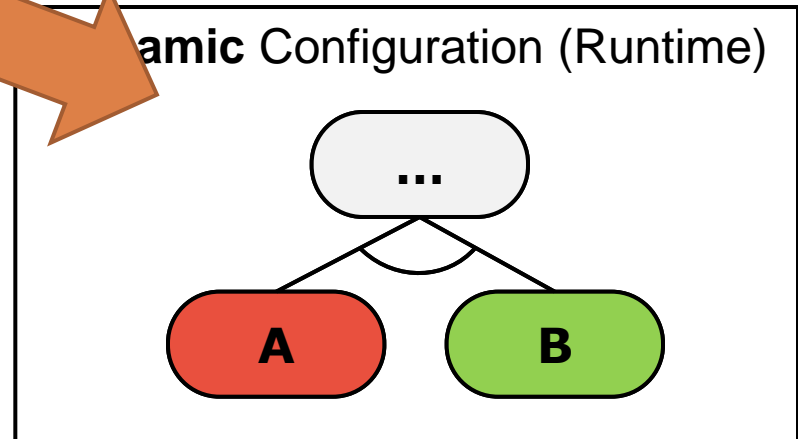
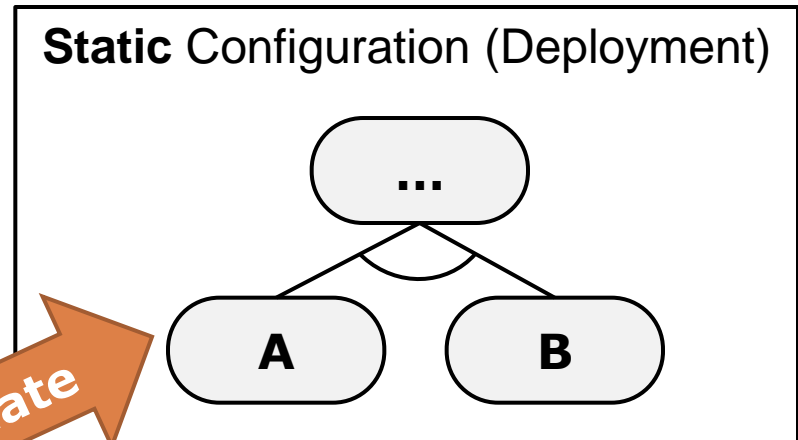
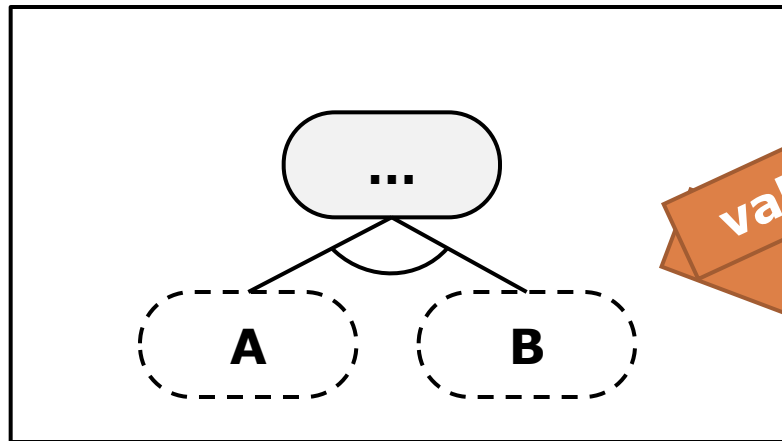


1. Validation of dynamic configurations
2. Configuration using dynamic execution context
3. Realization of 1. & 2. with dynamic AOP

Validation of dynamic configuration



Single model for dynamic and static configuration



Extending Feature Models to validate dynamic configurations

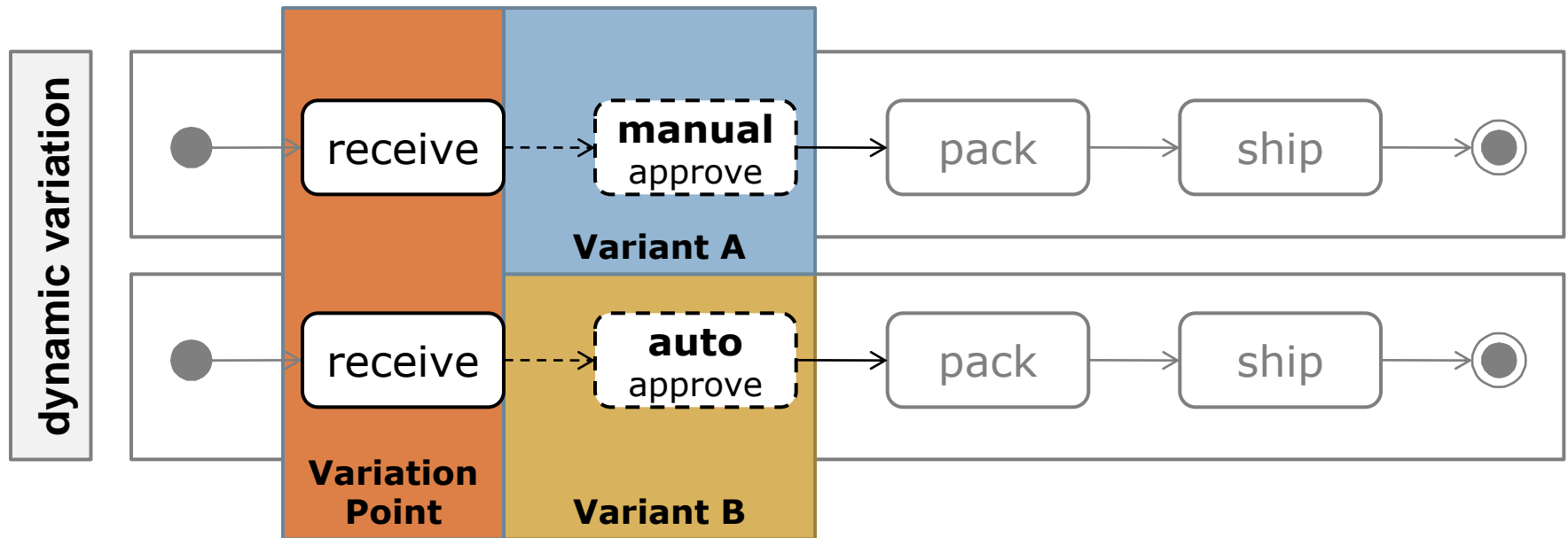


Validated Constraints:

- implies: $\mathbf{A \rightarrow B}$ (require activation of targeted feature)
- excludes: $\mathbf{\neg (A \wedge B)}$ (require deactivation of targeted feature)
- precedes: $\mathbf{priority(A) > priority(B)}$
(executes A before B resolves interaction)

Dynamic Variations

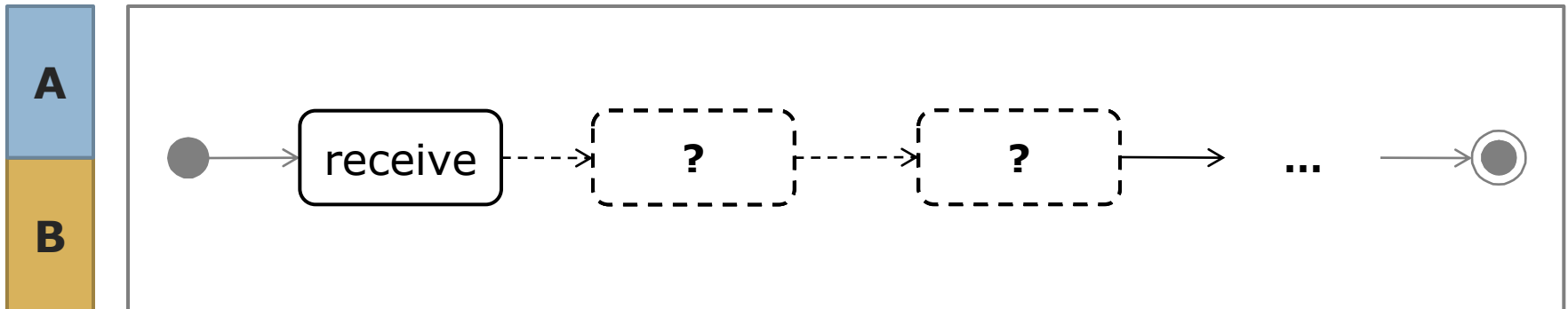
- Approving orders manually or automatically



Combining Variations

→ Requires resolution strategy

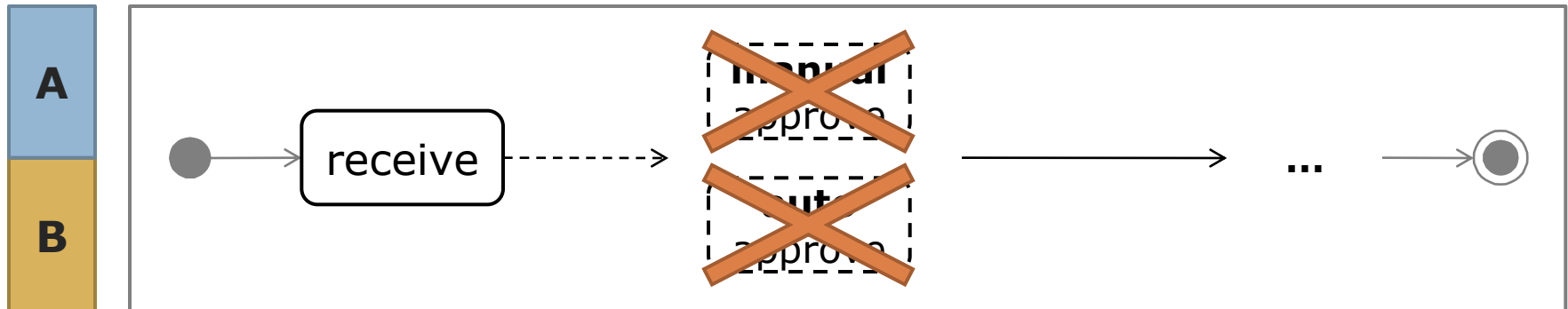
- **Expressible in our notation:**



Combining Variations

→ Requires resolution strategy

- **Expressible in our notation:**

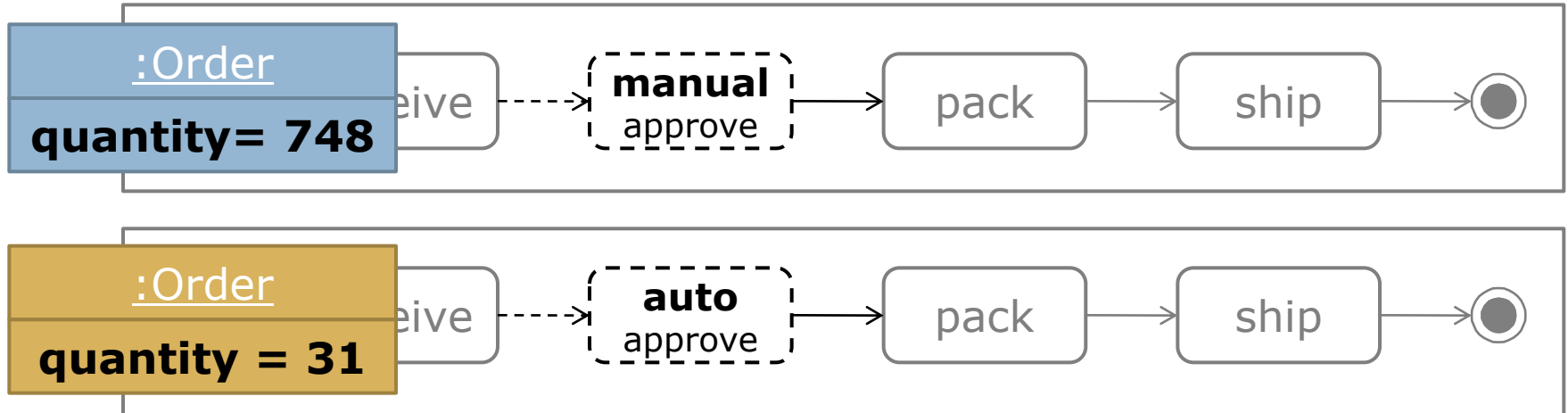




2. Configuration using **dynamic execution context**

Context dependent Variation

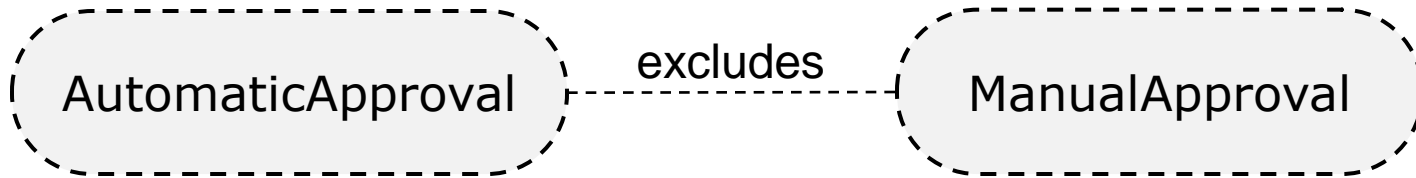
- Resolve interaction by quantity of orders



Validate dynamic configurations



Model



Realize

```
... AutomaticApproval  
{  
  // quantity < 100  
  ...  
}
```

\cap

```
... ManualApproval  
{  
  //quantity >= 100  
  ...  
}
```

= \emptyset

Dynamic Aspect Language & Runtime

Validate

Runtime Constraint Model



3. Realization with dynamic AOP

for Validation (1.) & Dynamic Context (2.)

Encode Dynamic Features as Dynamic Aspects



- Dynamic aspects provide de-/activation
- Feature constraints are defined on aspects
- Aspects expose runtime context
- General advantages of aspects
 - flexible modularization
 - enable crosscutting features (e.g. security)

Constraints with dynamic AOP



```
aspect (name:"AutomaticApproval", deployed:true) { ... }
```

```
aspect (name:"ManualApproval", deploy
```

dynamically deployable

```
aspect (name:"ApprovalInteraction", deployed:true) {
```

```
    declare_exclusion "ManualApproval", "AutomaticApproval";
```

```
}
```

Realization with dynamic AOP



```
aspect (name: "ManualApproval") {  
    after ( receive_order() ) {  
        boolean trusted =  
            UI.approvalDialog(order).isCustomerTrustable();  
        if (! trusted ) // disapprove order  
    }  
}
```

**abstract definition
of variation point**

Context at variation point.

resolved via:

```
order = thisJoinPoint.context.get("order")
```

Dynamic Context



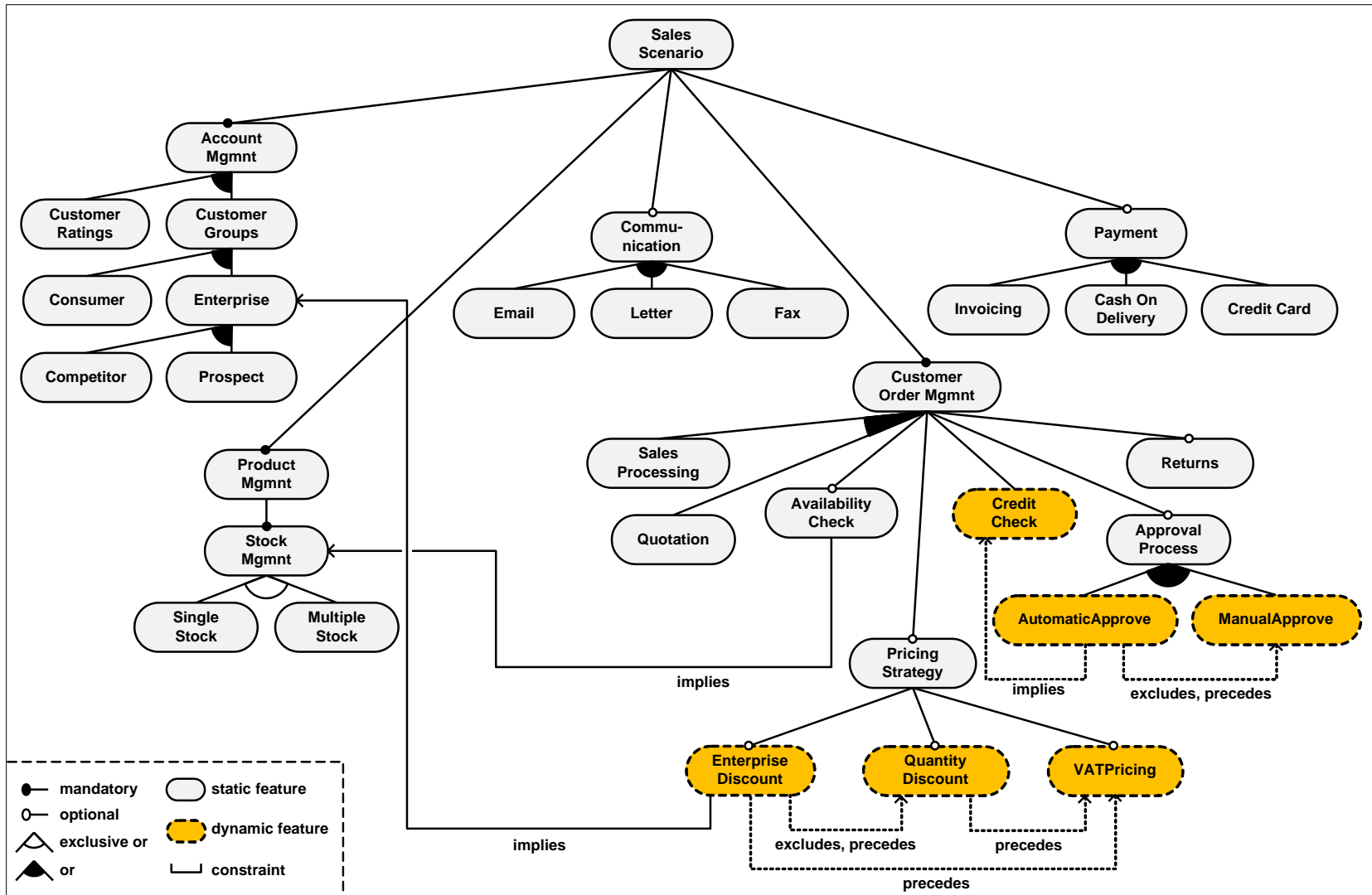
```
aspect (name: "ManualApproval") {  
  
    // quantity >= 100  
    after( receive_order(100, *) ) { ... }  
  
}
```

```
aspect (name: "AutomaticApproval") {  
  
    // quantity < 100  
    after( receive_order(0, 100) ) { ... }  
  
}
```



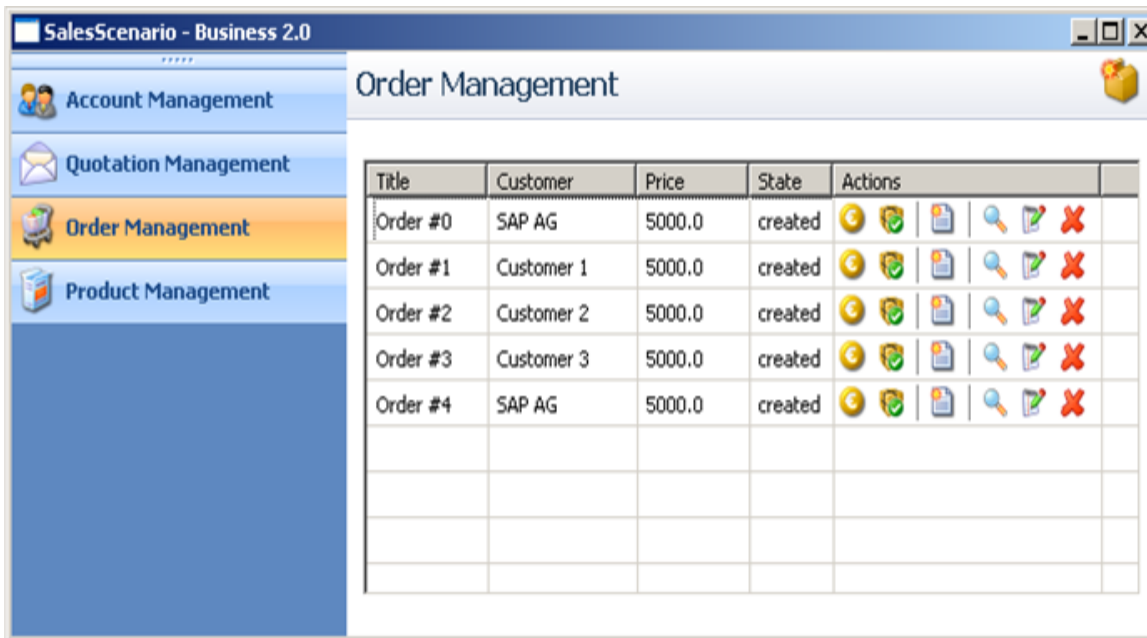
Case Study

Sales Scenario - Feature Model

























Sales scenario approach

- Business-driven end-user features
- User-driven feature adaptation (feature management console)



The screenshot displays the 'SalesScenario - Business 2.0' application window. On the left, a navigation sidebar contains four menu items: 'Account Management', 'Quotation Management', 'Order Management' (highlighted in orange), and 'Product Management'. The main content area is titled 'Order Management' and contains a table with the following data:

| Title | Customer | Price | State | Actions |
|----------|------------|--------|---------|--|
| Order #0 | SAP AG | 5000.0 | created |       |
| Order #1 | Customer 1 | 5000.0 | created |       |
| Order #2 | Customer 2 | 5000.0 | created |       |
| Order #3 | Customer 3 | 5000.0 | created |       |
| Order #4 | SAP AG | 5000.0 | created |       |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Contributions

- Dynamic feature models with novel dynamic constraints
- Realization with dynamic aspect runtime model
 - constraint enforcement
 - context dependent interactions
- Case study as basis for evaluation

