Wissenschafterinnenkolleg Internettechnologien

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A UML 2 Profile for Variability Models and their Dependency to Business Processes

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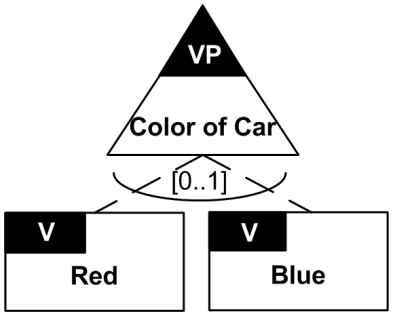
Introduction into Variability Models

- Variability models define the variability of a product line
  - It shows the different variation points and variants of a software product line.



- Variability models can be used during the different life cycle stages of software product lines
- Variability modelling is a domain specific modelling technique
  - Continual integration into traditional software engineering.

Motivation and Goals

- Variability models are not integrated into an modelling framework like the Unified Modeling Language (UML).
- Variability models have also an impact on processes. Variabilities can change the process flow, e.g.
  - in a car engine manufacturing process the decision if the variability *manufacture a diesel engine* or a *petrol engine* is chosen, changes the process flow.

1. Provide variability models to software developers in a UML notation

2. Show the dependency between variability models and business processes to make the relationship between structural models and behavioural models visible

Contribution

The UML profile for variability models ...

- ... can be easily created, presented and edited with existing UML modelling tools, as almost all newer UML tools support UML profiles.
- ... represents variability requirements to software developers or process engineers in a formal and well-known modelling notation.
- ... and its shown dependencies onto activity diagrams makes the relationship between variabilities and processes visible.

Outline

- A UML Profile for Variability Models
- Example of a UML Profile and its dependency onto UML 2 Activity Diagrams
- Related Work
- Conclusion

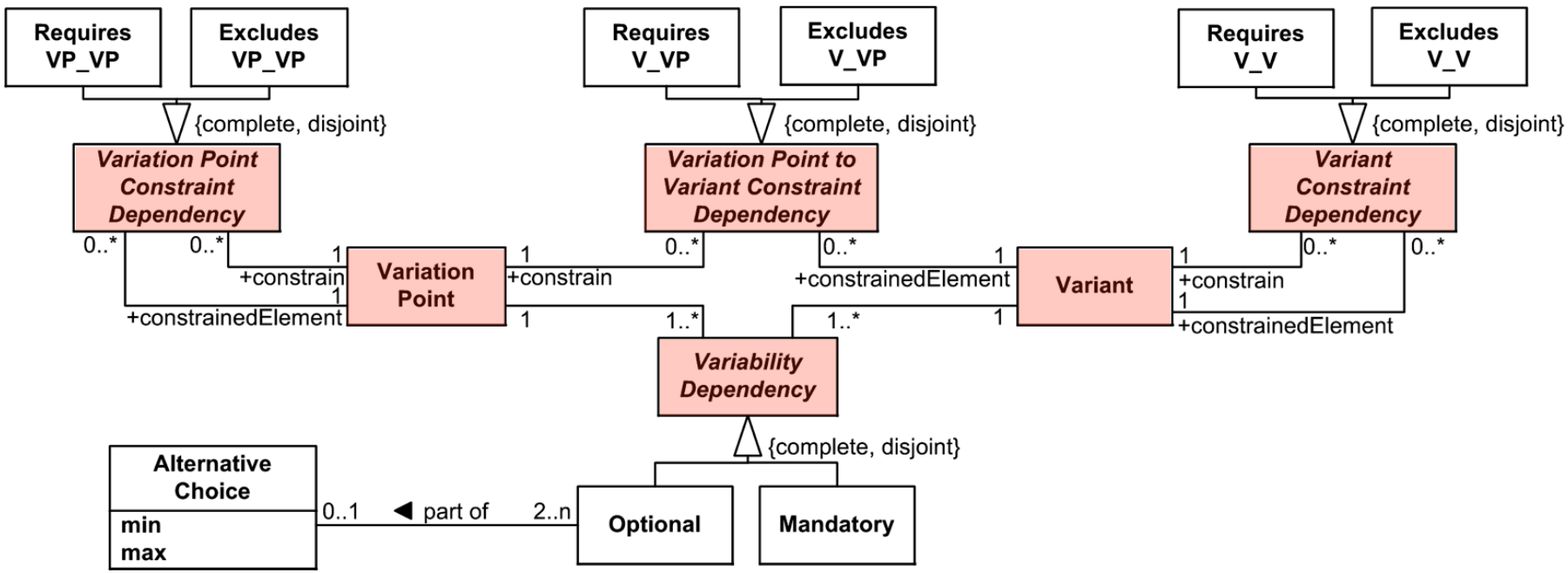
Unified Modeling Language 2.0

- The Unified Modeling Language is a well-known modelling language for different purposes
  - Consists of 13 Diagrams
  - 6 structural diagrams
  - 7 behavioural diagrams
- **UML 2.0 Activity Diagram (AD)**
  - Designed for modeling business processes and flows in software systems
  - Origin lies in the development of software
- **Provides different extension mechanisms** to adapt a diagram for the own purpose
  - We have chosen the light-weight extension mechanism, called **Profile**

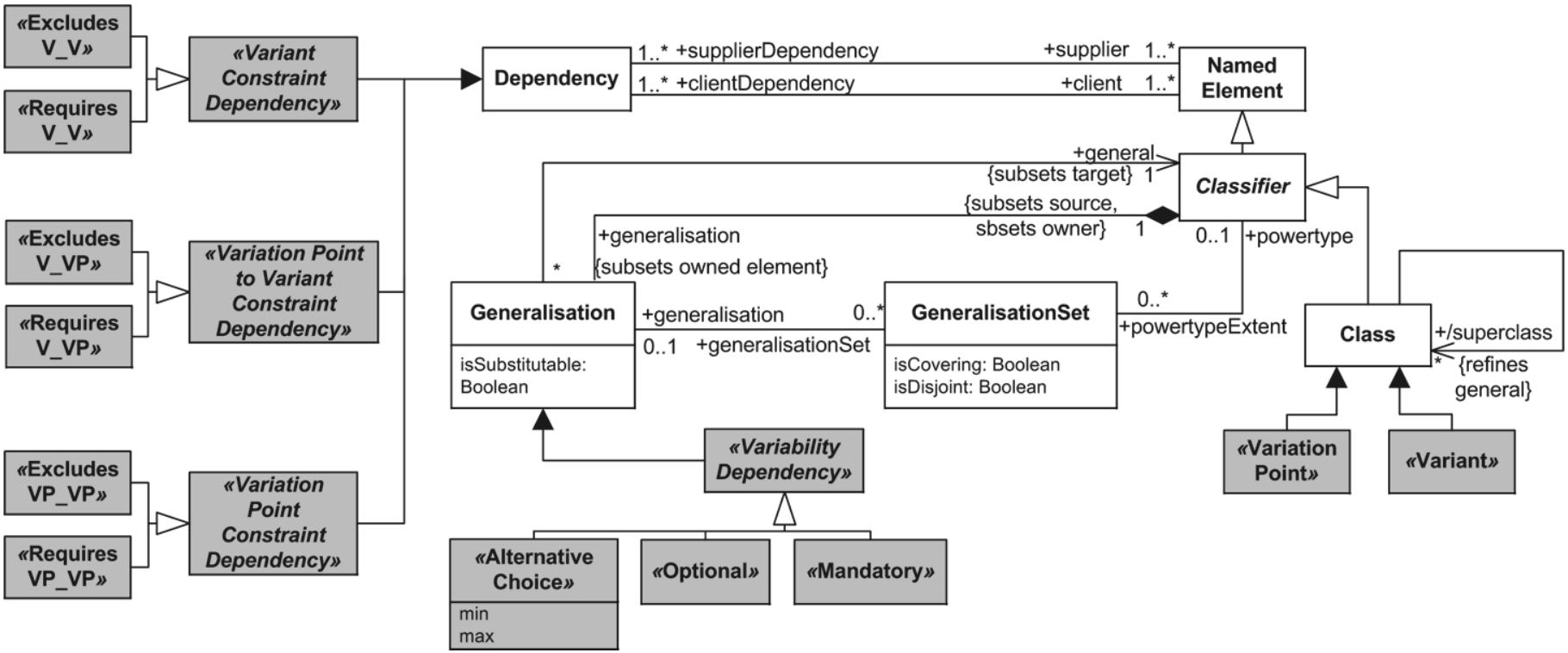
Introduction to UML Profiles

- UML 2 Profile allows the modeler to **create own model elements** within the UML specification, using:
- **Stereotypes**
  - extend existing (meta-)classes
  - preserve the syntax and semantics of extended elements
- **Constraints**
  - apply restrictions to a stereotype
  - e.g., pre- and postconditions, invariants
- **Tagged Values**
  - Additional attributes for stereotype

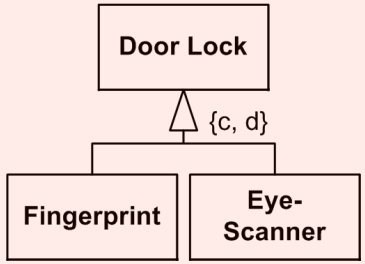
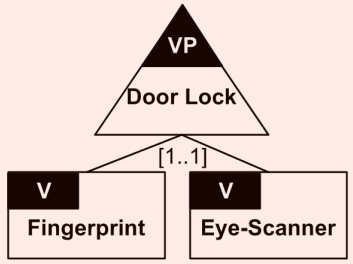
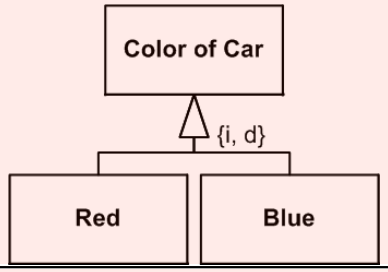
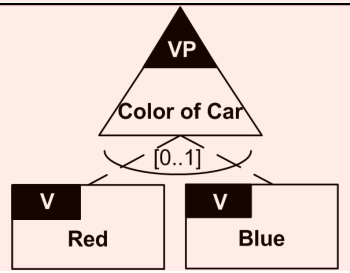
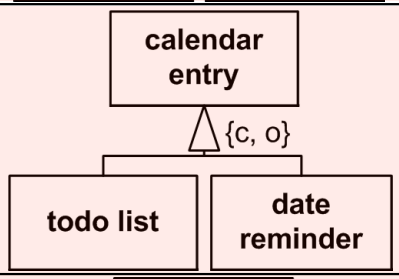
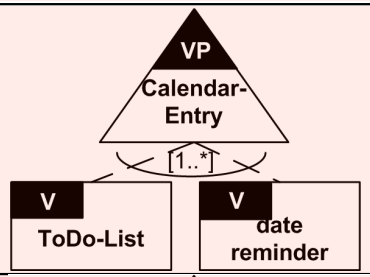
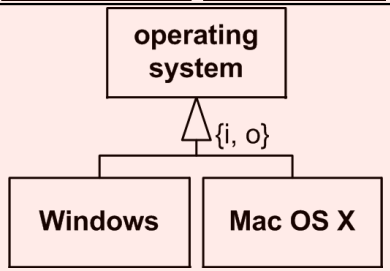
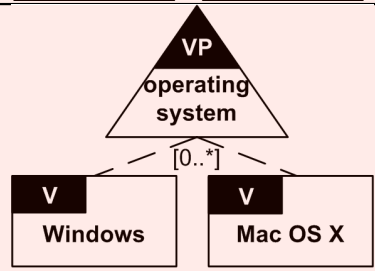
The Metamodel of Variability Models



A UML Profile for Variability Models



Variability Dependency and General Set

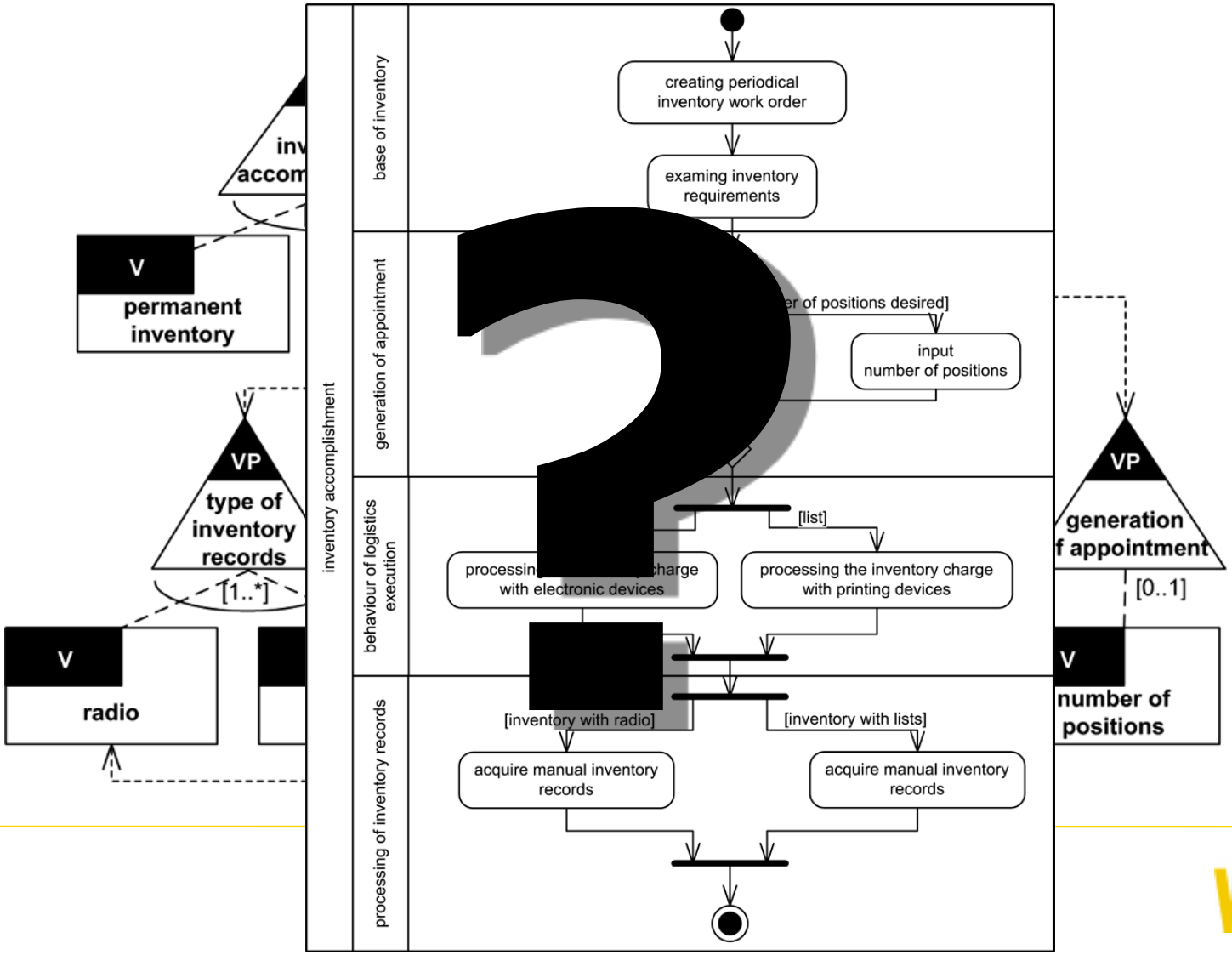
Variability Dependency	Multiplicity	Generalisation Set	Class Diagram	UML Profile
Mandatory	1	{complete, disjoint}		
Alternative	0..1	{incomplete, disjoint}		
Alternative	1..*	{complete, overlapping}		
Optional	0..*	{incomplete, overlapping}		

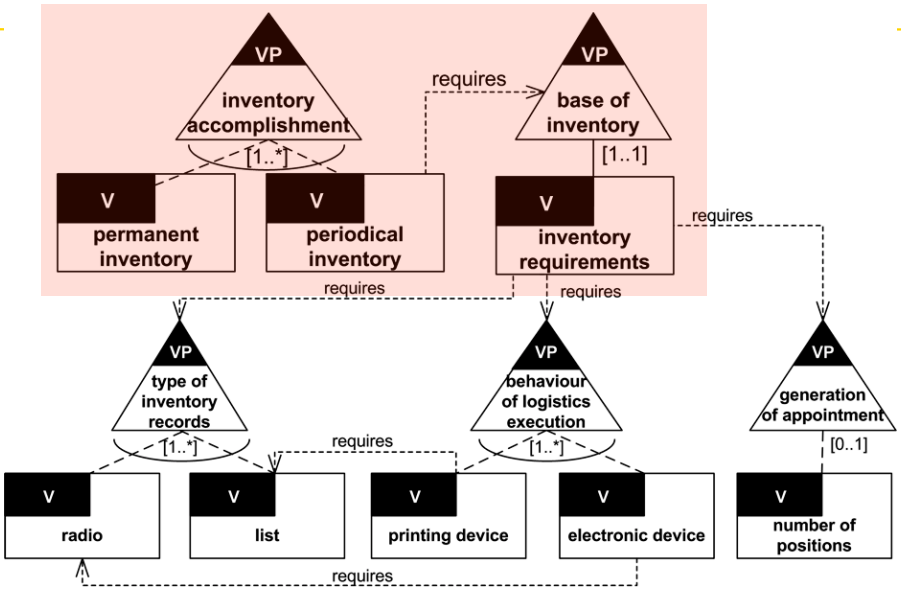
Dependency between Variability Models and Business Processes

- Variability models show the different variabilities of a software.
- Activity Diagrams are a part of the behavioural set of UML 2 diagrams
  - show the control and data flow between different tasks.
- The two modelling techniques describe the same concepts
  - variability model describes the structural view and the activity diagram the behavioural view.

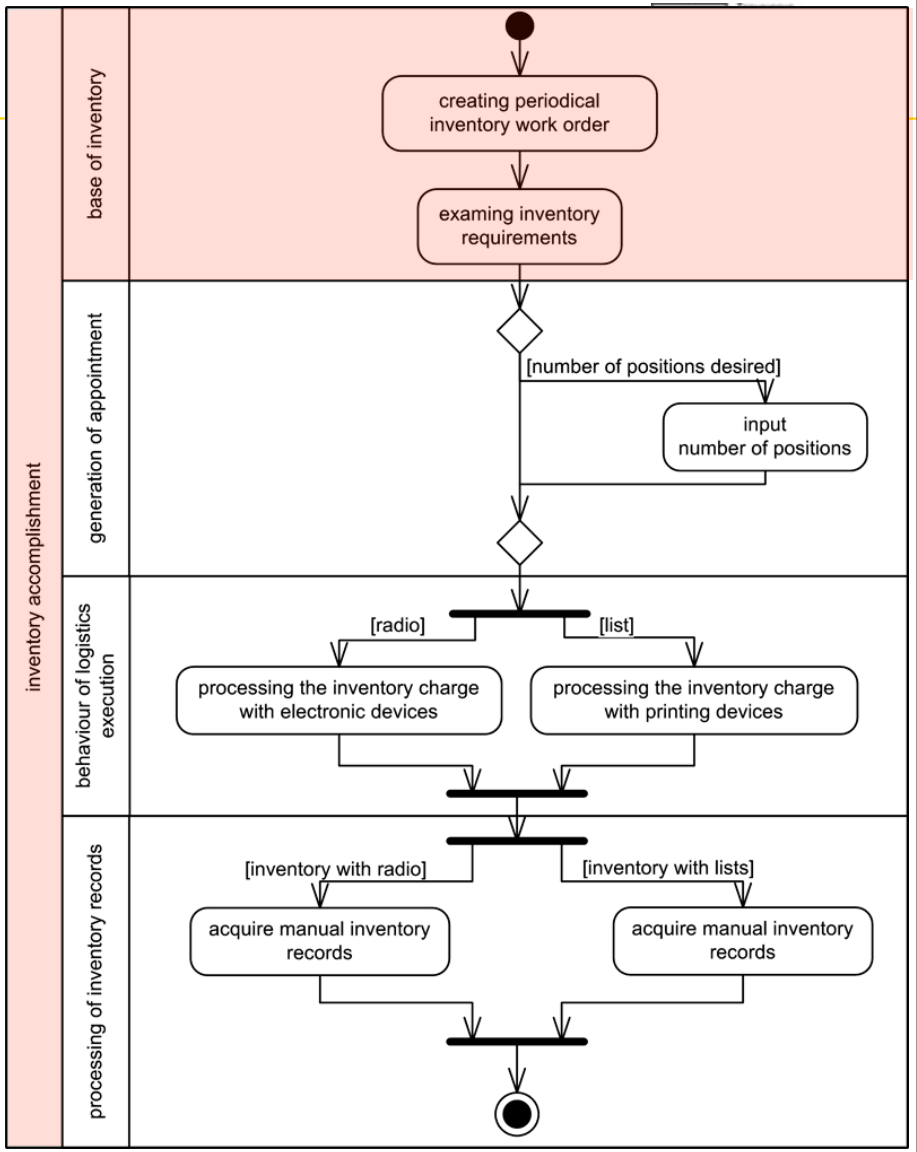
Mapping between these metamodels to examine in which way they are related to each other.

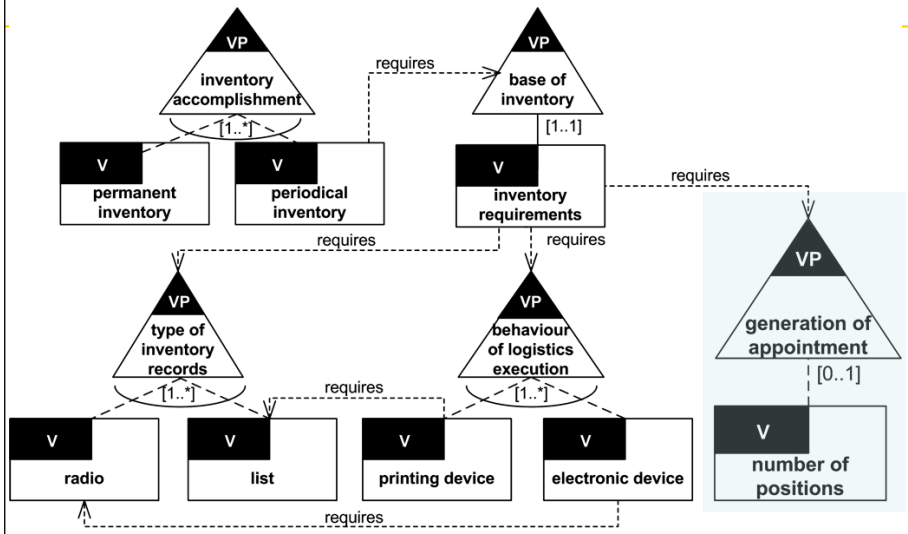
Example UML Profile and the Dependency onto UML 2 Activity



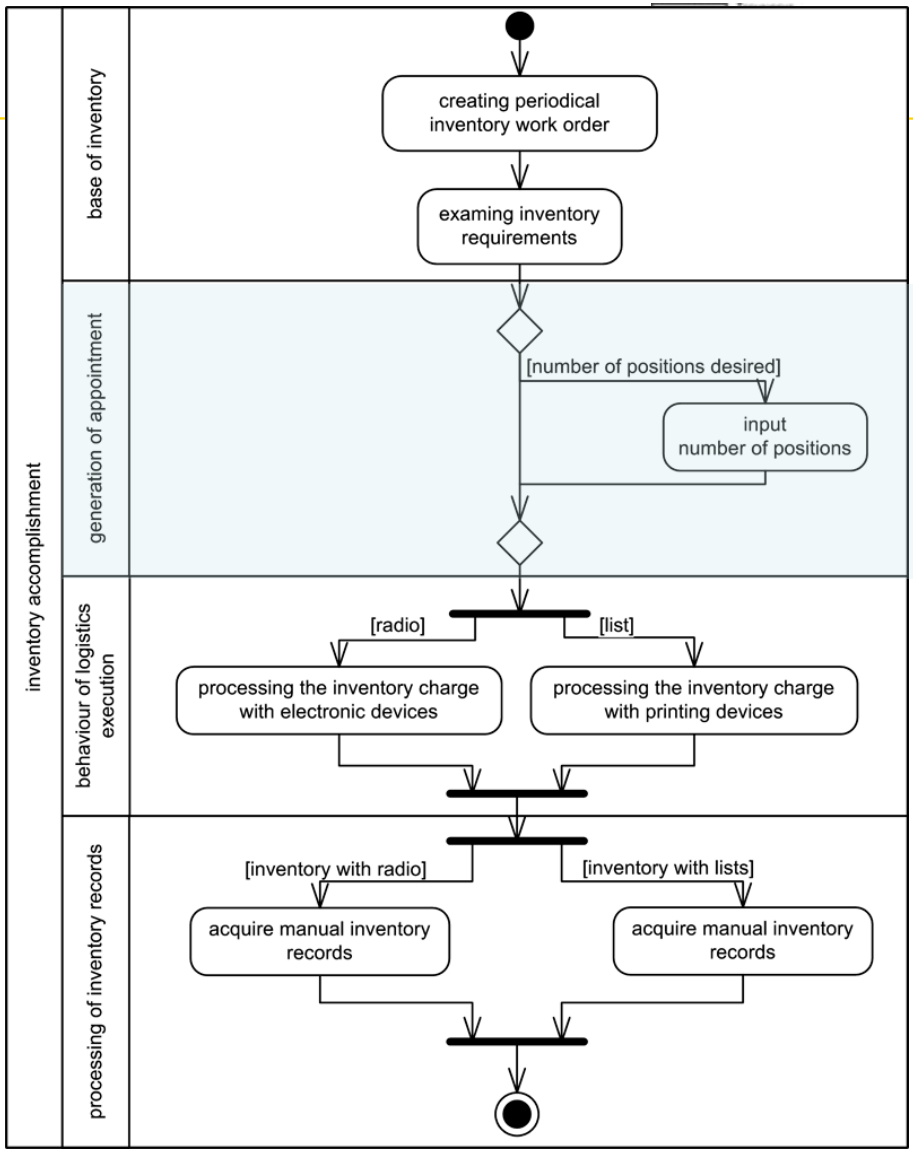


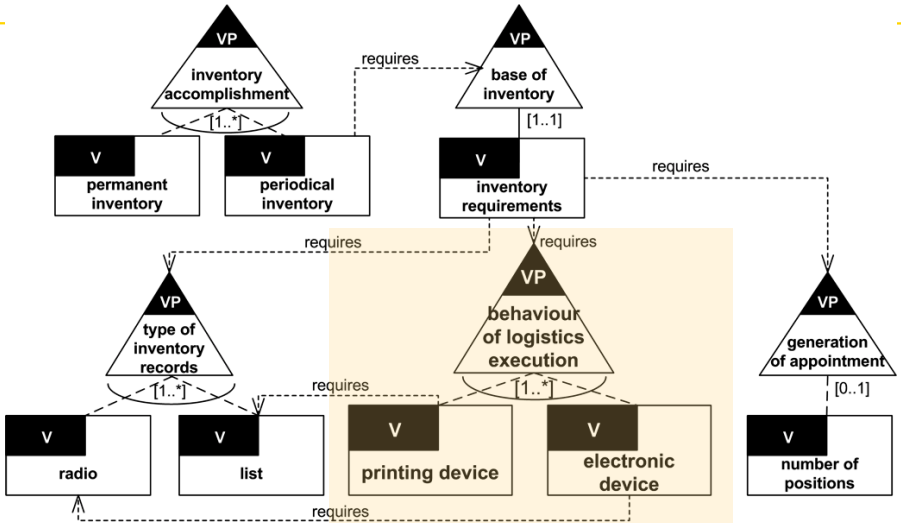
UML Profile	UML 2 AD
Variation Point	Activity Partition
Variant	Action



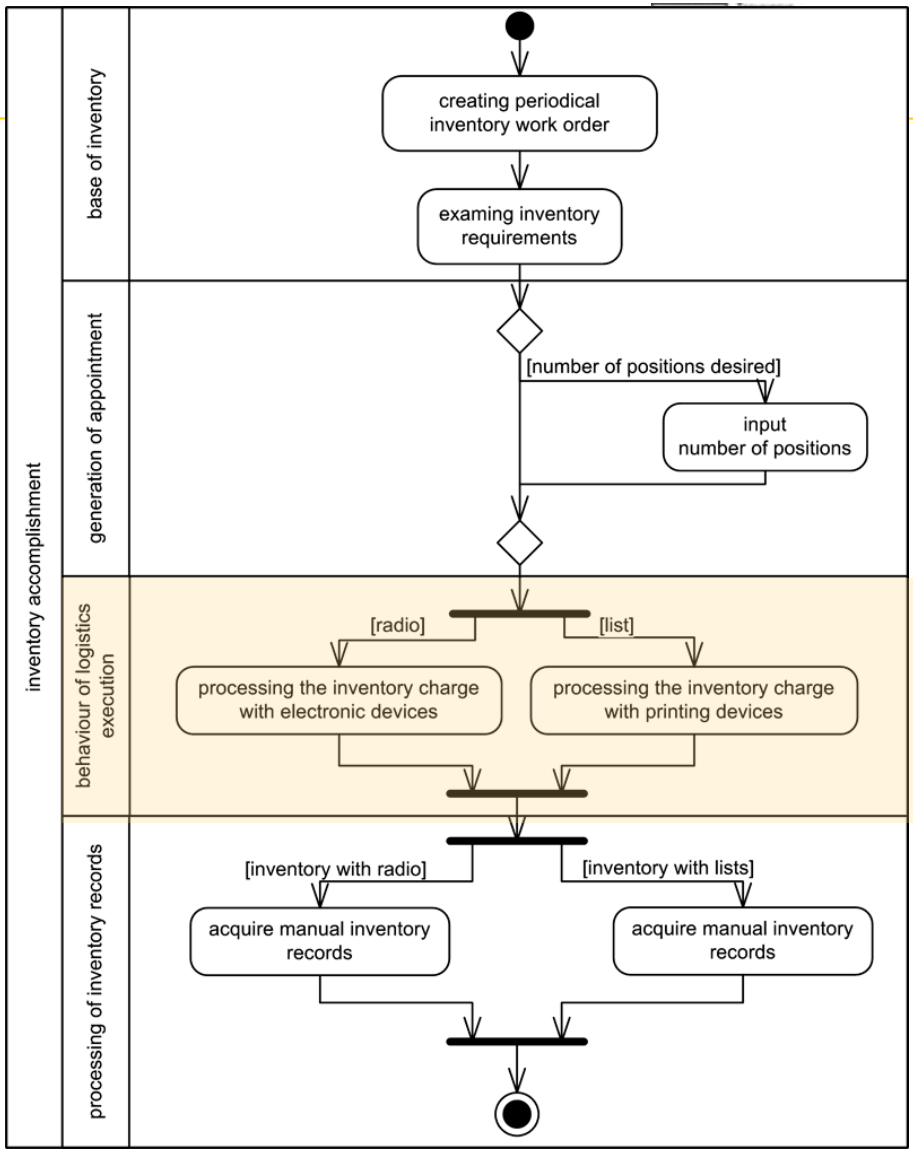


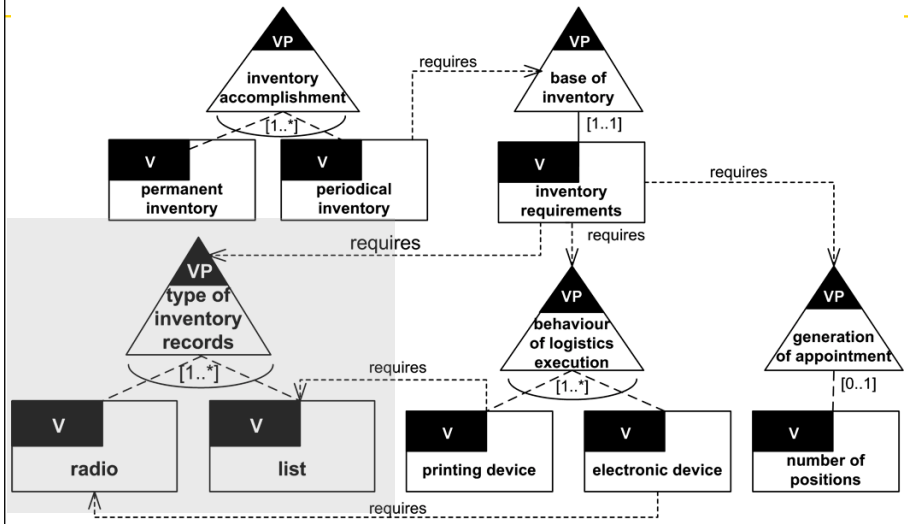
UML Profile	UML 2 AD
Alternative (0..1)	Decision - Merge Node

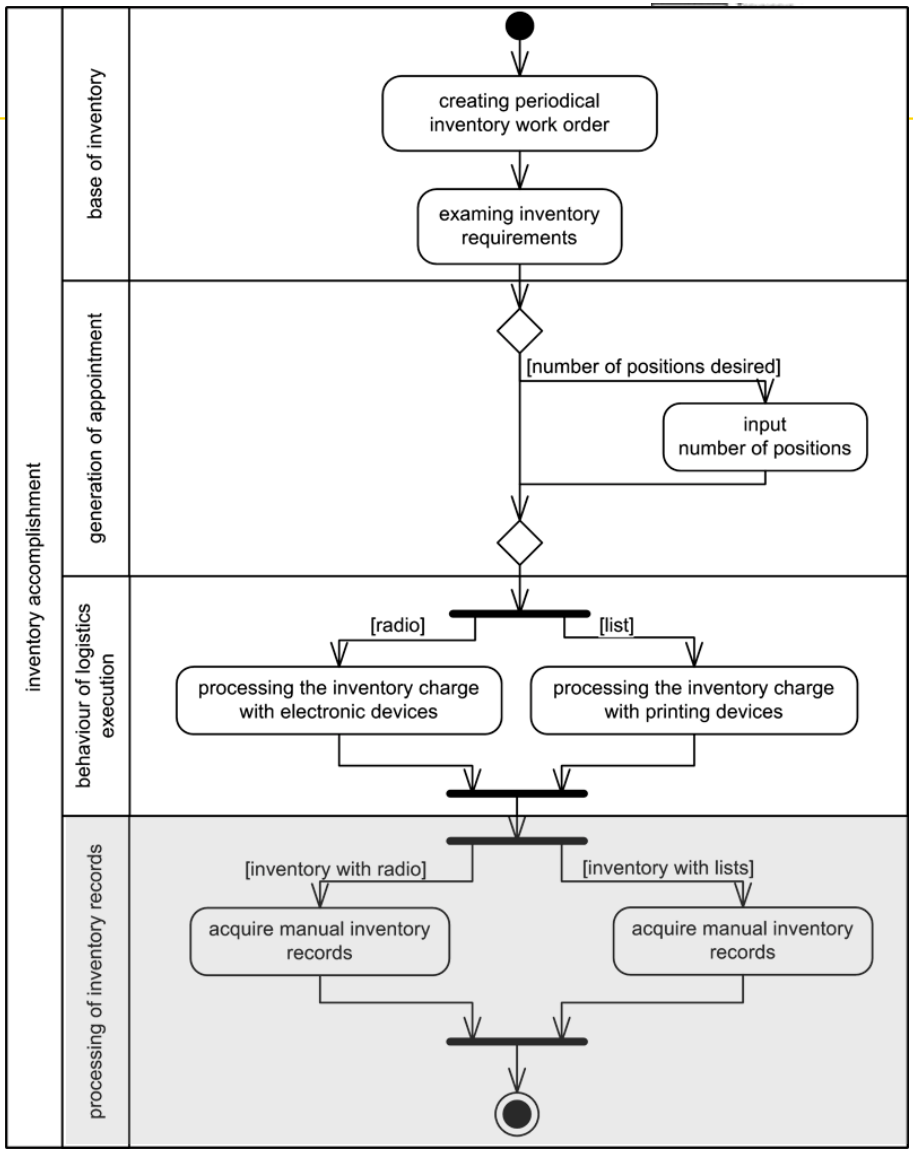




UML Profile	UML 2 AD
Alternative (1..*)	Fork - Join Node
requires	Control Flow




VP
inventory accomplishment
[1..*]
requires
VP
base of inventory
[1..1]
V
permanent inventory
V
periodical inventory
V
inventory requirements
requires
requires
requires
VP
type of inventory records
[1..*]
VP
behaviour of logistics execution
[1..*]
VP
generation of appointment
[0..1]
requires
V
radio
V
list
V
printing device
V
electronic device
V
number of positions
requires


inventory accomplishment
base of inventory
creating periodical inventory work order
examing inventory requirements
generation of appointment
[number of positions desired]
input number of positions
behaviour of logistics execution
[radio]
[list]
processing the inventory charge with electronic devices
processing the inventory charge with printing devices
processing of inventory records
[inventory with radio]
[inventory with lists]
acquire manual inventory records
acquire manual inventory records

Related Work

- **Rosemann et al.** proposed configurable Event-Driven Process Chains (EPCs) as an extended reference modelling language.
  - describes the configurability of a certain business process modelling language
- **Clauss** introduces a UML extension to support feature diagrams which are an extension for the explicit representation of variation points.
  - integrates feature models in UML diagrams like the Use Case Diagram
- **Becker** developed a general metamodel for variability models on an examination of the most common concepts in variability modelling.
  - describes variability models on a high-level

Conclusion

- **UML 2 profile for variability models** to:
  - integrate the best concepts of variabilities and class diagrams in one model, and
  - to overcome the gaps that variability models have no extension mechanism and no tool support.
- The UML profile for variability models can be **easily created, presented** and **edited** with almost all newer UML modelling tools.
- **Dependency** between the **UML profile** and **UML 2 activity diagrams**
  - to make the relationship between structural models and behavioural models in all stages of the software developing process visible.