

# From generic requirements to variability

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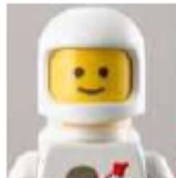
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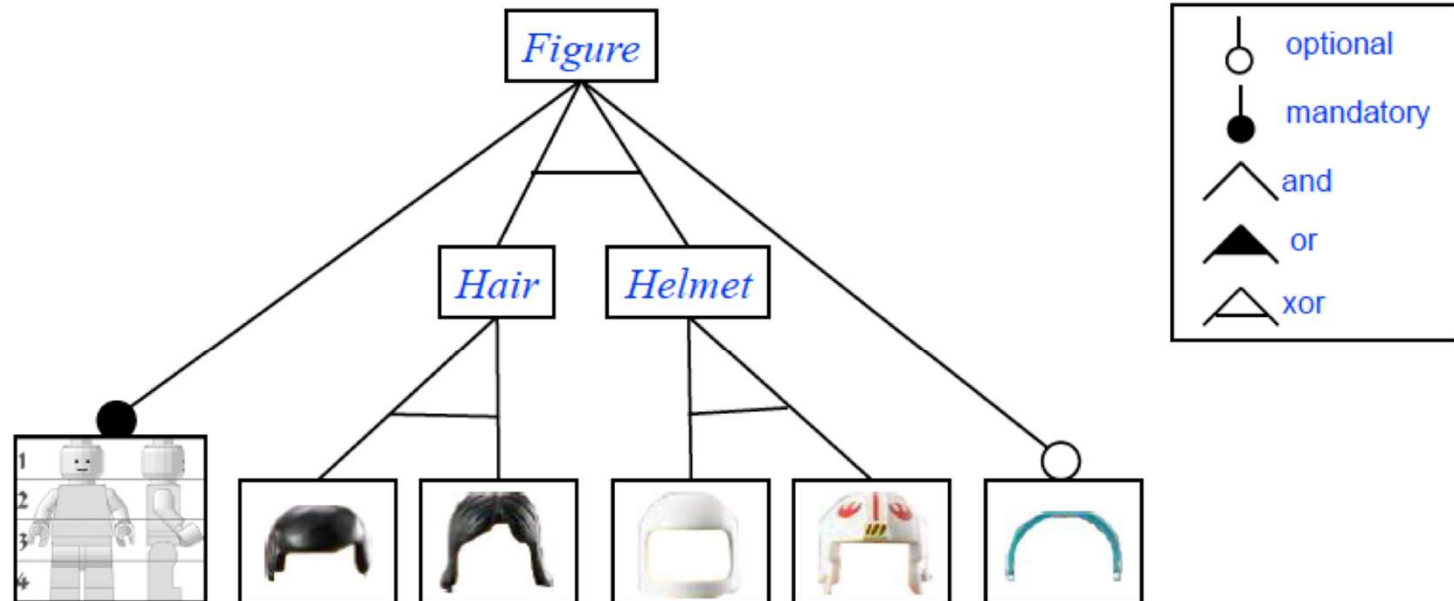
# Context: SPLE

- **Software product line engineering (SPLE):** software engineering methods, tools and techniques for creating a **collection of related software systems**
- Among the fundamental activities of SPLE there is **the identification of variability** in different artefacts of the development process, such as **requirements, architecture** and **test cases**
- **Variability:** the ability of an artefact to be configured, customised, extended, or changed for use in a specific context



# Features 4 SPL

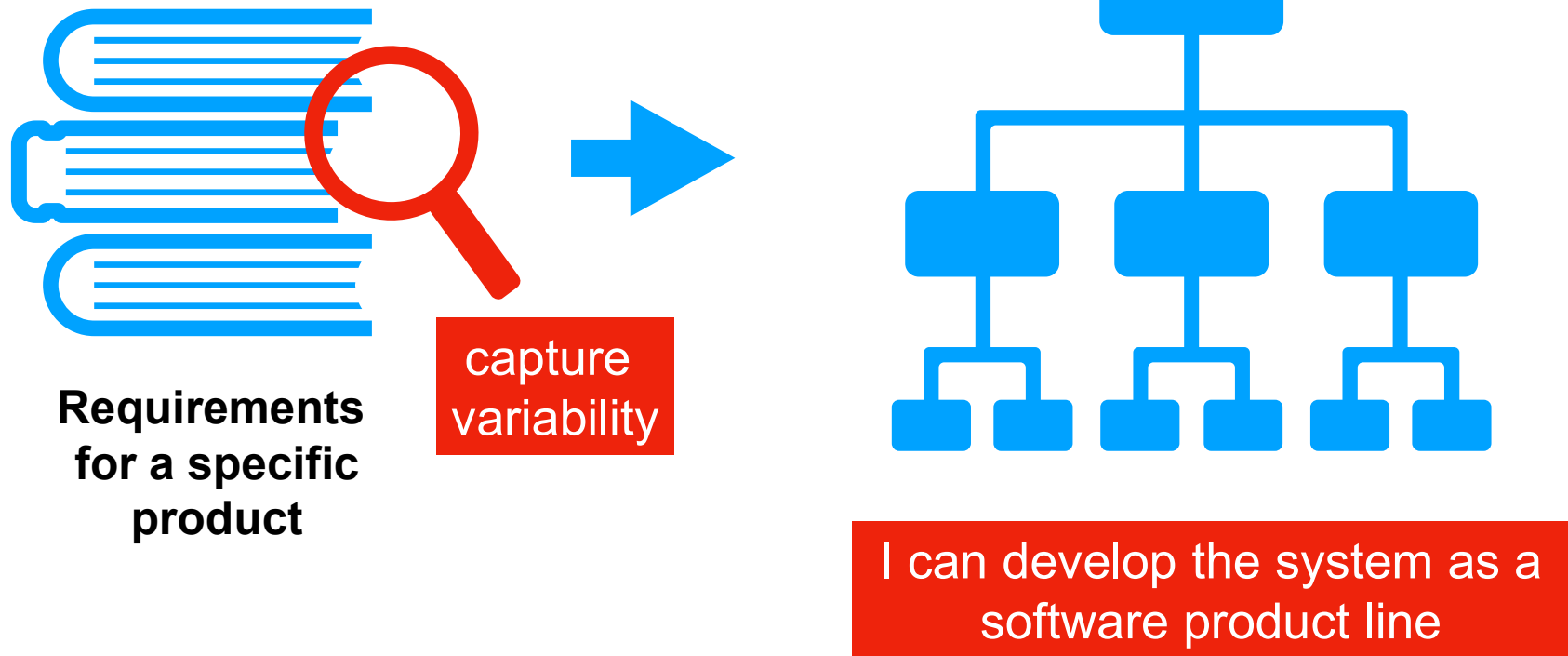
- **Features** are used to design SPL
- **Feature diagrams** describe how to select valid products, i.e. valid combinations of features



*Visor* ⇒ *Helmet*

# Our long term goal

- identify **sources of variability** in natural language requirements documents



# Main ingredients

- Functional & structural features
- Generic requirements
- Running example
- Ambiguity detection
- QuARS

# Structural & Functional Features

- In the **structural perspective**, a feature defines a domain or an architectural element
- In the **functional perspective**, a feature defines a service offered by the system

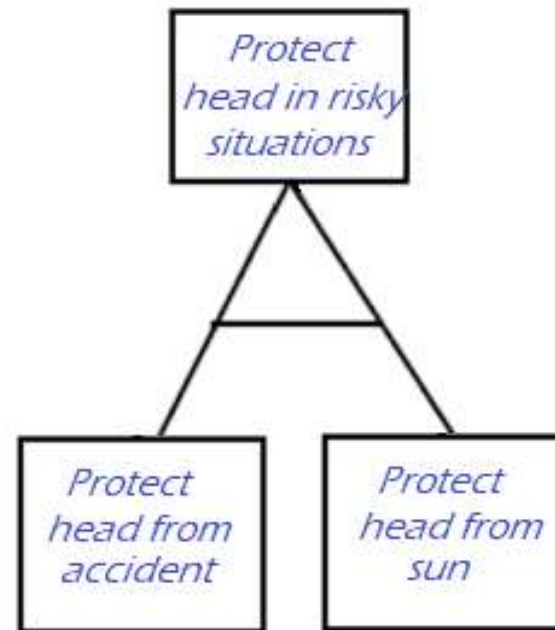
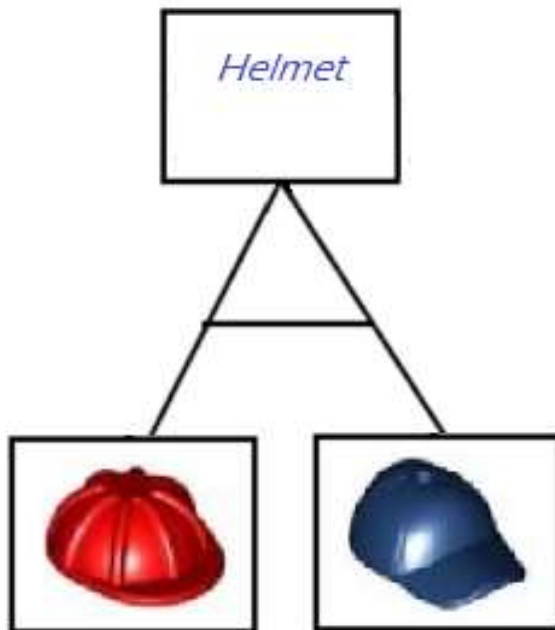
[Itzik, Reinhartz-Berger SPLC'14]

*Helmet*

*Protect  
head in risky  
situations*

# Specialization of generic requirements in SPL

- Generic requirements can **hide** a family of different products
- These can be **revealed** looking at different specializations both under a structural and a functional perspective



# Mobile phone example

GENERIC:

The phone shall offer a suitable interface to enter a text.

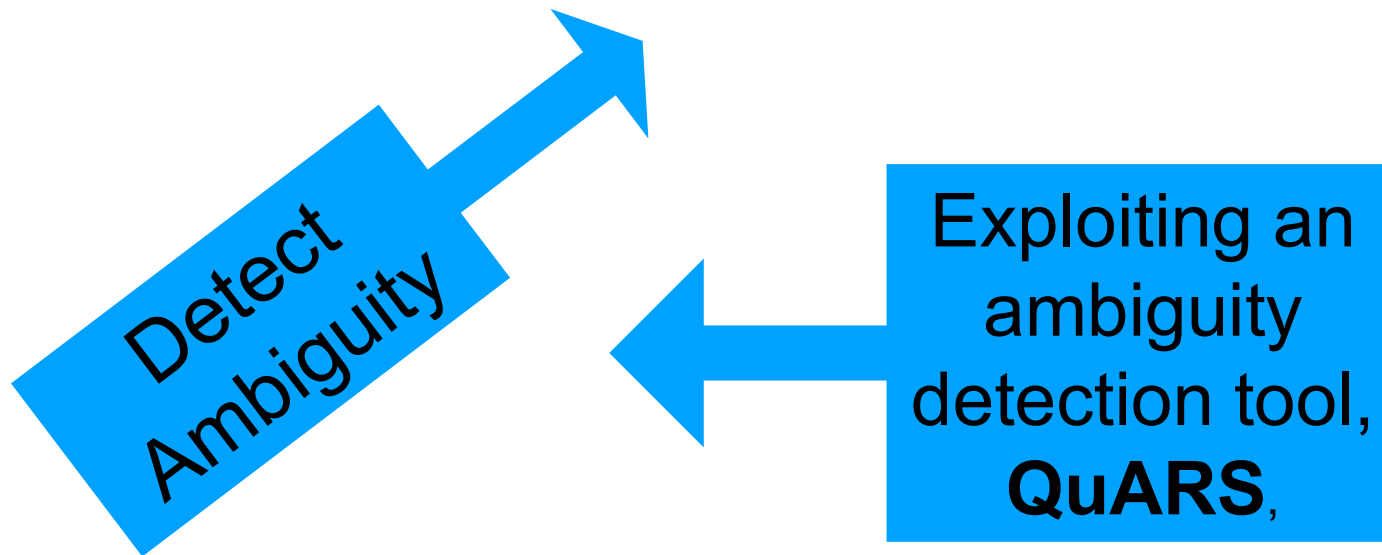


- The mobile phone shall permit the user to enter a text through the touchscreen keyboard or through the 3x4 physical keyboard.
- The mobile phone may offer a voice to text functionality and permit the user to enter a text through voice dictation.



# Address Ambiguity

- The phone shall offer a **suitable** interface to enter a text



- **Ambiguity** in requirements may be due to the (conscious or subconscious) need to postpone choices for later decisions
- Ambiguity can also be used as a way **to capture variability aspects** to be solved later in software development

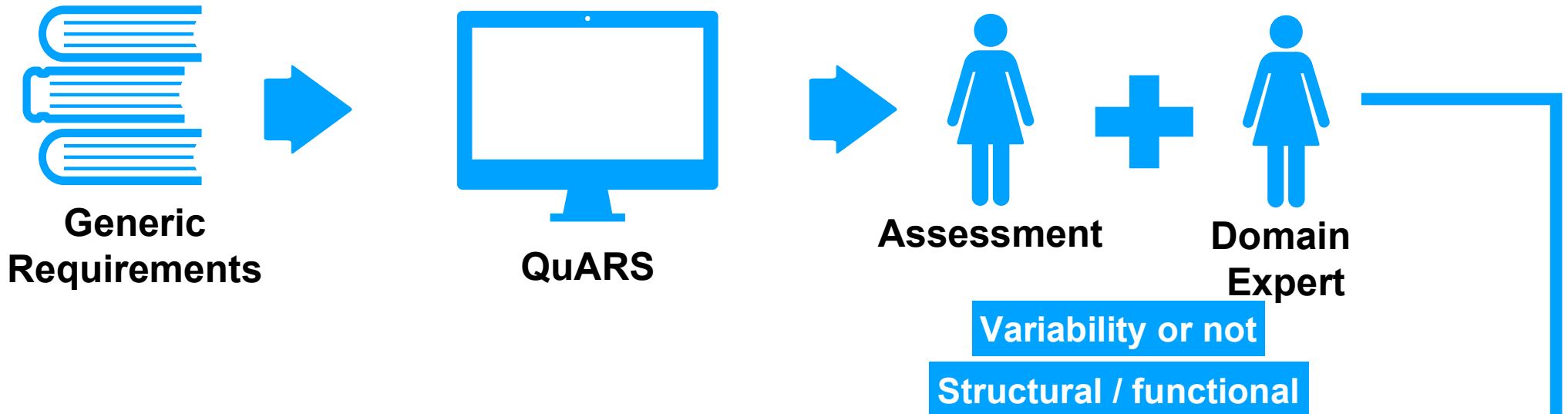
# QuARS



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- QuARS: **Quality Analyser for Requirements Specifications**
- Developed at ISTI - CNR, Pisa
- Analysis at sentence level, both **lexical** and **syntactical**, whose aim is to find the evidence of indicators of potential **ambiguity** and **variability**
- These indicators are either lexical elements (verbs, adjectives) taken from **user defined dictionaries** or syntactical elements and constructs.

# The process (1/2)



**Generic Requirements**

**QuARS**

**Assessment**

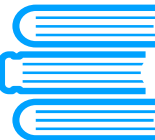
**Domain Expert**

**Variability or not**

**Structural / functional**



**Structural Requirements**

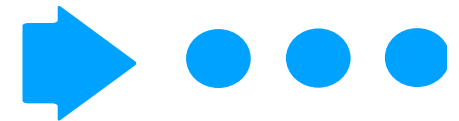


**Functional Requirements**

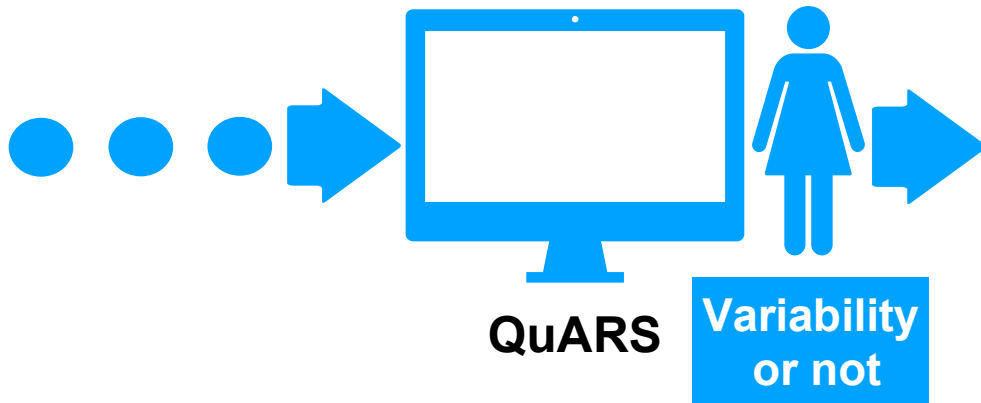
The input modalities in a mobile phone device are the touchscreen or the old style 3x4 physical keyboard, and the microphone.

The mobile phone shall permit the user to enter a text through the touchscreen keyboard or through the 3x4 physical keyboard.

The mobile phone may offer a voice to text functionality and permit the user to enter a text through voice dictation.



# The process (2/2)

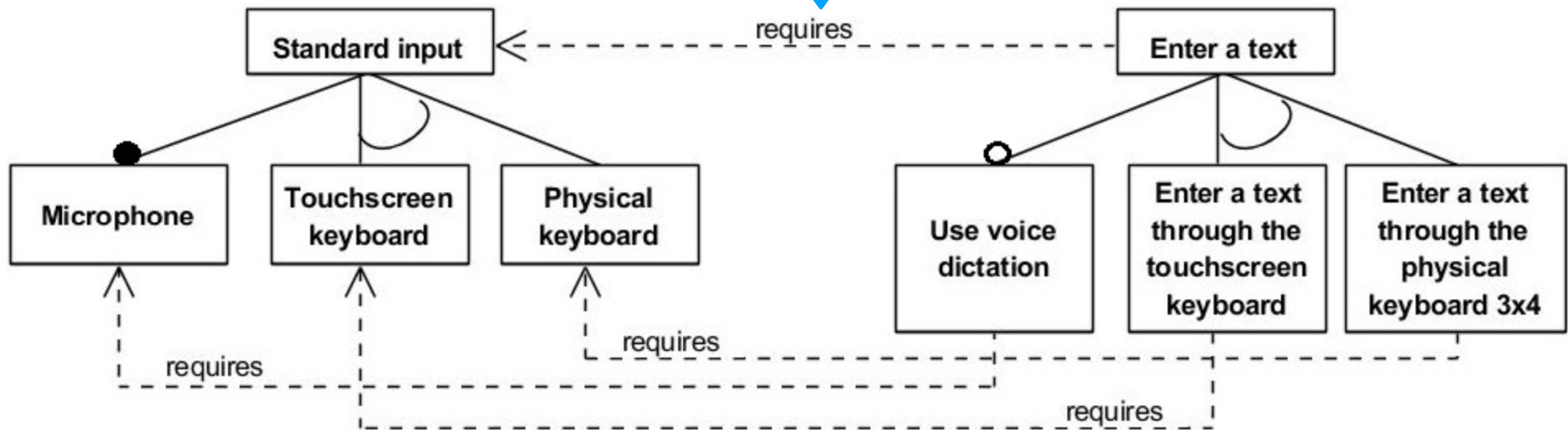


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**Systematic mapping**



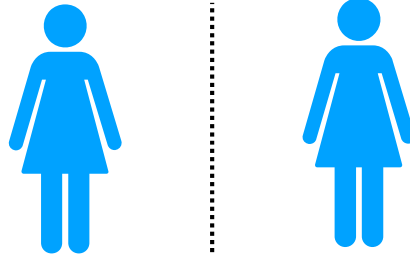
# Evaluation



Requirement Documents



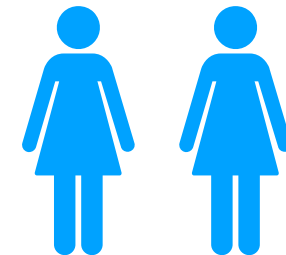
QuARS supported process



Independent Review

RQ1

RQ2



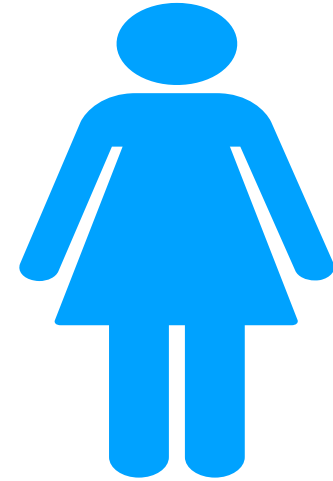
Assessment

RQ1

RQ2

- RQ1: Is there a preferred order (structural / functional) in the process of variability identification? Or the two parallel processes should actually interleave?
- RQ2: How much industrial users will appreciate this approach in terms of
  - ✓ perceived usefulness and
  - ✓ perceived ease-of-use

# Discussion



- Independent review
  - vs testbed (welcome)
- Manual intervention to distinguish structural from functional features
  - Like domain vs requirements
- Manual intervention to detect variability
  - Lesson learned: loof for
    - under-specifications and vaguenesses in generic requirements (step 1)
    - optionality and multiplicity to build the feature diagram (step 2)

Thank you

# Ongoing and future work

1. Collaboration with colleagues that are developing a tool for feature extraction
  - Their ability to recognize feature and subfeatures with QuARS ability to detect variability
2. Thesis combining QuARS with NLP tool to extract feature names and class diagrams
3. Map to other (than FD) variability description languages