A Preliminary Comparison of Using Variability Modelling Approaches to Represent Experiment Families

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Motivation & Key Questions

Motivation and Application Context

- Replication is essential to build knowledge
  - Gain confidence in results
  - Understand sources of variability
- Lack of variability modeling of experiments

Replications

Key questions

- How can we plan variability on experiments in software engineering?
- What is the most appropriate way of modeling variabilities?
- What extent they support experiment replication planning?

Goal of this presentation

- Report on ongoing research on exploring the use of Variability Modeling Approaches (VMAs) to represent families of experiment.
- Identify advantages and limitations of selected VMAs.

Variability Modeling Approaches (VMAs)

Feature Model (FM)

- Represents static feature commonalities and variabilities.
- Represents dependencies between features.
- Determines allowed or forbidden combinations of features.

Decision Model (DM)

- Emphasizes decisions in the process of product derivation.
- Guides adaptation of work products.
- Documents the decision made to specify a member of a domain.

Orthogonal Variability Model (OVM)

- Relates commonalities and variabilities to requirements, architecture, and other lifecycle artifacts.
- Only variabilities are documented.
- Composed of Variation Points (functionalities) and Variants (possible instances).

Research Questions

Objectives and Approach

- Investigate whether and how Variability Modeling Approaches can be useful to represent experiment families.
- Initial understanding on if and how they can support the planning of experiment replications.

Key Element and Starting Point:

- Variability modeling is based on the experiment structure.

Research Questions

- RQ.1: How can software variability modeling approaches (VMAs) be used to represent experiment families?
- RQ.2: How can VMAs representations support planning experiment replications?

Study Setup and Design

Basic Study Design

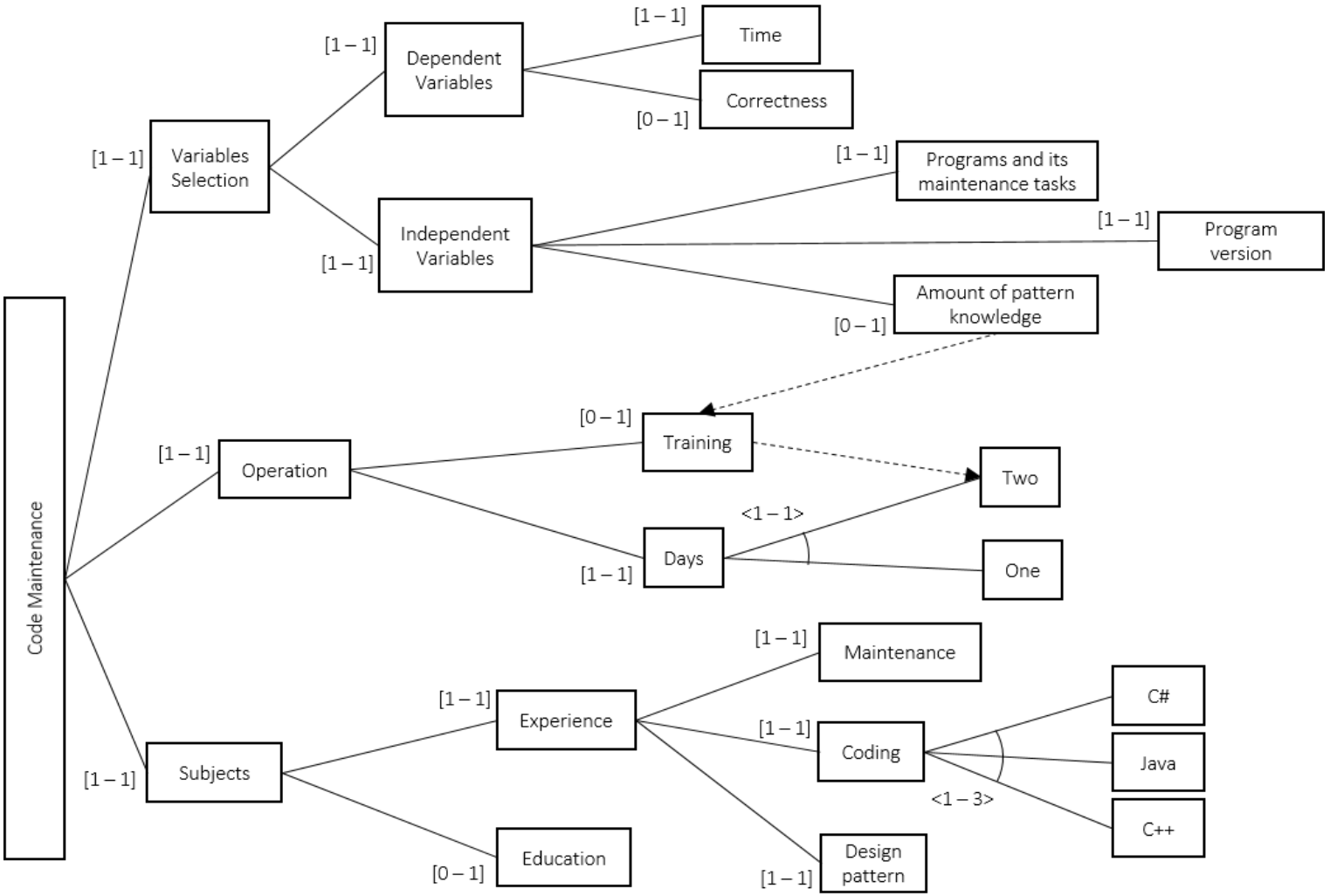
	Round 1	Round 2
Subject 1	*OVM (FamilyOne)*	*DM (FamilyTwo)*
Subject 2	*DM (FamilyOne)*	*FM (FamilyTwo)*
Subject 3	*OVM (FamilyTwo)*	*FM (FamilyOne)*

- Study Type: controlled experiment
- FM vs. DM vs. OVM with cross-over design.

- 3 participants with experience on experiment replications (2 MSc and 1 Phd degree).
- Study Material:
  - Two experiment families based on published reports with solid design and various replications:
    - FamilyOne: Study on Software Inspection (Porter *et al.*, 1995).
    - FamilyTwo: Study on Code Maintenance (Prechelt *et al.*, 1997).
  - Six different models: two per subject, one per round.
  - Questionnaires (experience and feedback).
  - Guidelines for task execution, e.g., planning a new replication in the study context.

Variability Modeling Approach (VMA) Feature Model Example (FamilyTwo)

Experiment family on Code Maintenance represented by Feature Model.



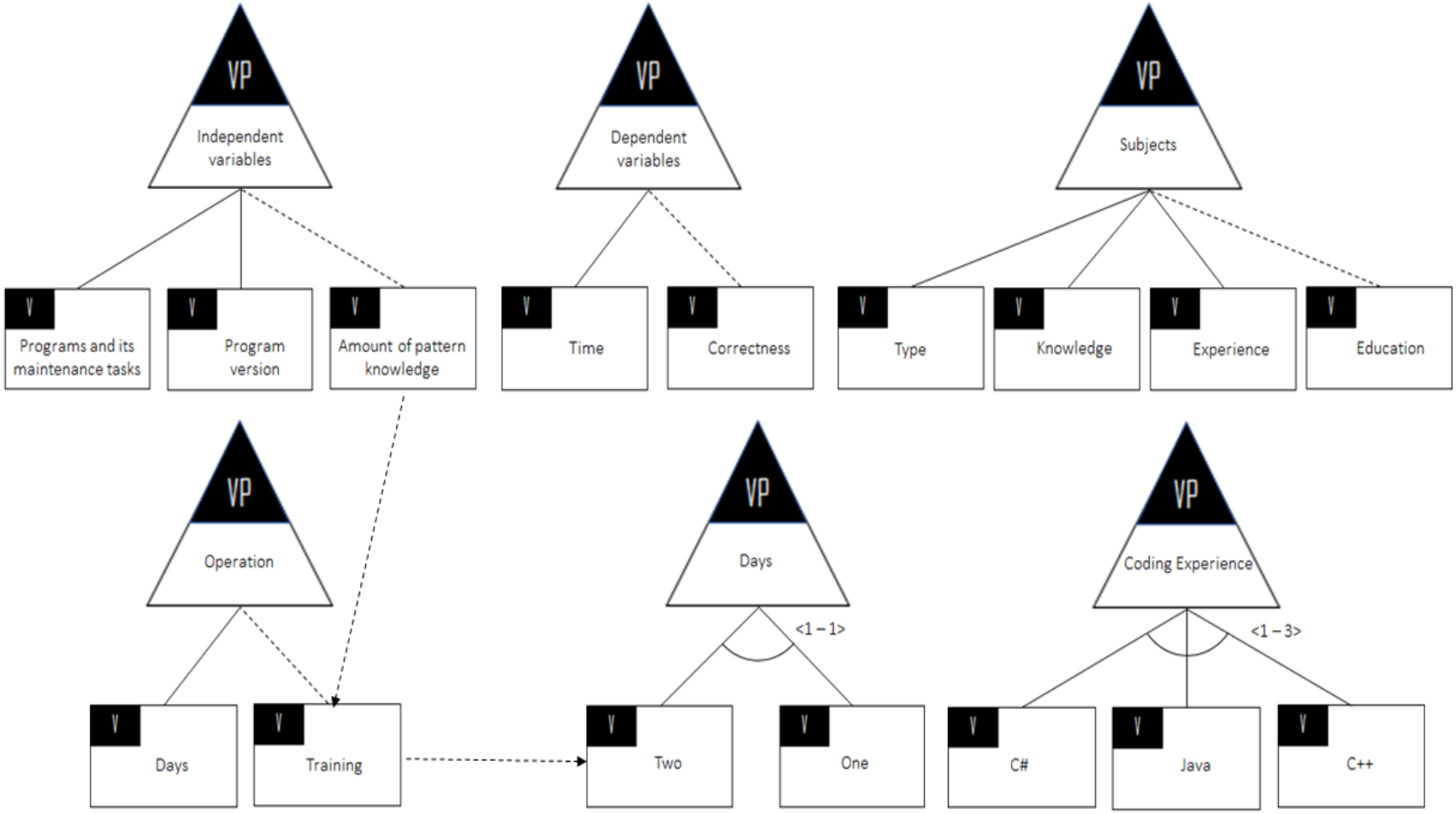
Variability Modeling Approach (VMA) Decision Model Example (FamiliyTwo)

Experiment family on Code Maintenance represented by Decision Model.

Decision name	Description	Type	Range	Cardinality/constraint	Visible/relevant if
Correctness	Do you use the correctness as dependent variable?	Boolean	true | false		
Pattern_Knowledge	Do you use the amount of pattern knowledge as independent variable?	Boolean	true | false	If selected Training = true	
Training	Do you conduct training before experiment execution?	Boolean	true | false	If selected Days.Two = true	
Days	How many days to conduct the experiment?	Enum	One | Two	1:1	
Coding	Which programming language do the subjects have experience in coding?	Enum	C# | C++ | Java	1:3	
Education	Do you use subjects' education as metric to form groups?	Boolean	true | false		

Variability Modeling Approach (VMA)
OVM Example (FamilyTwo)

Experiment family on Code Maintenance represented by an Orthogonal Variability Model.



Results

Qualitative Analysis based on open questions in the feedback form on ..

Strategy to use the model

- Mapping variation points and decision names (Subject 1).
- Experiment plan according to their experience based on the overall experiment scenario (Subjects 2 and 3).

Advantages of VMAs

- Help to get an overview of the experiment family and its components.
- Reuse of components – could be beneficial for novice researchers.
- Can represent best practices.
- Can generate new scenarios to expand an experiment family.

Limitations of VMAs

- Lack of sequence when using OVM.
- Lost graphical overview when using DM.
- Lack of overview on elements when using DM and OVM (focus on variabilities rather than on commonalities).

Limitation of the study

Small number of subjects

- Three participants participated in the evaluation.
- Focus was qualitative evaluation results (feedback questionnaire).
- No quantitative analysis was conducted yet.

Sequence of using different Variability Modeling Approaches.

- Feature Models (FM) used in Round 2.
- Decision Model used after Orthogonal Variability Model.

- We intended to mitigate learning effects by using different Experiment Families.
- VMAs include significant differences
  - FM: focus on variations and commonalities.
  - DM/OVM: focus on variability

Summary and Future Work

Summary

- We were able to represent the experiment replication variabilities using VMAs for both selected experiment families (RQ.1)
- All three VMAs are useful for easily identifying variabilities and reusable elements (RQ.2).
- There was a consensus among the subjects that the Feature Model approach provides a more comprehensive overview.

Future Work

- In depth analysis of VMA applications (also quantitative data)
- Replication of the study in a larger context.
- Use others VMAs to represent experiment families.
- Incorporate a VMA and the experimental artifacts in a tool.

Thank you ...

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