

Evaluating the Effort of Integrating Feature Models: A Controlled Experiment

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This talk...

- **Why**
- **How**
- **What**

Why...

Model composition...

...really important and hard

...error-prone

...time-consuming

...the literature fails to
provide empirical evidence

Why...

It is not clear to what extent

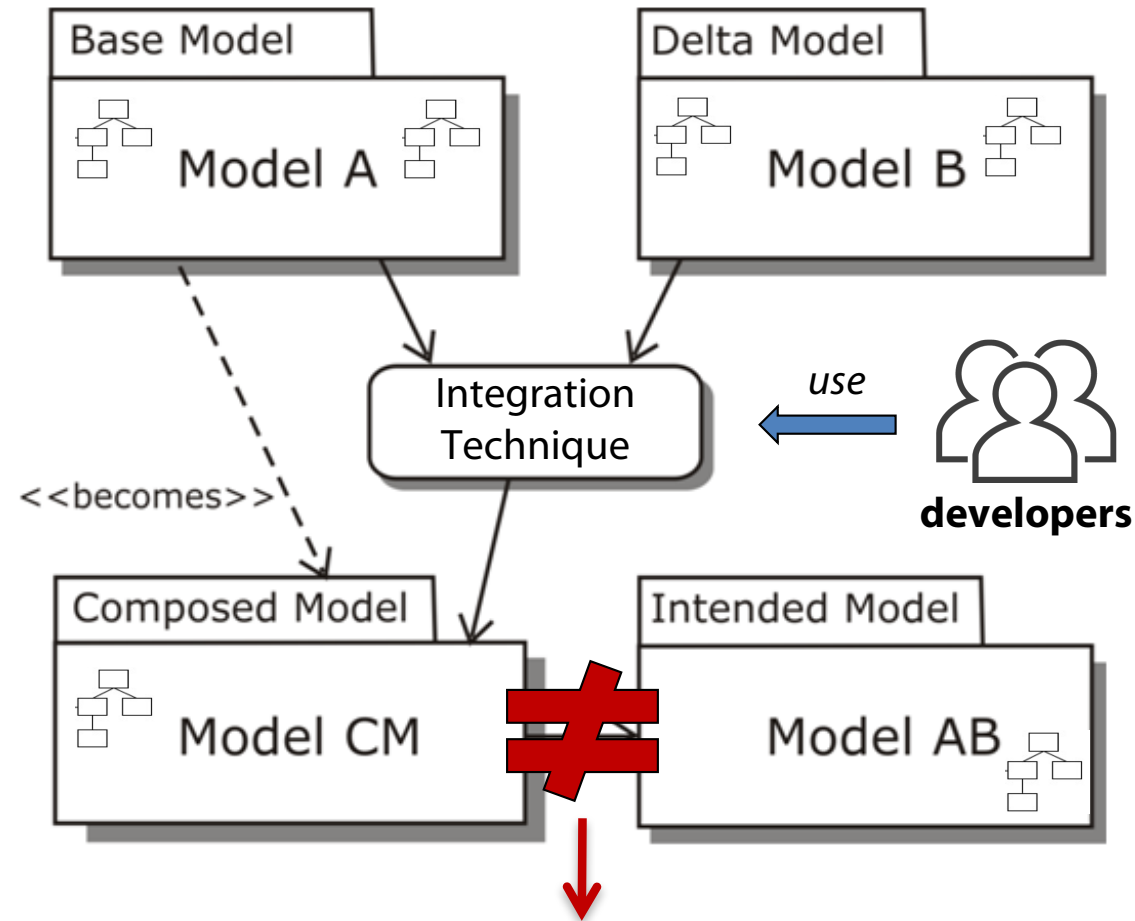
...the level of experience



...composition effort

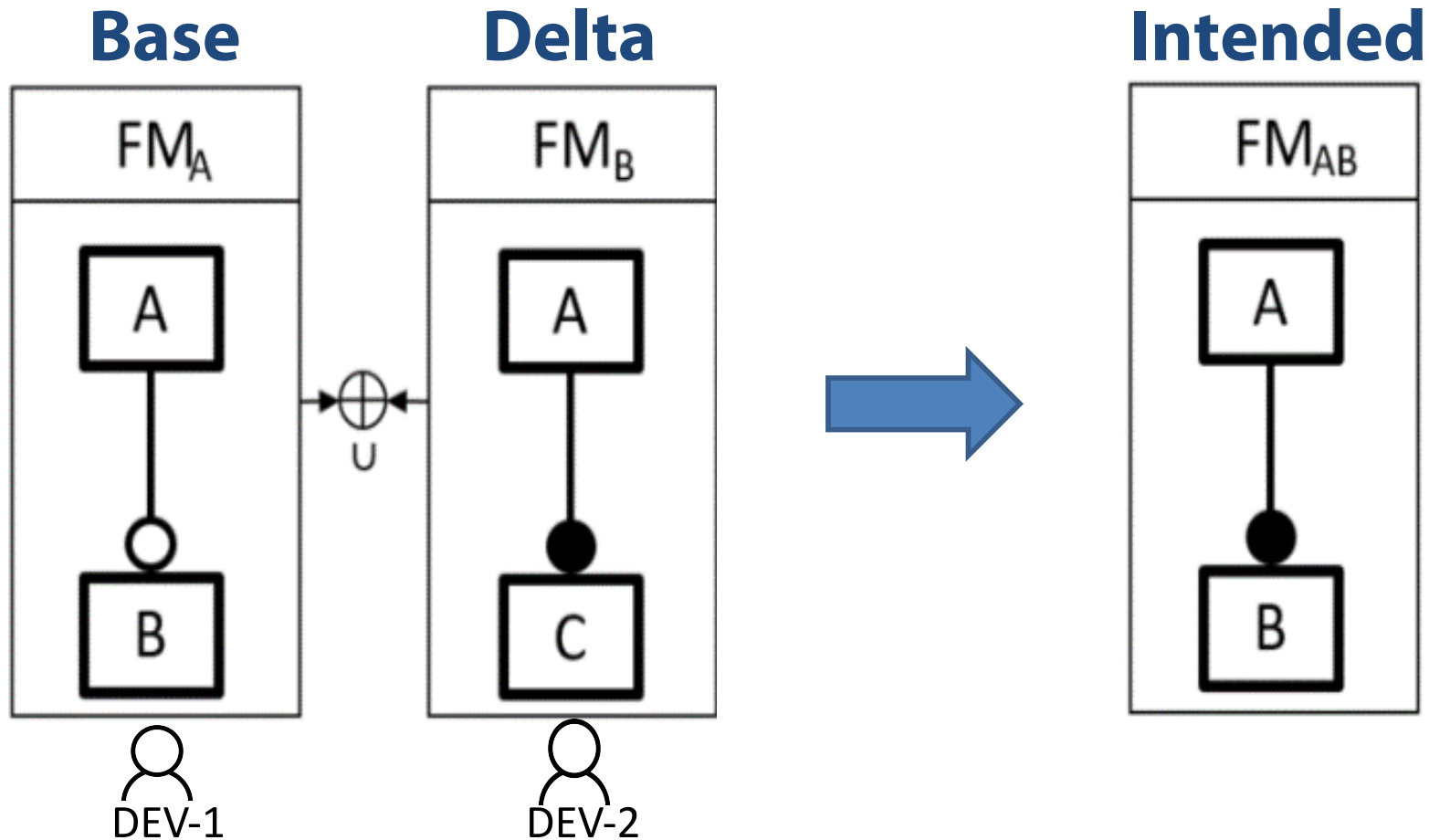
...number of correctly
composed models

Introduction

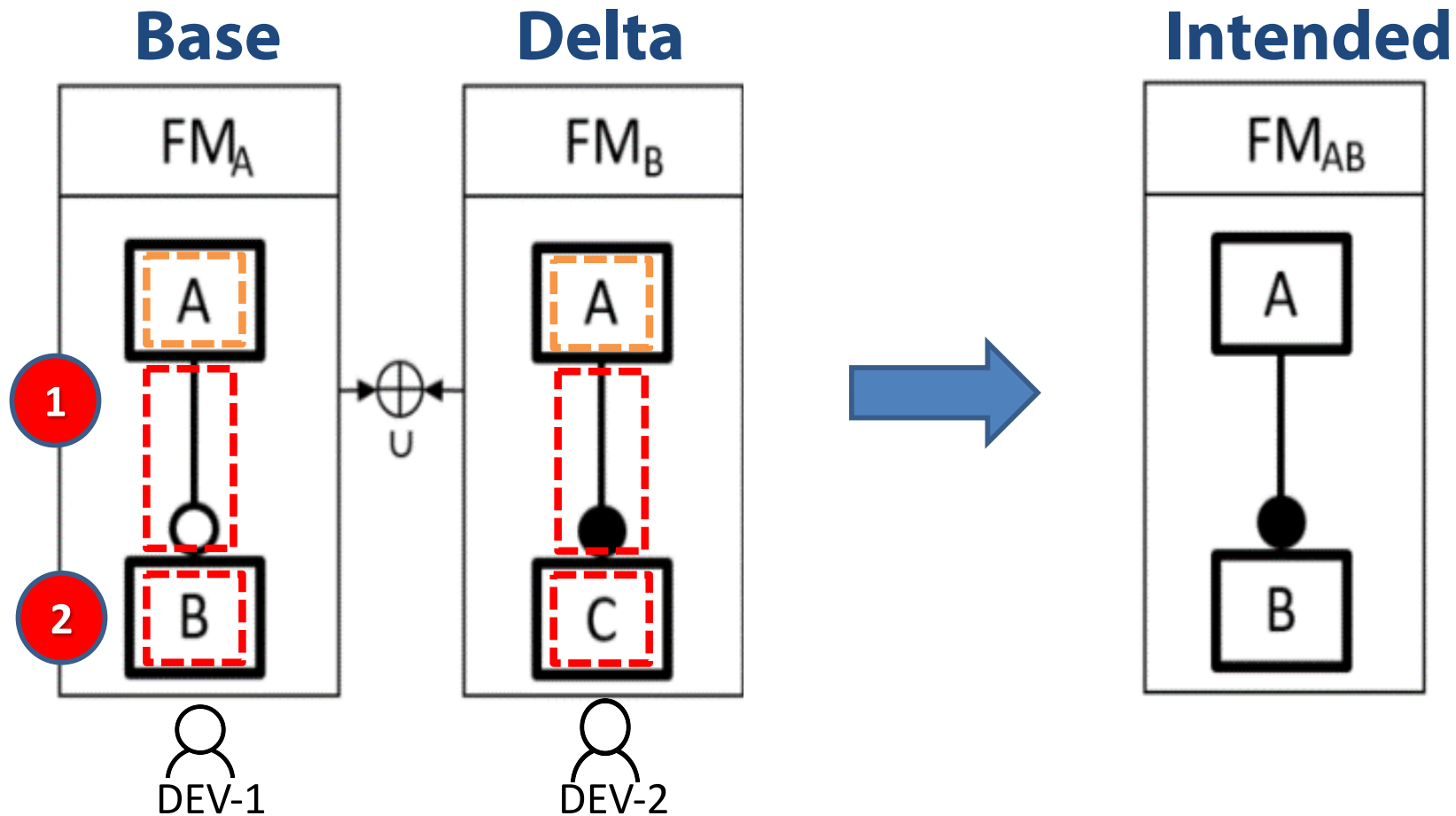



There is a difference because the input models conflict with each other in a some way.

Example: Integrating Feature Models

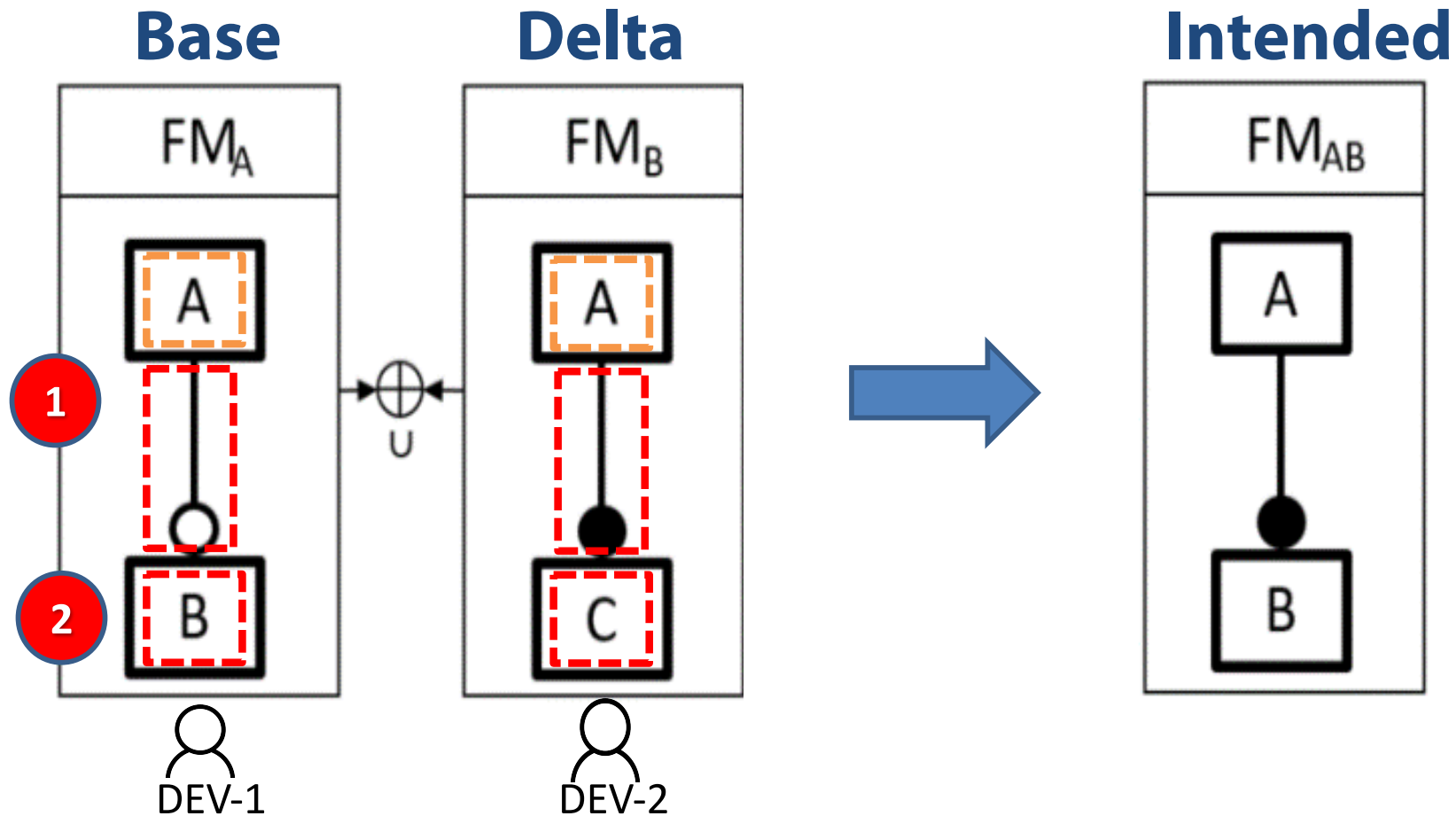


Example: Integrating Feature Models



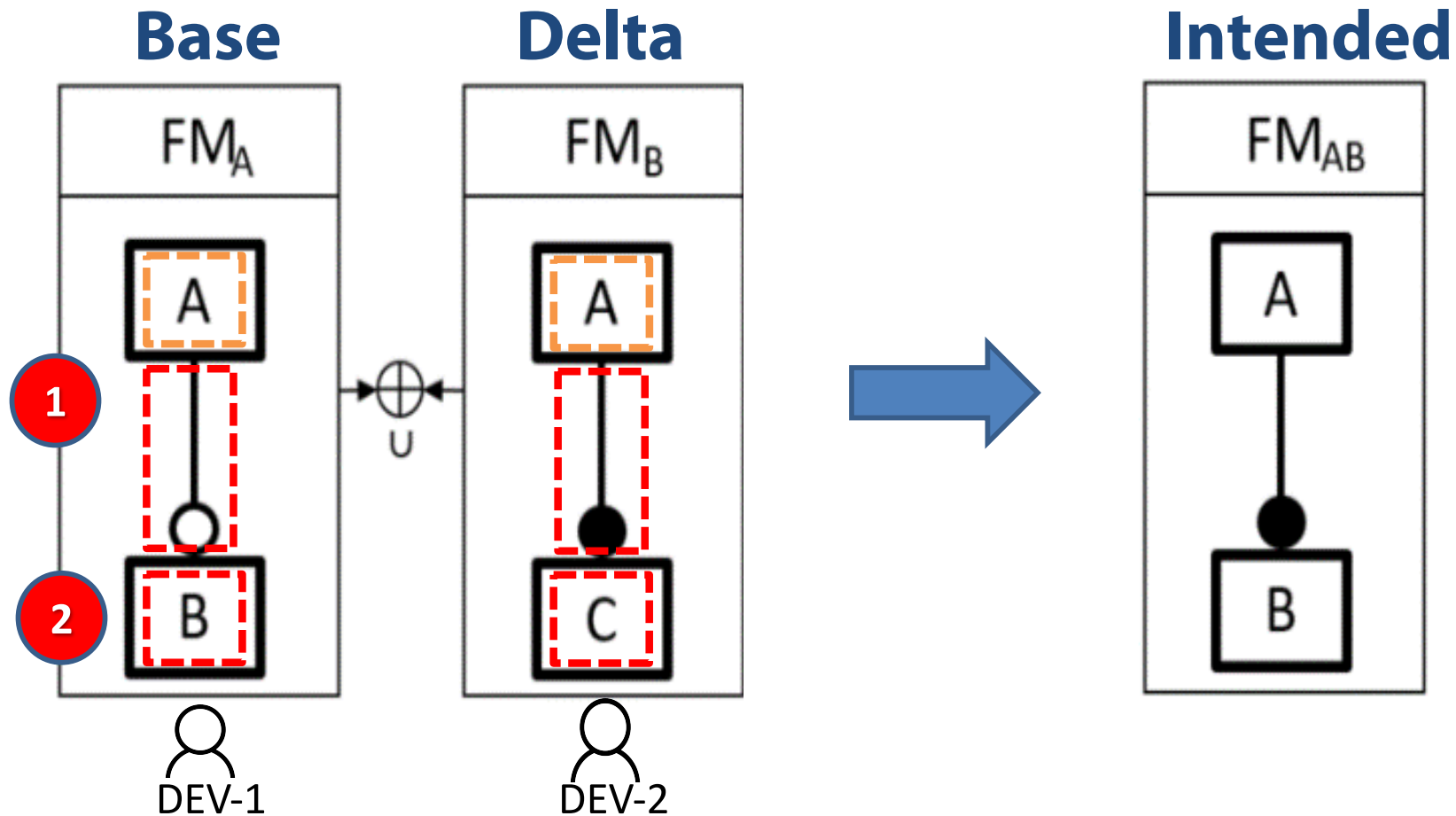
 **Conflict** is a contradicting value assigned to the properties of feature models.

Example: Integrating Feature Models



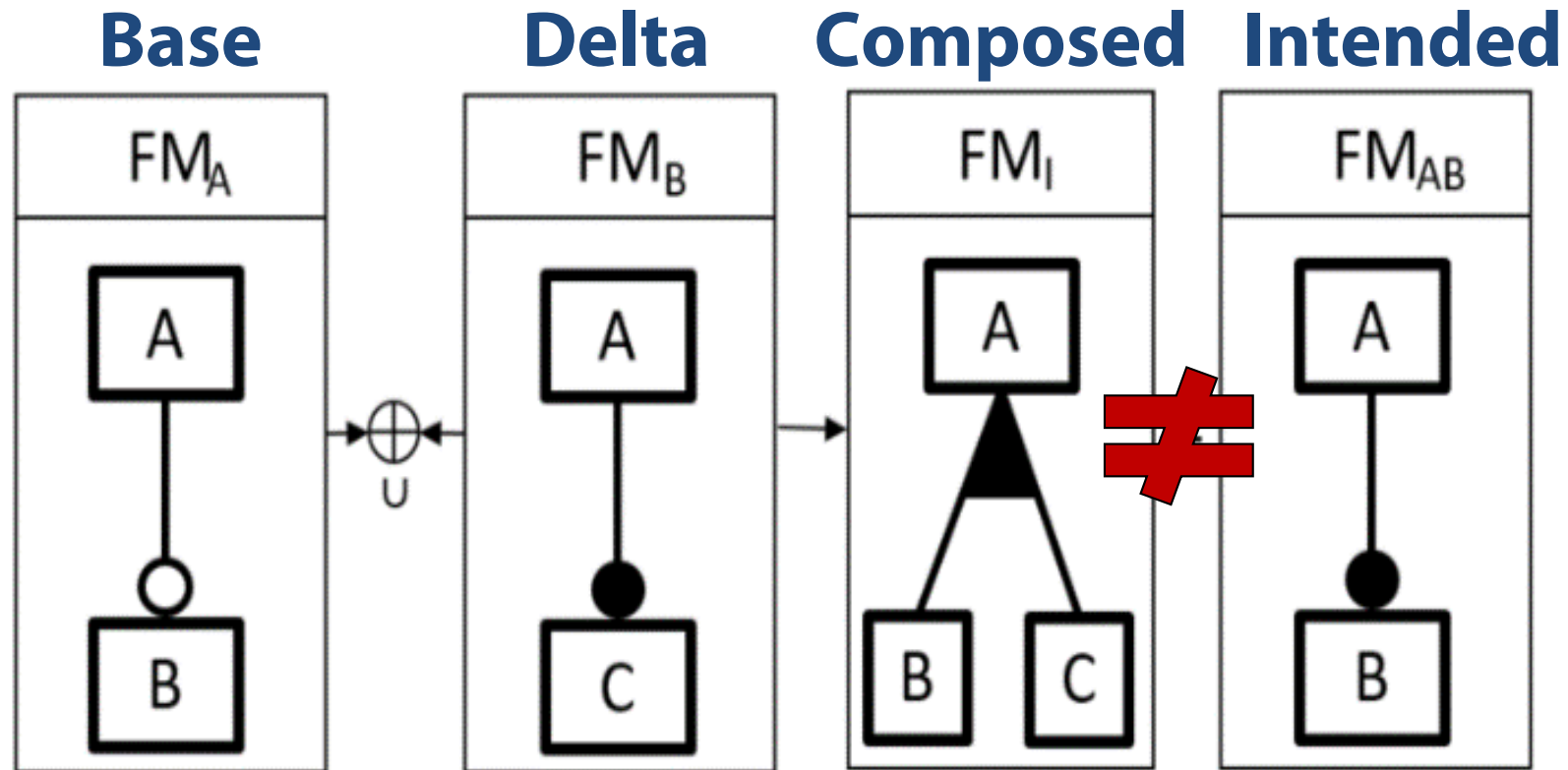
- 1 The first conflict is that we have one feature named as B in the base model, while we have the other feature named as C in the delta model.

Example: Integrating Feature Models



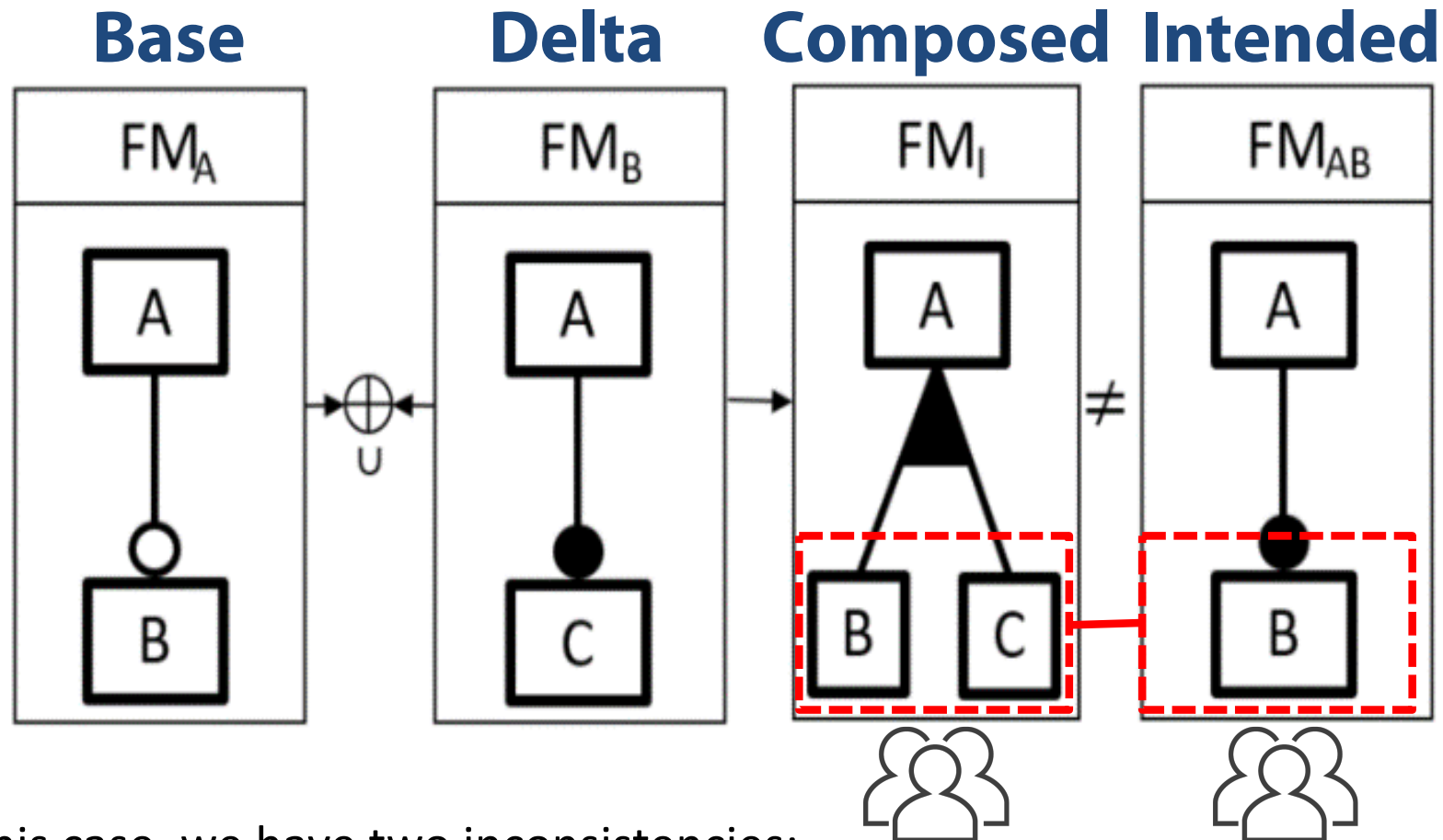
- 2** The second conflict is that the relationship between the features A and B in the base model is optional, while the relationship between the features A and C in the delta model is mandatory.

Example: Integrating Feature Models



In this case, the composed and intended models are inconsistent. Inconsistencies are contradicting values between the output-composed model and the output-intended model.

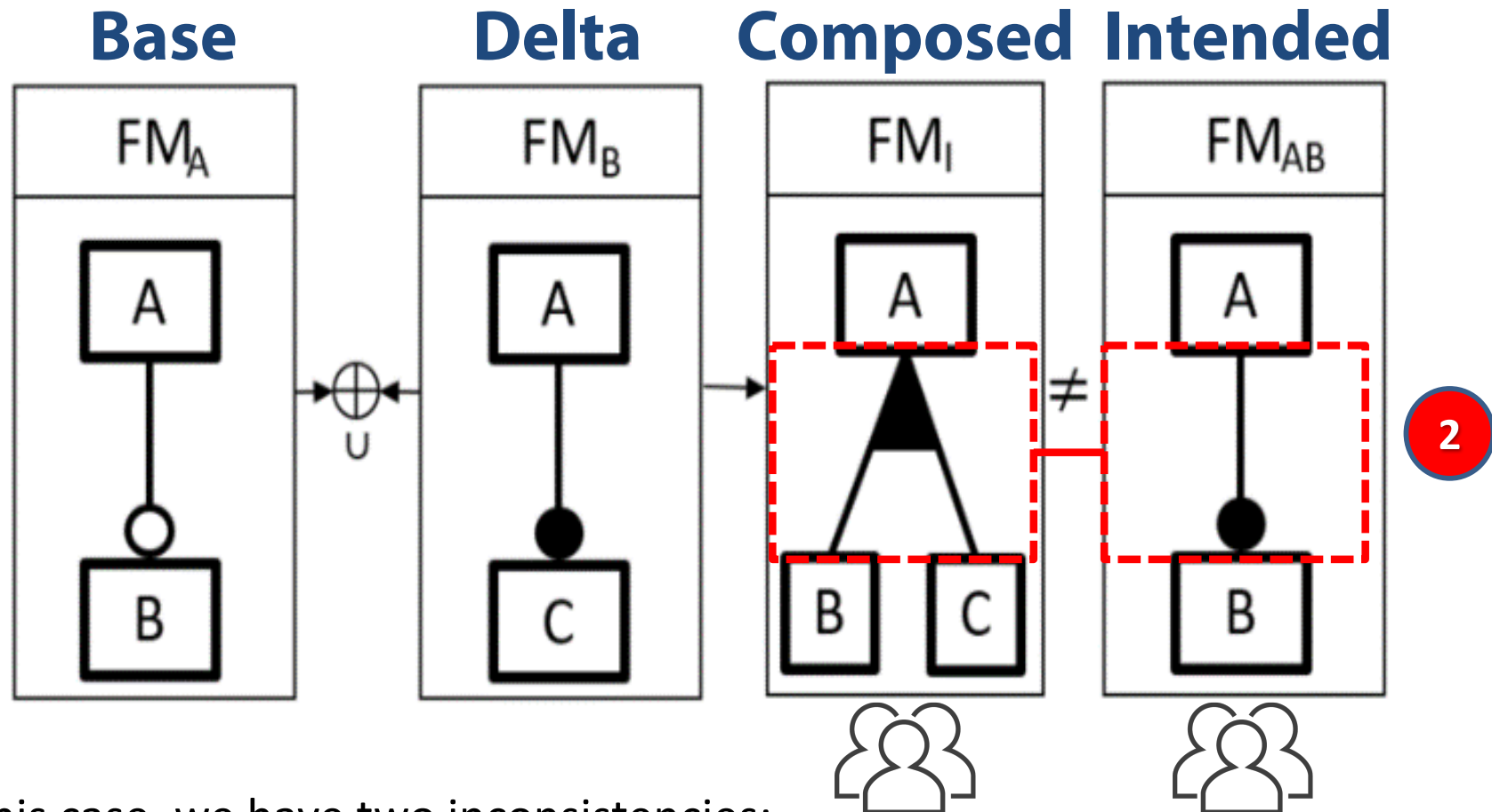
Example: Integrating Feature Models



In this case, we have two inconsistencies:

- 1 The first inconsistency is that the features B and C were inserted into the output-composed model, rather than just the feature B.

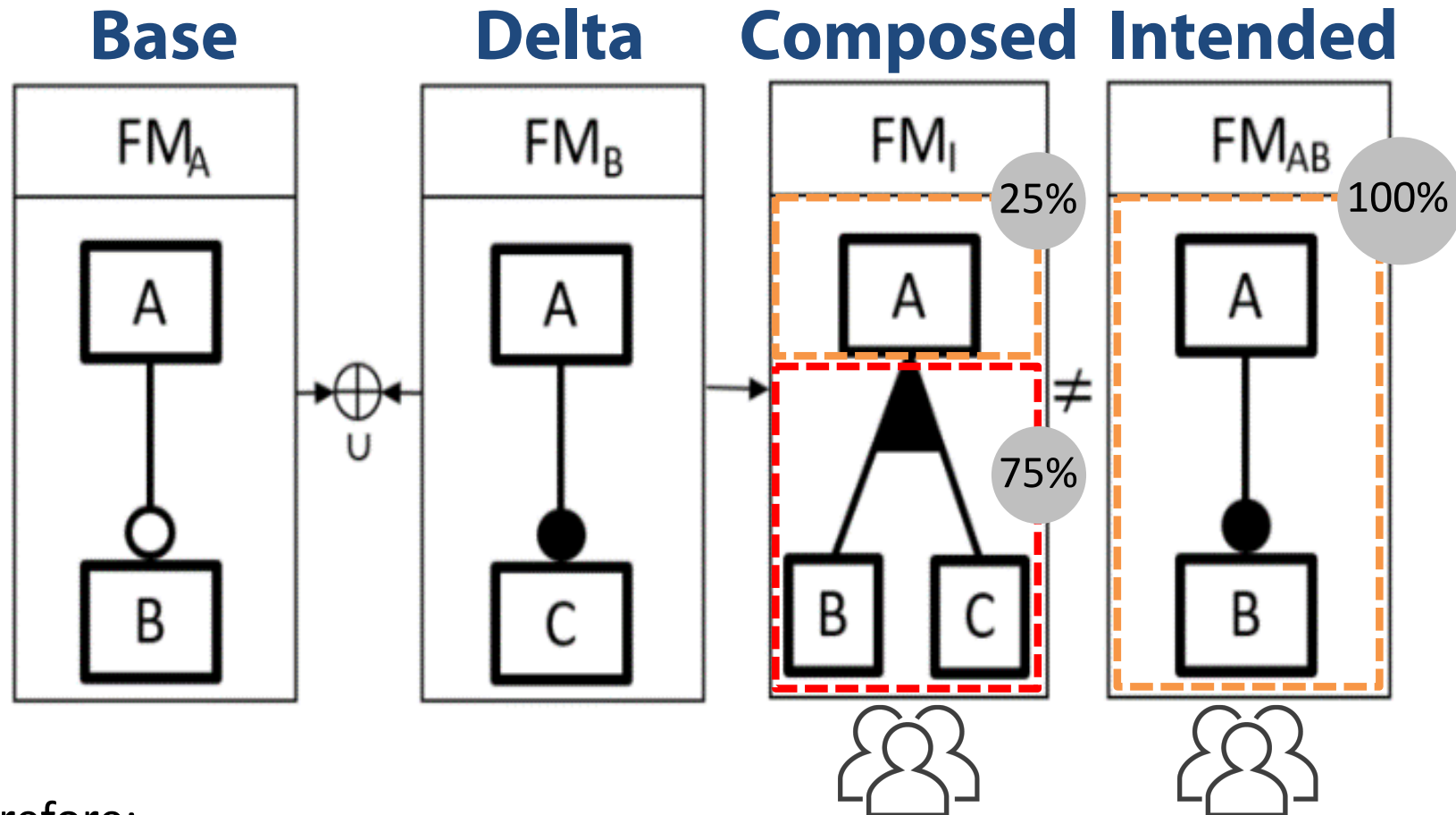
Example: Integrating Feature Models



In this case, we have two inconsistencies:

- 2 The second inconsistency is that an alternative relationship between the features A , B and C was created, rather than a mandatory relationship between the features A and B .

Example: Integrating Feature Models



Therefore:



The output-composed model has just 25% of the output-intended model. 75% of the composed model conflict with the output-intended model.

How...

...performing a controlled experiment with 25 participants

...quantifying 250 compositions

...two research questions were formulated and investigated.

...following a well-known experimental process.

...quantifying effort and correctness of the composed models created by the 25 participants.

Methodology

► Objective:

Analyze the integration of feature models for the purpose of investigating their effects with regard to the effort and correctness from the perspective of students and professionals in the context of evolution of feature models.

Methodology

► Research questions:

RQ1: What is the effort to compose feature models?

RQ2: What is the rate of correctly integrated feature models?

Experimental Process

Our experimental process has three steps:

Step 1 – Training:

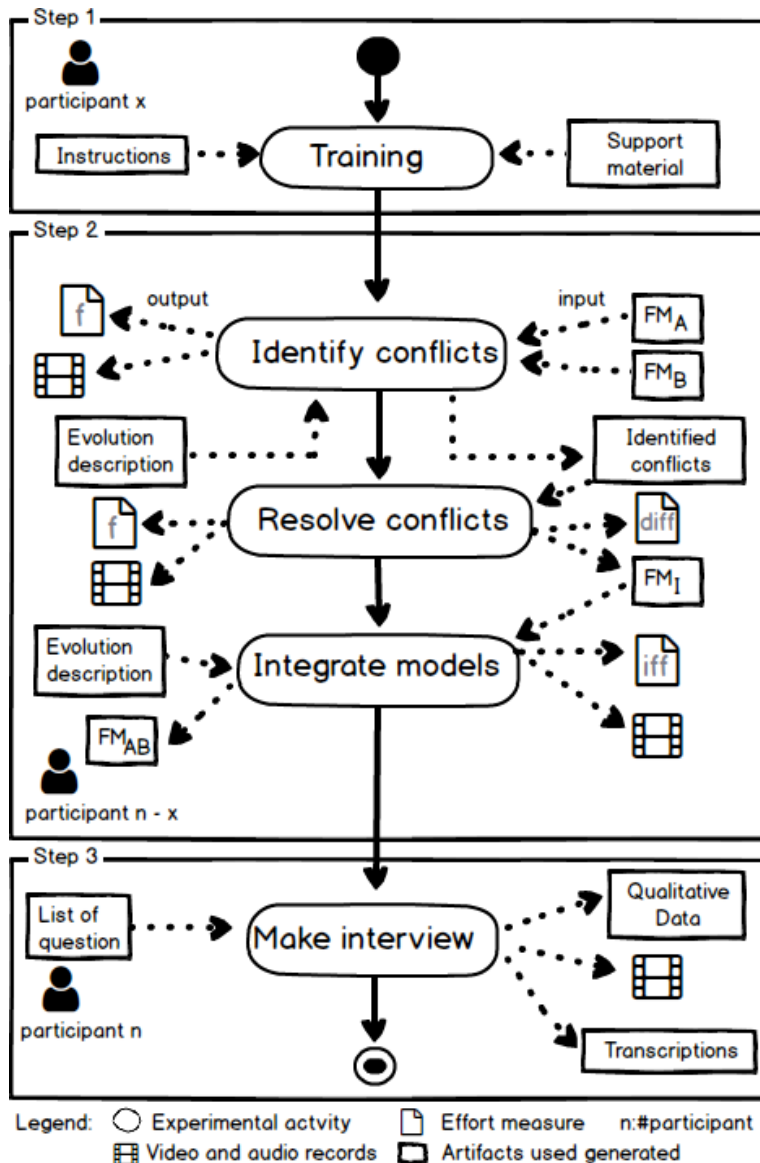
- All participants were trained to ensure that they obtained the necessary familiarity with model integration techniques.

Step 2 – Integration of feature models:

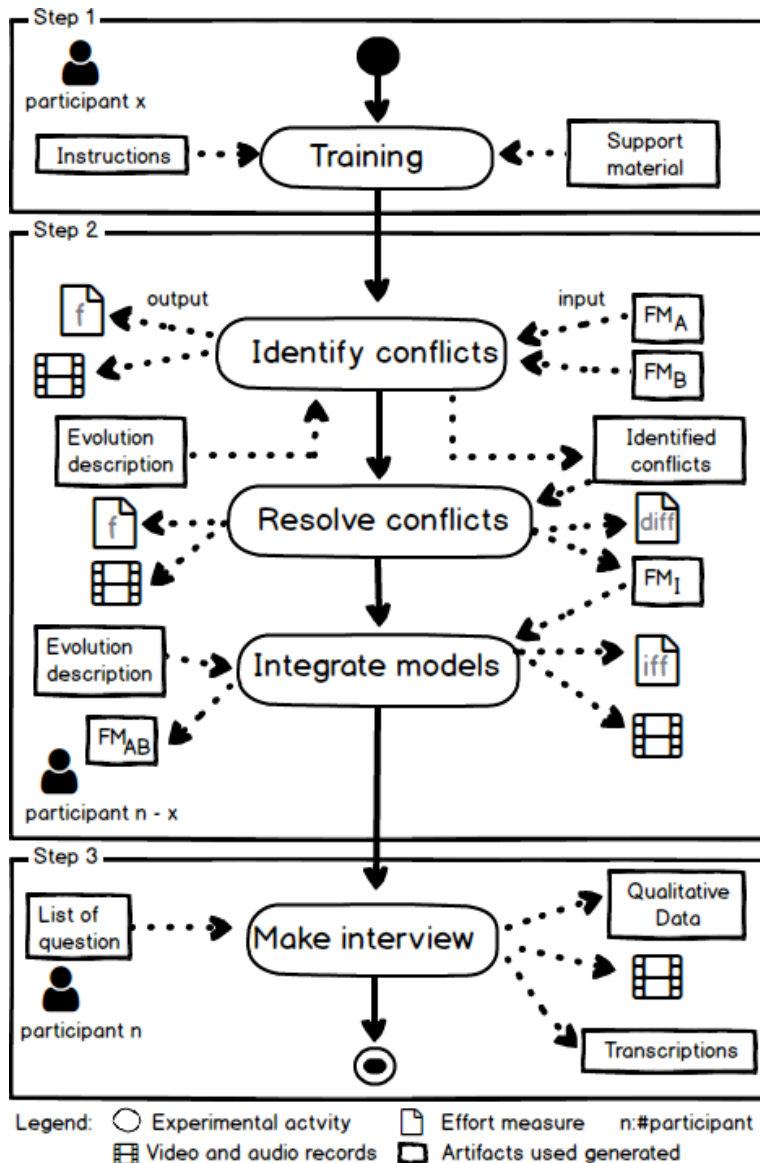
- The 25 participants integrated feature models based on change descriptions of 10 evolution scenarios.
- The effort invested and the number of correctly composed model were quantified.

Step 3 – Participant Data Collection

- Data related to participants were collected, such as age and level of experience.

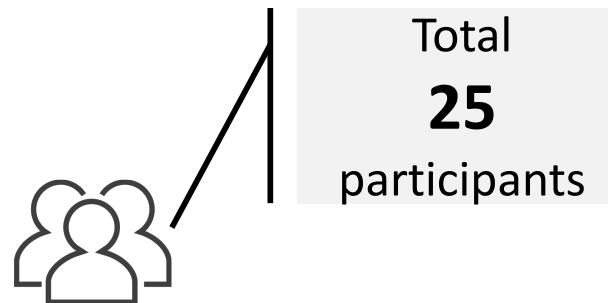


Experimental Process



Study participants:

- We had 25 participants, being 8 academic students, 7 professionals, and 10 technical students.



Results: Composition and Correctness

RQ1: What is the effort to compose feature models?

RQ2: What is the rate of correctly integrated feature models?

- ▶ **Finding 1:**
Academic students invested **25% less effort** to integrate feature models and produced **6% more correctly composed feature models** compared to technical students.
- ▶ **Finding 2:**
Academic students invested **2% less effort** to integrate feature models and produced **26% more correctly composed feature models** compared to professionals.

Result: Composition and Correctness

RQ1: What is the effort to compose feature models?

RQ2: What is the rate of correctly integrated feature models?

► **Finding 3:**

Professionals invested **23% less effort** to integrate feature models than technical students. However, the technical students produced **20% more correctly composed models** than the professionals.

► **Finding 4:**

Technical and academic students invested **12% less effort to integrate feature models** and produced **22% more correctly composed feature models** compared to professionals.

Conclusions

▶ **First exploratory study:**

- evaluating the effort to apply composition technique, detect and resolve inconsistencies
- analyzing the key factors that affect developers' effort .

▶ **Main finding:**

- The results show that professionals tend to invest less effort to integrate feature models, but they produced a lower number of correctly composed feature models compared to students.

▶ **Future work:**

- Run this study in different contexts
- Study the conflict-management problem more carefully

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