

Product Line Variability

Gruppe 1

Silke Gegenbauer

Simon Poltier

Nils Krönert

Agenda

- Definition and need
- Approaches to variability modeling
- Benefits
- Summary

Definition of Product Line Variability

- Defines possible features for a product line
- Necessary to establish a product line
- Example in FastFood:
 - Core features: Bread, Meat
 - Variable features: Cheese, Bacon, Salad, ...
- Example in Software Engineering:
 - Core feature: Booking system, ...
 - Variable features: Type of Cancellation, Confirmation, ...

Definition of Product Line Variability

Variability can be

- Optional feature
- Choice between depending features

Example:

- Payment in a booking system (Transfer, Credit Card,...)
- Booking system doesn't have to have a confirmation feature. (Depending: no or a confirmation)

Impact on RE

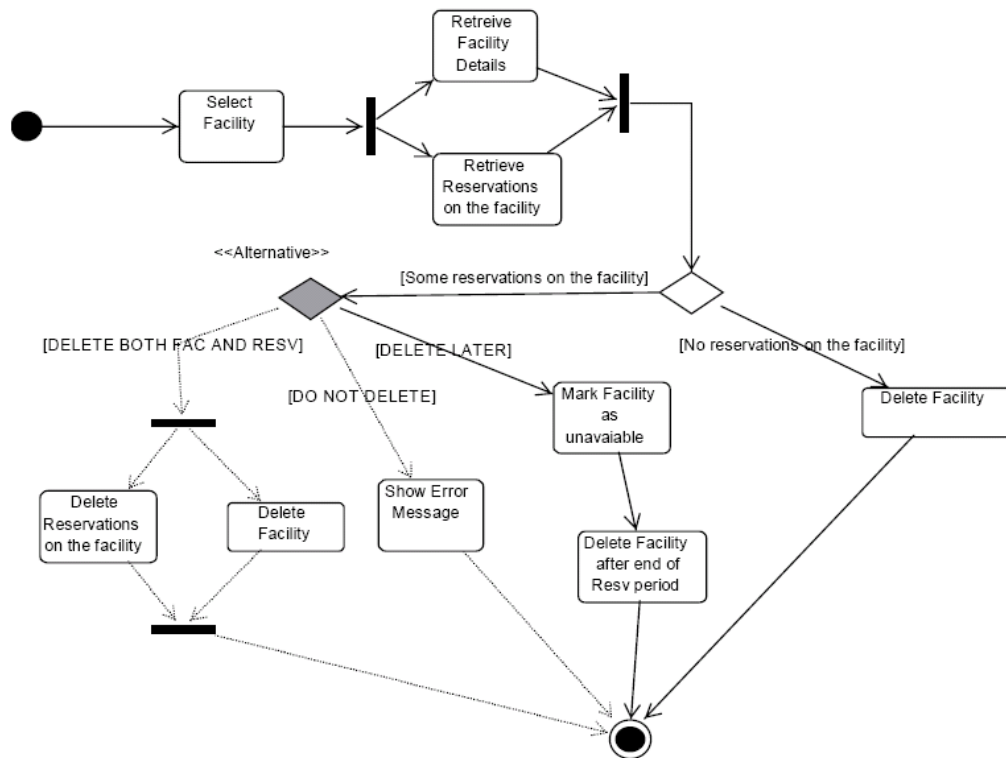
Variability has to be handled specifically in requirements specification.

- Requirements have to be “abstract” to fit different applications
- Requirements have also to be “specific” to provide a base for implementation

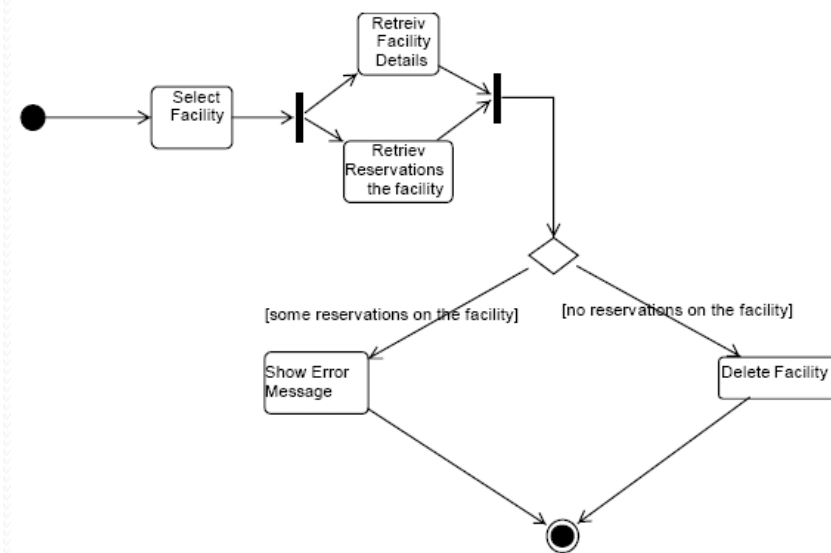
Approaches to variability modeling

- Jarzabek & al., 2003 : Extending process models
 - Feature diagram : hierarchical representation of function variability and interdependencies
- Use cases and UML Workflow diagrams for detailed specification
 - Describe domain defaults
 - Apply customisation script

UML Workflow example



Workflow with variation point



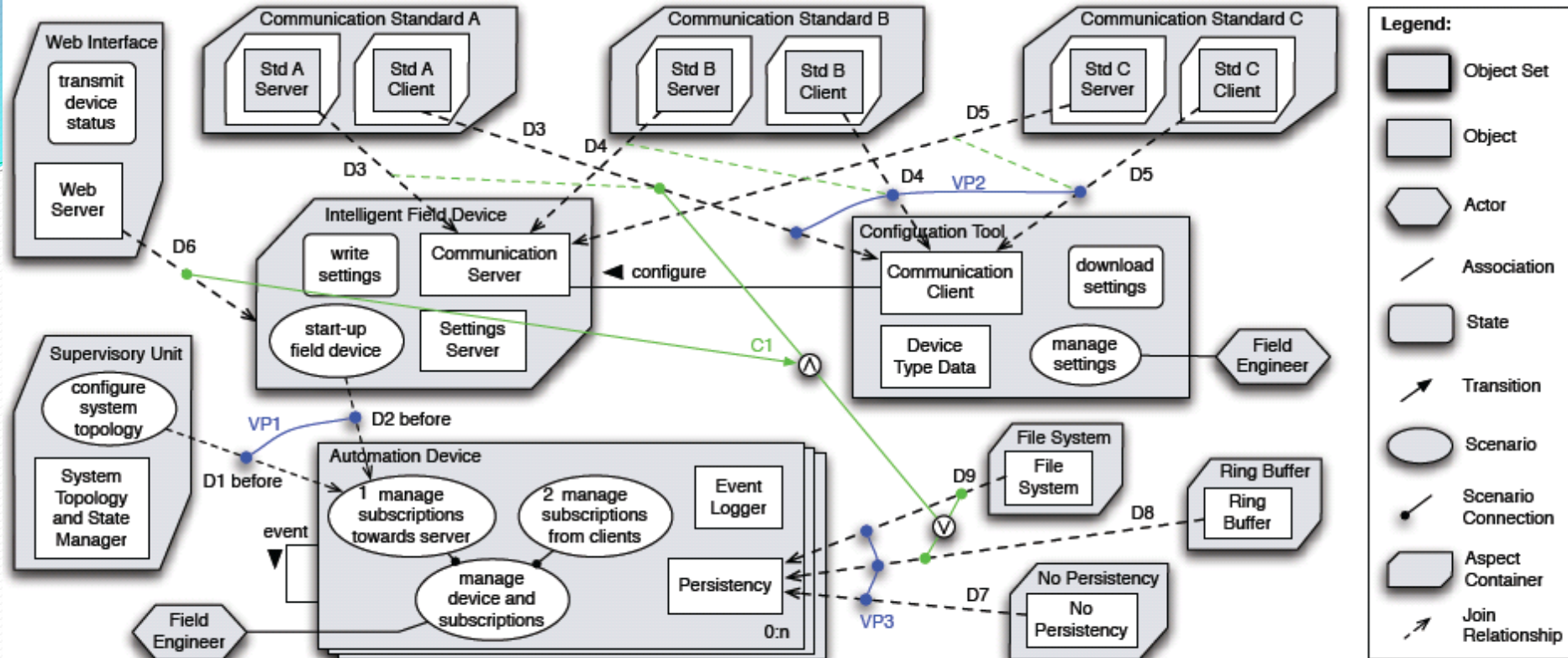
Customised workflow

Process models - evaluation

- Advantages
 - Customised models for a given application can be generated
- Disadvantages
 - Representing all variability points on a process diagram may result in loss of understandability
 - Difficult to show all the interdependencies between variants

Approaches to variability modeling

- Stoiber & Glinz, 2009 : aspect-based diagram
 - ADORA Language
 - Common requirements in abstract objects or object sets
 - Variable requirements in aspects linked to common requirements
 - Main types of links :
 - Decision
 - Variation Points
 - Constraints
- Example (next slide)



Decision Table

ID	Description / Derivation Question	Design Rationale	Constraints	ifTrue	ifFalse	Decision
D1	Should the automation device be a supervisory unit?	The automation device platform is used for cost and quality reasons.	VP1	~D2	D2	undecided
D2	Should the automation device be an intelligent field device?	The automation device platform is used for cost and quality reasons.	VP1	~D1	D1 ~D6	undecided
D3	Should the intelligent field device support communic. std. A?	Standard A is the newest and most performant one.	VP2, C1		~D6	undecided
D4	Should the intelligent field device support communic. std. B?	Is a must in some countries.	VP2			undecided
D5	Should the intelligent field device support communic. std. C?	C is still required by many legacy systems.	VP2			undecided
D6	Should the intelligent field device a web interface?	The web interface allows access over the world wide web.	C1			undecided
D7	Is there no memory in the automation device?	Might be interesting for non-critical systems.	VP3	~D8 ~D9 ~D6		undecided
D8	Is there a ring buffer in the automation device?	Ring buffers are cheap to implement and fast.	VP3, C1	~D7 ~D9		undecided
D9	Is there a file system in the automation device?	File system offer huge amounts of storage space.	VP3, C1	~D7 ~D8		undecided

Variation Points Table

ID	Description / Rationale	minCard	maxCard	Decisions Involved
VP1	An automation device always can be either a supervisory unit or an intelligend field device.	1	1	D1, D2
VP2	There are three different communication standards to configure a field device: standard A, B, and C. At least one must be chosen.	1	3	D3, D4, D5
VP3	There exist three different persistency types: no persistency, a ring buffer, or a file system. One of these must be selected.	1	1	D7, D8, D9

Constraints Table

ID	Description / Rationale	Antecedent	Operator	Consequent
C1	A web interface always requires the communication standard A and a local persistency installed (either ring buffer or FS).	D6	=>	D3 and (D8 or D9)

Aspect Diagrams - evaluation

- Advantages
 - Surface tacit knowledge through aspects, links and rationales
 - Understandable overview of relatively complex systems : aspects meaningful to group variants
- Disadvantages
 - Does not propose a way to propagate impact of links and constraints on lower-level models (scenarios, ...)



Benefits of Explicit Variability Specification

- more detailed and distinct specification
- very precise and clear
- beneficial to development, maintenance and enhancements
- constraints and interdependencies are better understood

Summary

- product line variability defines possible features for a product line
- variability has to be handled specifically in requirements specification
- approaches:
 - extending process model
 - use cases and UML workflow diagrams
 - aspect-based diagram
- benefits development, maintenance and enhancements