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# *The VisualAORE DSL*

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**SOLAR**

**Software Languages Engineering for  
Requirements Specification and Design**

# Context

- Motivation
- AORE method
- DSL – Domain Specific Language
- The VisualAORE DSL
  - VisualAORE Metamodel
  - VisualAORE Components
- Evaluation
- Related Work
- Conclusions

# Motivation

- AORE is one of the most cited aspect-oriented approaches
- Supported by ARCADE which provides XML textual specifications.
  - Difficult to read and understand
- So, AORE method doesn't have a visual support to improve its usability
- Also,
  - Lack of a metamodel specifying it more formally

# But...

- The approach could be better defined using a visual DSL
  - Specific and concrete domain that can be represented by a DSL;
  - A visual DSL is preferred by the common Software Engineering: easier to use modeling in higher levels of abstraction.

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# AORE method

## ***AORE – Aspect Oriented Requirements Engineering:***

- Has the **Aspect** as the base concept;



Module that encapsulates a **crosscutting concern**: an concern scattered by various units of the system specification

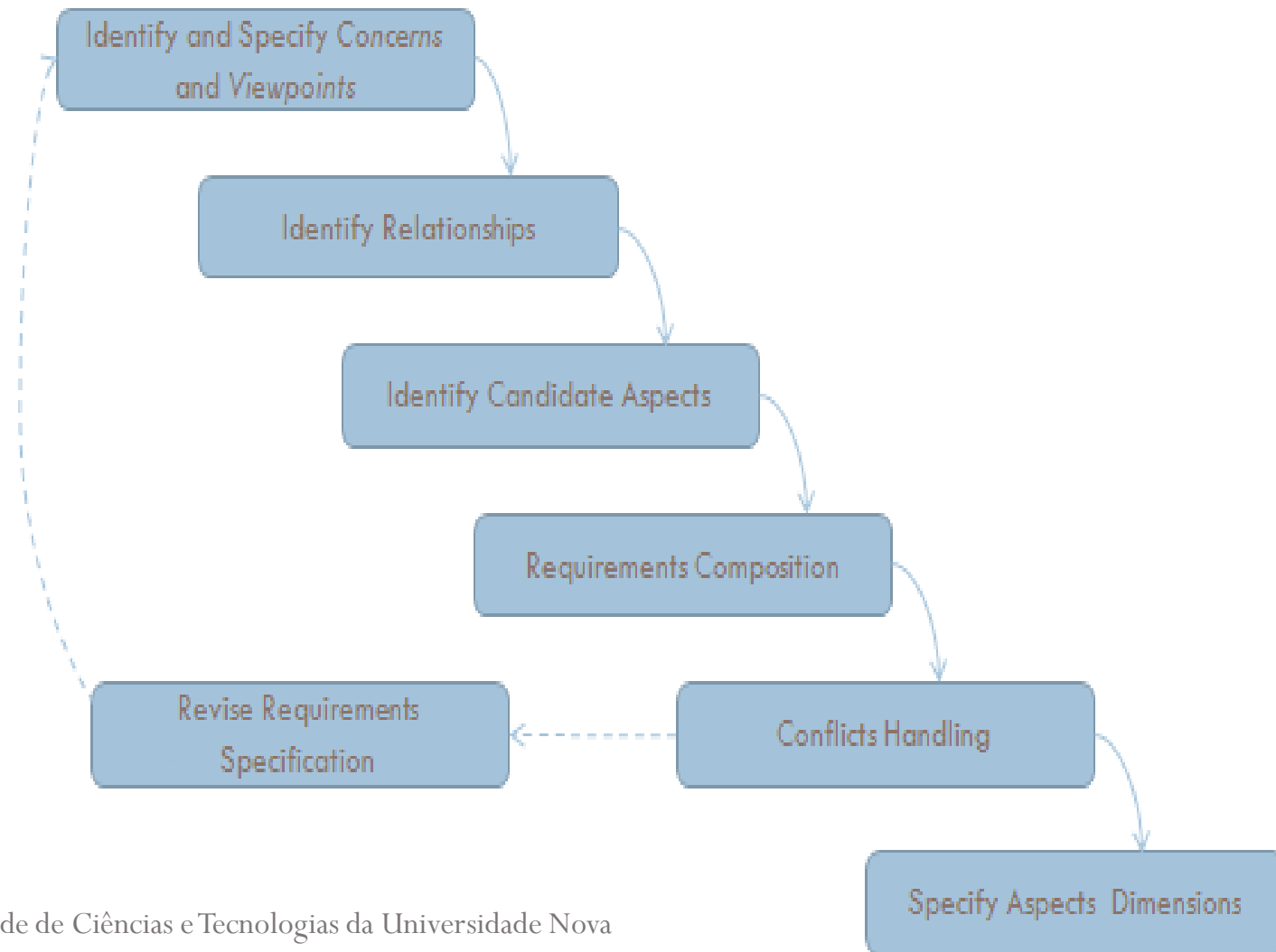
# AORE method

- Identify
- Modularize
- Specify
- Compose



Crosscutting Concerns

# AORE method





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# DSL – Domain Specific Language

- Specific domains characterized by sets of terminologies and concepts.
- More concise;
- Model and express specific concepts of formal way;
- Offer solutions that increase the level of abstraction.

# DSL – Domain Specific Language

- By offering a higher abstraction and expression power makes it easier understanding, validating and modifying a language.
- Use a model called metamodel to specify the concepts of a language;
- Can be textual, visual / diagrammatic or both.

# DSL – Domain Specific Language

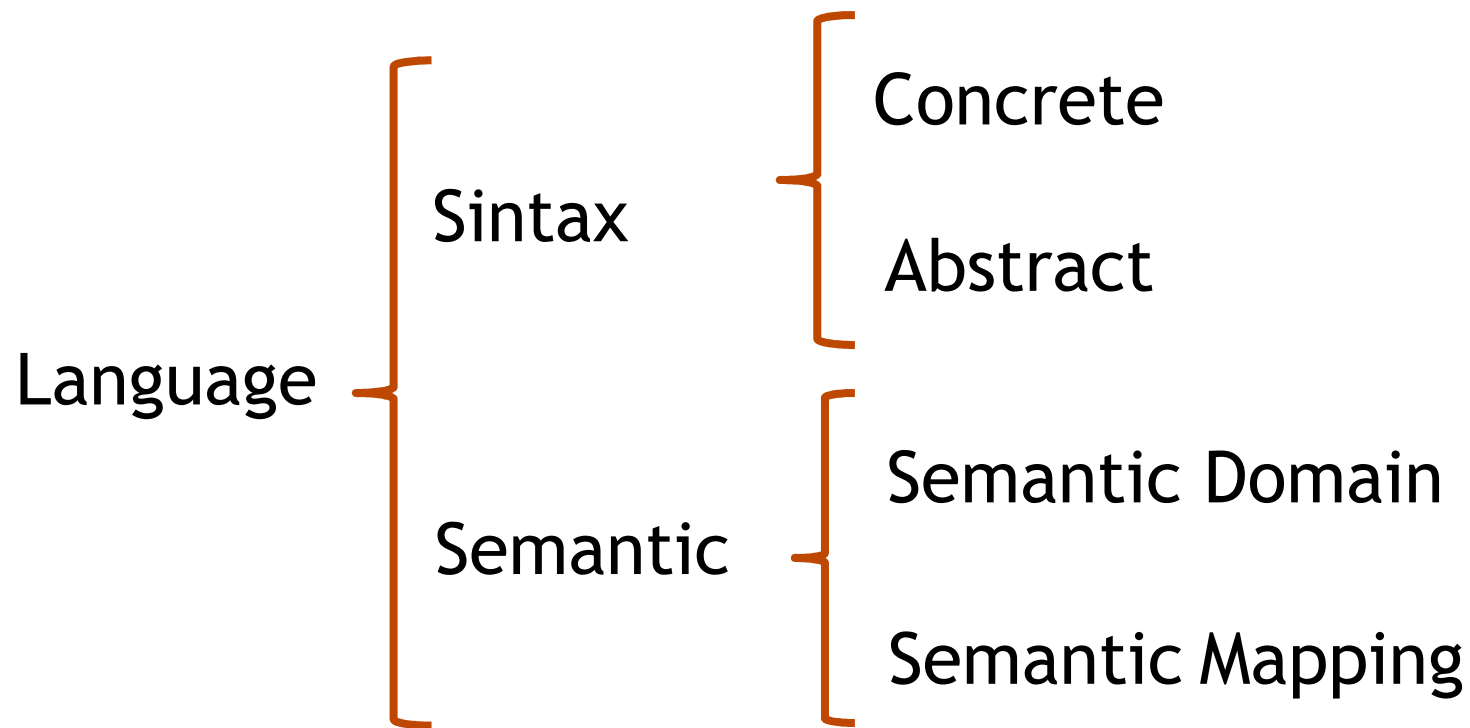
- Used in **Model-Driven Development** (MDD):



Perform system design through models to get their overall structure.

- A **model** is a more simple and abstract representation of a system structure, functionality or behaviour.

# DSL – Domain Specific Language



# DSL – Domain Specific Language

## Development Process:

- **Domain Analysis**
  - FODA - creation of a feature model composed by features, or system properties.
- **Language Design**
  - Formal notation- context free grammars and/or meta-models of the language;
  - Informal notation - natural language.
- **Test and Evaluation**

# DSL – Domain Specific Language

- Solutions are expressed in terms of the problem domain;
- The validation and optimization may be done in the problem domain level;
- The changes in requirements are quickly made by the expert;
- Language that explains itself due to the great closeness of the experts with the domain concepts of the problem;

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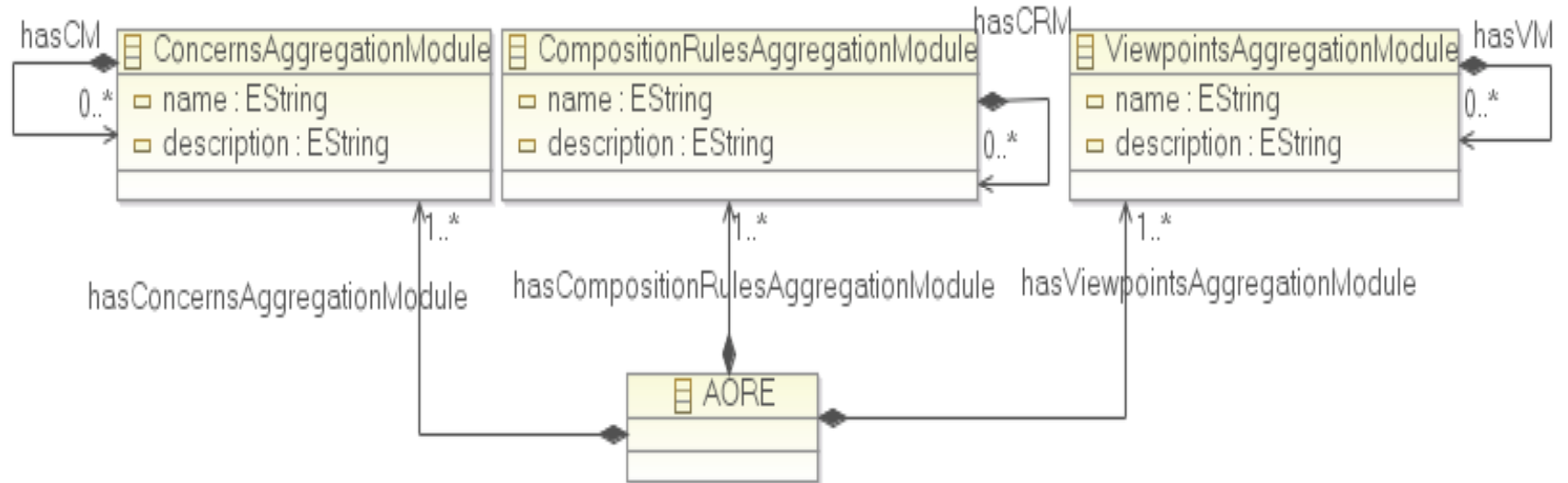
# The VisualAORE DSL

- Visual language that allows the creation of AORE models;
- Implemented using the **EMF/GMF** platform of Eclipse
  - **Emfatic** and **Epsilon** plug-ins;
- Composed by the base editor and three sub-editors;
- Introduction of the concept **Aggregation Module**.

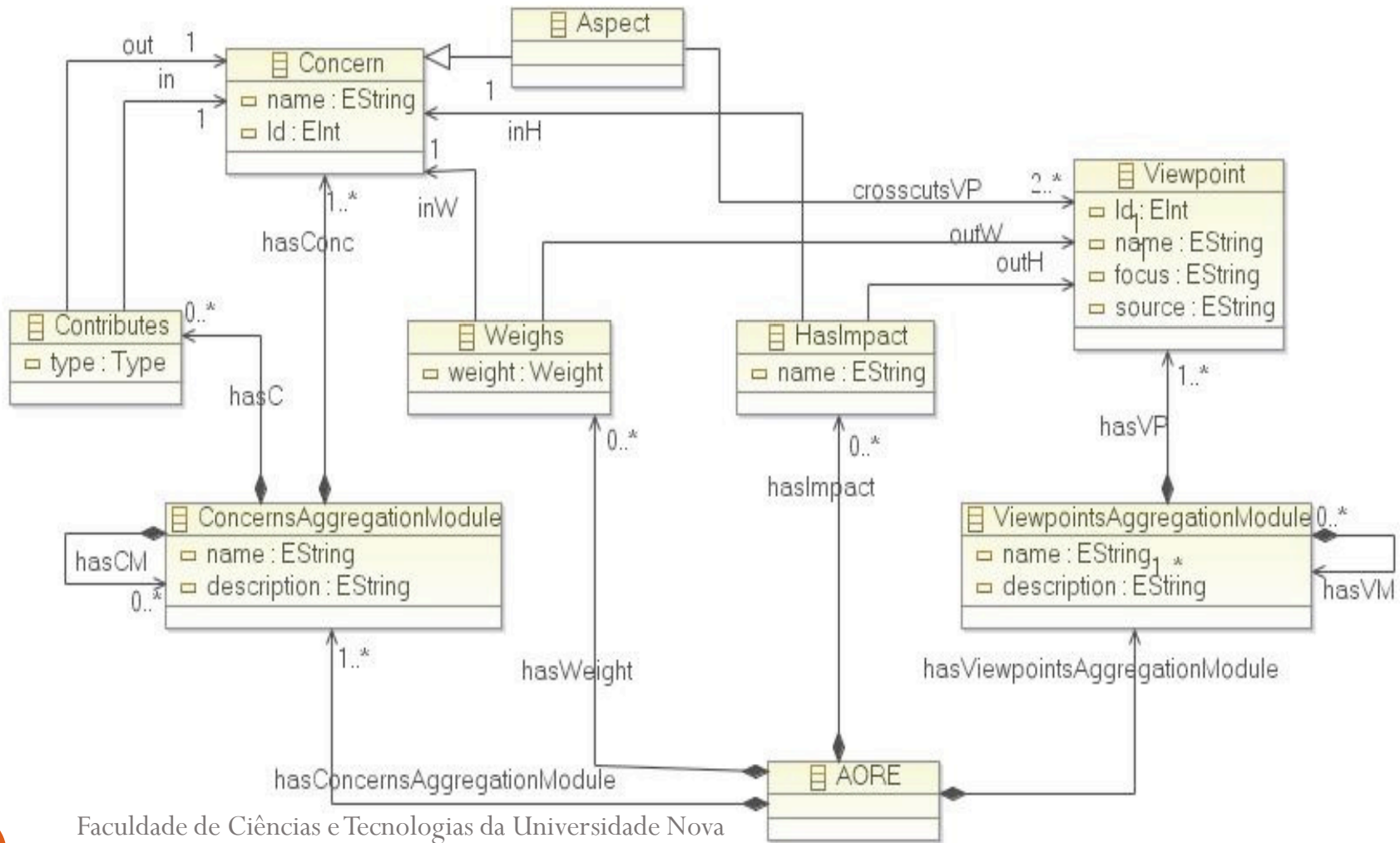
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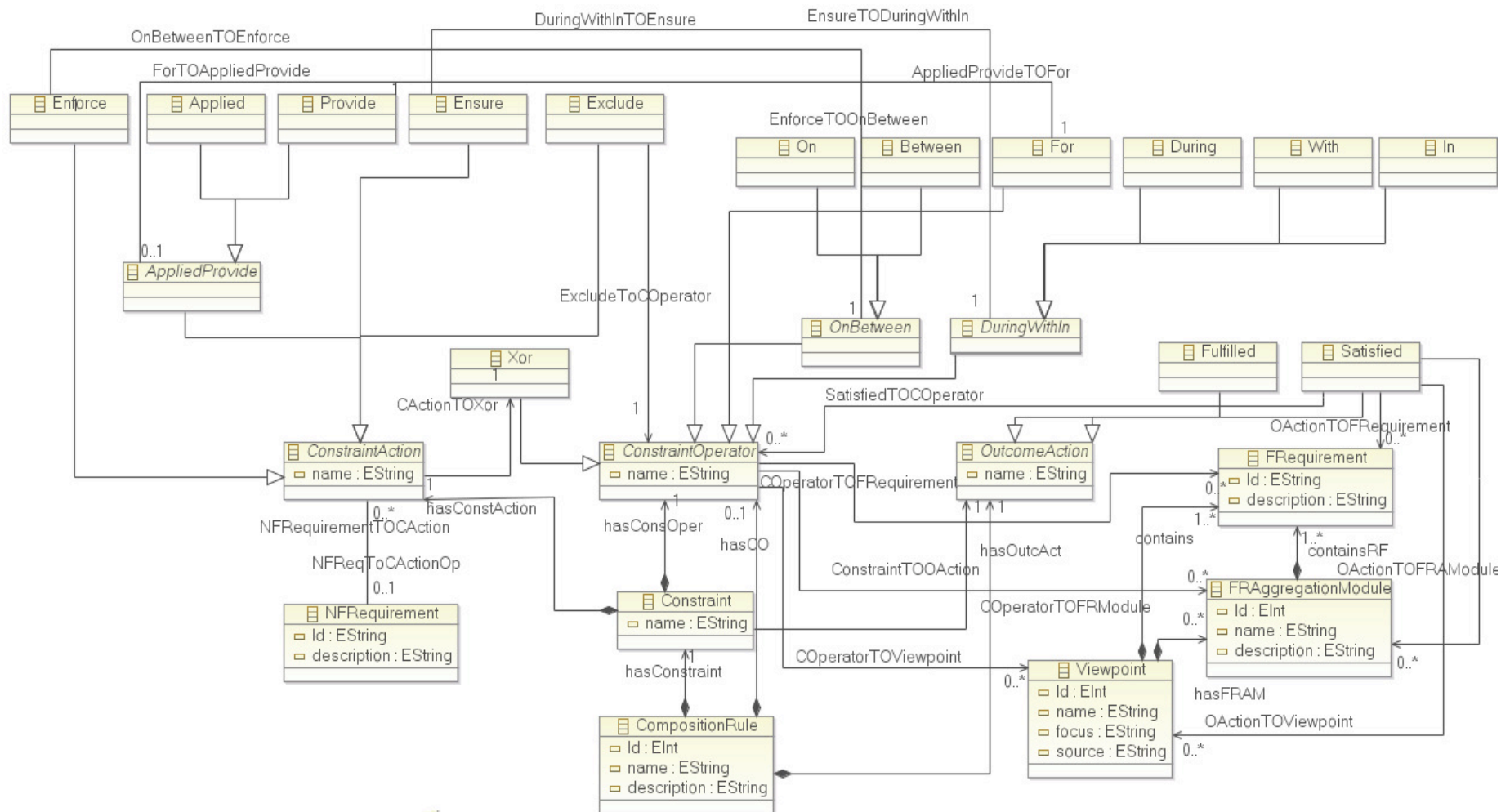
# VisualAORE Metamodel – Aggregation Modules



# VisualAORE Metamodel - Concern and Viewpoint



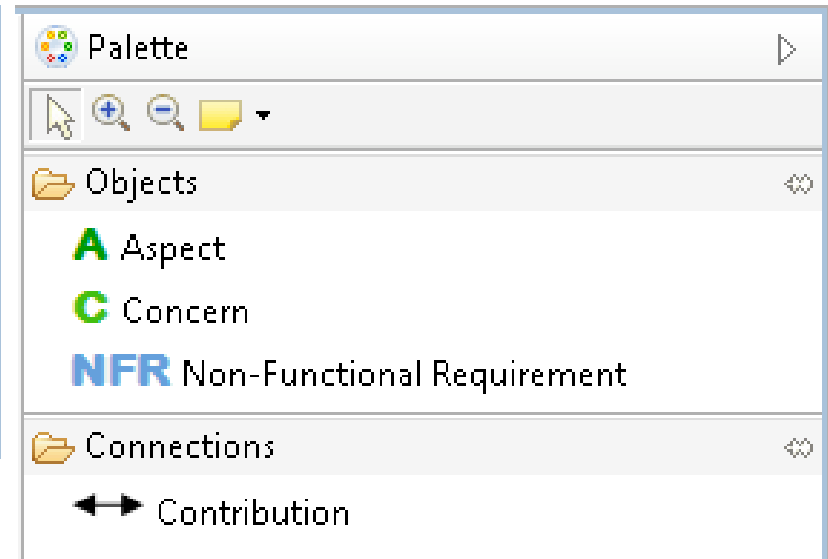
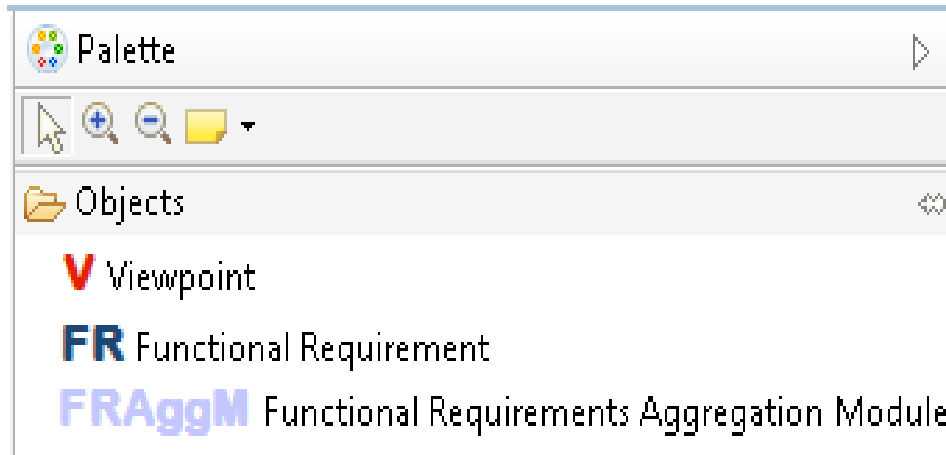
# VisualAORE Metamodel- Composition rule's concepts



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# VisualAORE – Viewpoint's and concern's palette



# VisualAORE – Viewpoint’s module

## VAggM Toll Gate

### V Paying Toll

1. A green light is turned on if the gizmo is valid;
2. A yellow light is turned on if the gizmo is not valid;
3. An alarm is sounded if the gizmo is not present or invalid;
4. The amount being debited is displayed if the gizmo is valid.
  - 4.1. The amount being debited depends on the class of the vehicle;

### FRAggM 1. Mod1

1. A green light is turned on if the gizmo is valid;
2. A yellow light is turned on if the gizmo is not valid;

### FRAggM 2. Mod2

4. The amount being debited is displayed if the gizmo is valid.
  - 4.1. The amount being debited depends on the class of the vehicle;

### V Exit Toll

1. A yellow light is shown if the vehicle did not enter using a green lane
2. The amount being debited depends upon the entry point.

### V Single Toll

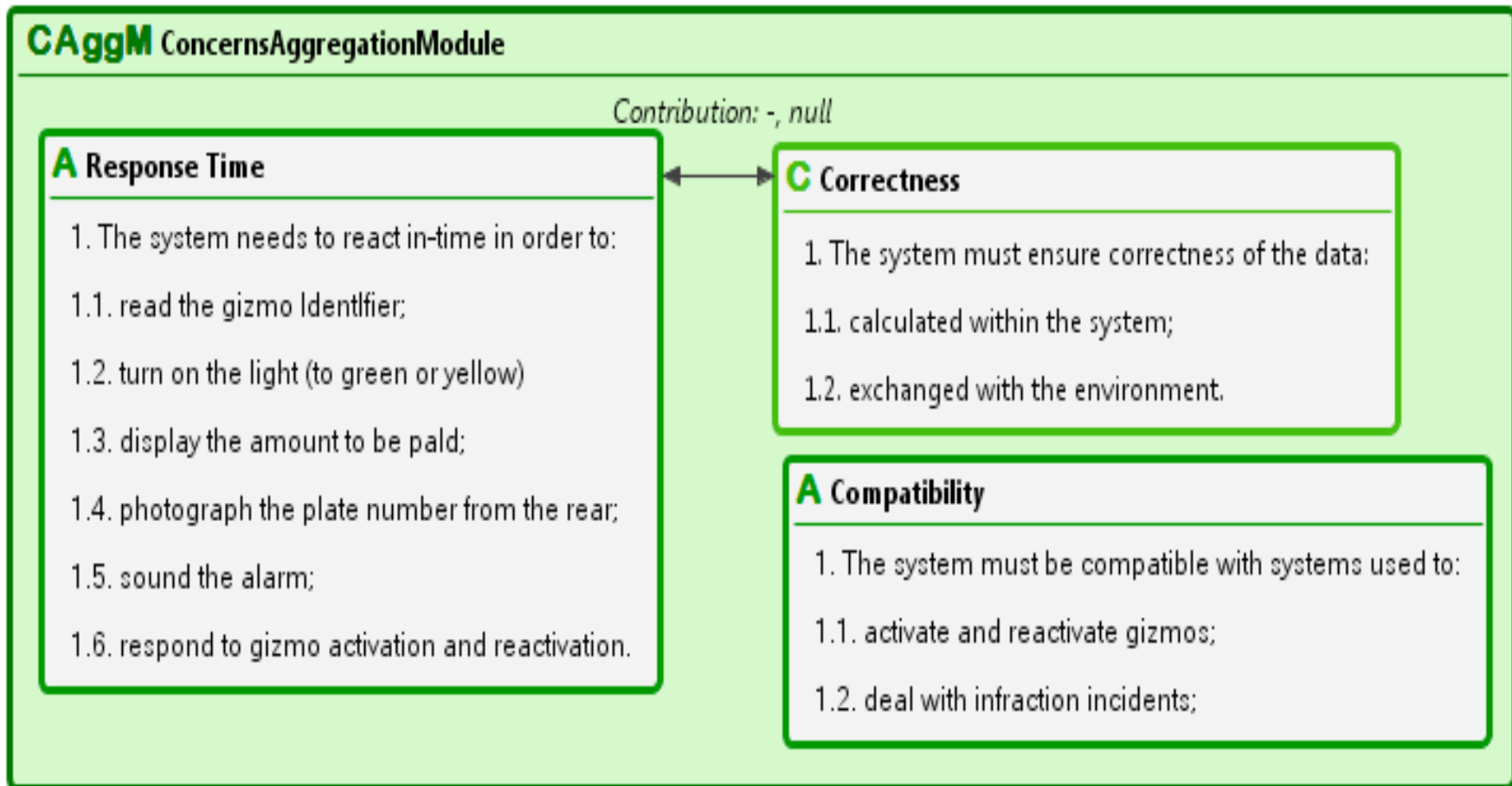
1. The amount being displayed is fixed.

### V Entry Toll

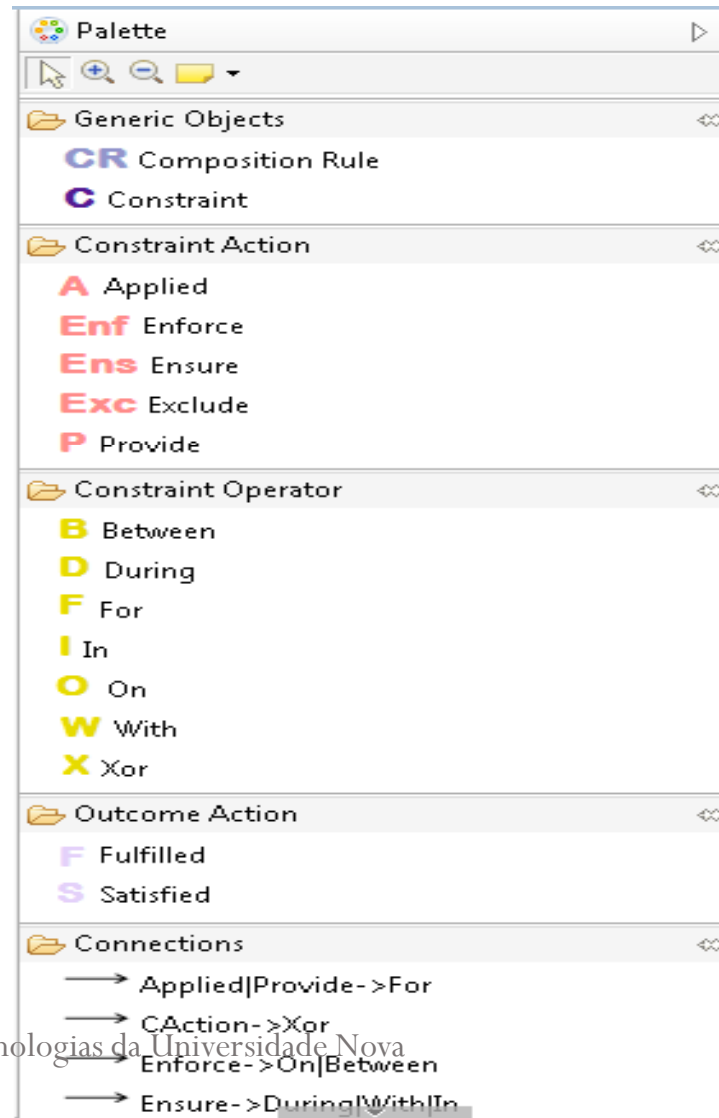
1. No signals are shown on passing an entry point.



# VisualAORE – Concern's module



# VisualAORE - Composition palette



# VisualAORE – Composition Example

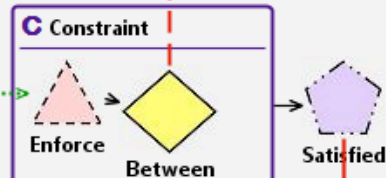
## C<sub>AggM</sub> "Via Verde" Concerns Module

### A Response Time

1. The system needs to react in-time in order to:
  - 1.1. read the gizmo Identifier;
  - 1.2. turn on the light (to green or yellow)
  - 1.3. display the amount to be paid;
  - 1.4. photograph the plate number from the rear;
  - 1.5. sound the alarm;
  - 1.6. respond to gizmo activation and reactivation.

## CR<sub>AggM</sub> Response Time

### CR 1. ResponseTime-Req1.1



## V<sub>AggM</sub> Vehicles

### V Vehicle

1. The vehicle enters the system when it is within ten meters of the toll gate;
2. The vehicle enters the toll gate.
3. The vehicle leaves the toll gate.
4. The vehicle leaves the system when it is twenty meters away from the toll gate.

### FR<sub>AggM</sub> 1. Mod1

2. The vehicle enters the toll gate.
3. The vehicle leaves the toll gate.

## V<sub>AggM</sub> Viewpoints

### V Gizmo

1. The Gizmo identifier is read by the system.
  - 1.1. The gizmo identifier is validated by the system;
  - 1.2. The gizmo is checked by the system for being active or not.

### V ATM

1. The ATM sends the customer's card number, account number and gizmo identifier to the system for activation and reactivation;
  - 1.1. The ATM Is notified If the activation or reactivation was successful or not;
    - 1.1.1. In case of unsuccessful activation or reactivation the ATM Is notified of the reasons for the failure.

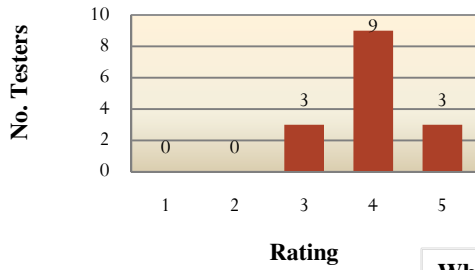
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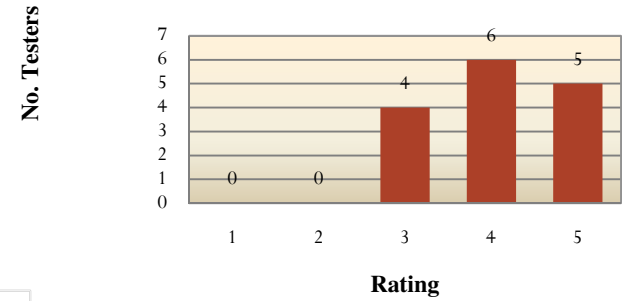
# Evaluation

- Validation of tool usability:
  - Smart Home case study solved with the VisualAORE.
- Conceptual validation of the language and tool usability:
  - Test and Questionnaire;
  - Sample of 15 users (with MSc in Computer Engineering at the Universidade Nova de Lisboa).

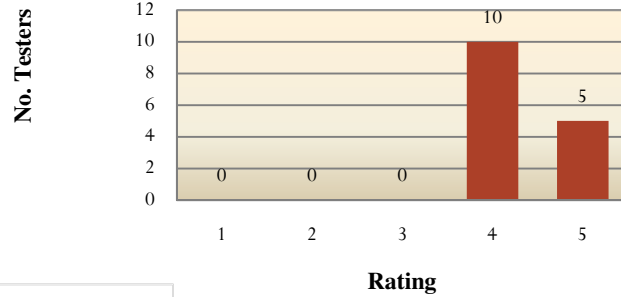
**Did you understand the VisualAORE language?**



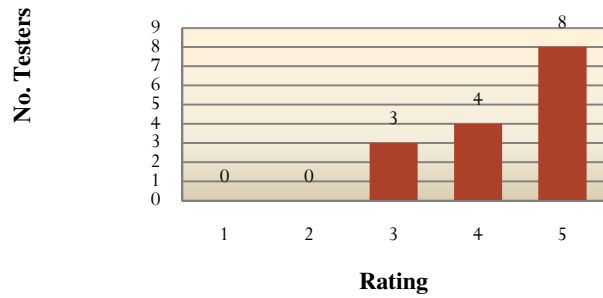
**How easy did you find learning the concepts?**



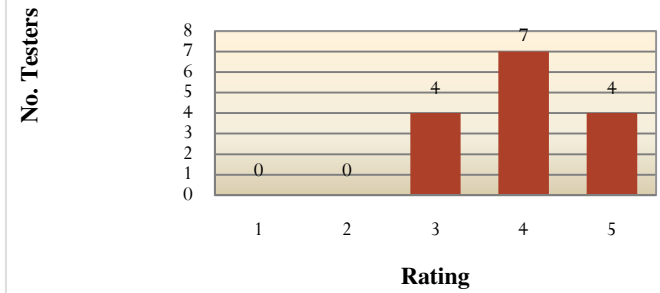
**What is your overall appreciation of the VisualAORE DSL?**



**Do you consider the tool helpful?**



**How easily did you create the AORE model?**



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## Related work

- A. Dias V. Amaral. J. Araujo, “A Domain Specific Language for KAOS”, RCIS’09
- C. Nunes, J. Araujo, V. Amaral , “A Domain Specific Language for the I\* Framework”, ICEIS2009
- **3. R. Monteiro, J. Araujo, V. Amaral, “MDGore: Towards Model-Driven and Goal-Oriented Requirements Engineering”, Poster, RE’10.**



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# Conclusions

- VisualAORE offers a graphical notation/language and a tool to support it;
  - Allow the definition of AORE visual models.
- The approach becomes easier to be used by requirements engineers;
  - The tool enhances the process of modeling requirements for the common Software Engineer.

# Conclusions

- Introduction of the module concept;
  - Produce organized models and enhances its scalability.
- As a future work:
  - Apply the evaluation process to a larger set of users, in an industrial environment;
  - Produce an extension with composition of aspectual viewpoints.

# Questions?