

What do we know about the Defect Types detected In Conceptual Models?



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- Motivation
- Mapping Study
- Quality Models for Conceptual Models
- Classification Scheme for Conceptual Model Defects
- Review Results
- Conclusions & Future Work

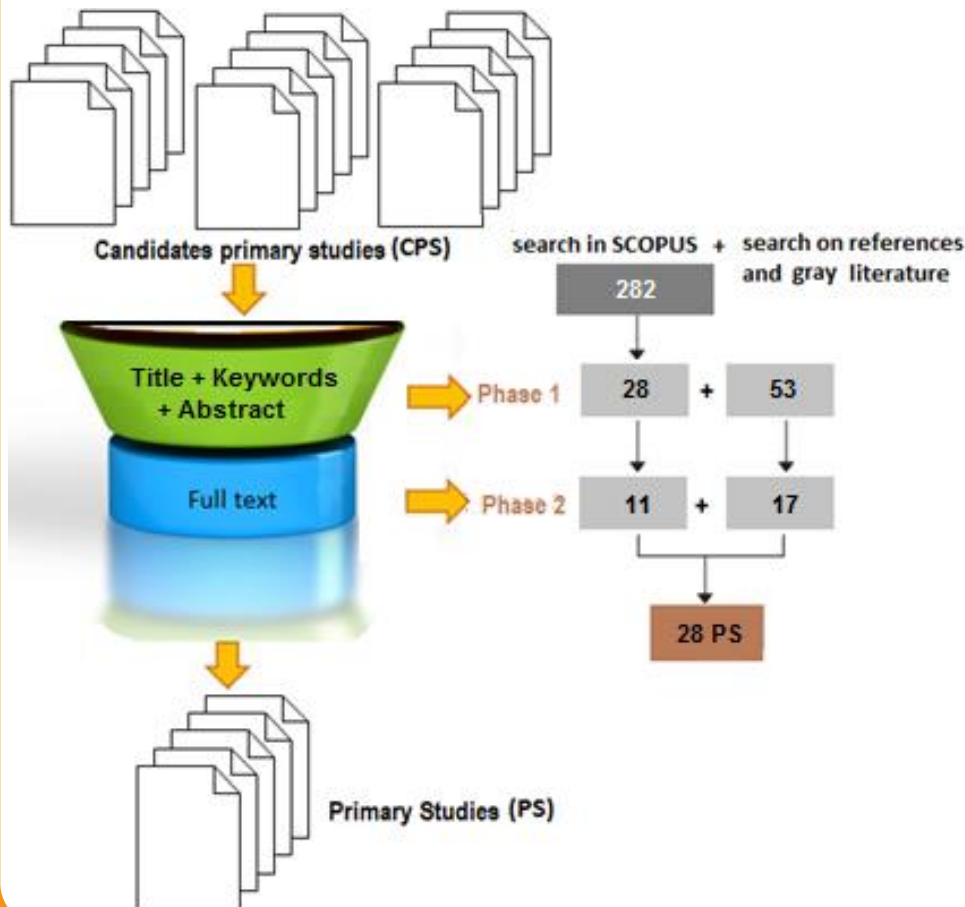
MOTIVATION



- Overview of the **type of defects** (classification scheme) that are **reported in the literature** (mapping study) at the **conceptual schema level**
- Determine **how and where** they have been **detected**.

MAPPING STUDY

- RQ1: What defects in UML-based CSs are reported in the literature?
- RQ2: How and where have these defects been detected?



Inclusion criteria	Exclusion Criteria
I1. Papers about defects or faults in CSs based on UML in particular and how or where defects have been detected.	E1. Papers that do not comply with the inclusion criteria presented.
I2. Studies available online.	E2. Informal literature e.g. editorials, keynotes, introductions to/abstract, posters and slides alone.
I3. Studies written in English.	E3. Duplicated reports (the most complete version of the work was included in the review).

- October to December/2014

MAPPING STUDY

To extract defect information from mapping study a **Defect Classification Scheme** was defined with:

- Appropriate (at CS level) defect causes (**sub modes**) related to :
 - a) IEEE std. 1044 (general standard for defects classification)
 - b) Quality Model for Conceptual Schema in MDD.
- **Attributes and defect classification process .**

QUALITY MODEL FOR CONCEPTUAL SCHEMAS

{Mohagheghi et al., 2009 }

Quality Goal (6 classes-6C)	Description
Correctness	Correct statements about the domain; not violating rules and conventions.
Completeness	Information that is relevant and being detailed enough according to the purpose of modelling.
Consistency	No contradictions in the models
Comprehensibility	Understandable by human users or tools
Confinement	agreement with the purpose of modelling and the type of system, and being restricted to the modelling goals
Changeability	Supporting changes or improvements

CLASSIFICATION SCHEME FOR CS DEFECTS

LIST OF DEFECT CAUSES

DEFECT CAUSE (IEEE std. 1044)	SUB MODES	AFFECTED QUALITY GOAL (Mohagheghi)
MISSING	Missing: something is absent that should be present.	Completeness Comprehensibility
WRONG	Inconsistent: contradictions in the models (vertical and horizontal inconsistency)	Correctness Consistency Comprehensibility Confinement
	Incorrect: misrepresentation of concepts about the domain, as well as the violation of the modelling and syntaxis rules.	Correctness Comprehensibility
	Ambiguous (wrong wording): The representation is unclear, and could cause a user to misinterpret or misunderstand the meaning of the concept.	Correctness Consistency
UNNECESSARY	Redundant: if an element has the same meaning that other element in the model.	Confinement
	Extraneous: items belong to another level of abstraction (e.g. details of implementation)	Confinement Changeability

CLASSIFICATION SCHEME FOR CS DEFECTS

DEFECT CLASSIFICATION PROCESS (WITH ATTRIBUTES)

PHASE: DEFECT RECOGNITION (1/2)

{Freimut , 2001}

- **Sub mode:** What is missing, inconsistent, incorrect, ambiguous, redundant, or extraneous?
- **Description:** How did the defect manifest itself? (e.g. missing class)
- **Modelling Element:** Which diagram element contains the defect? (e.g. class, association, message)

CLASSIFICATION SCHEME FOR CS DEFECTS

PHASE: DEFECT RECOGNITION (2/2)

- **Diagram Level:** What does level of the diagram is affected? (specification or instance)
- **Diagram Type:** Which diagram contained the defect? (e.g. CD, SD)
- **References:** Where (paper) was reported the defect?

CLASSIFICATION SCHEME FOR CS DEFECTS

PHASE: IMPACT IDENTIFICATION

- **Priority:** What is the importance of resolving the defect?
- **Severity:** How severe is the defect with respect to quality of conceptual schema? (e.g. high, medium)

CLASSIFICATION SCHEME FOR CS DEFECTS

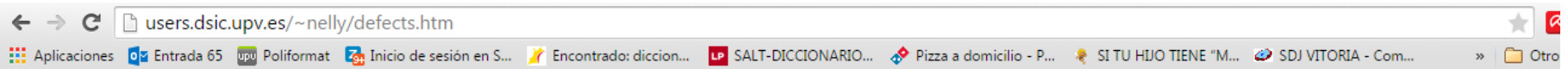
PHASE: DETECTION INVESTIGATION

- **Technique Type:** Which type of technique can detect it? (e.g. static)
- **Detection Mechanism:** Which is the detection mechanism used by the technique? (e.g. automated inspection, checking consistency rule)
- **Tool Support:** What does tool can detect/resolve/prevent it? (i.e. tool name)



CLASSIFICATION SCHEME FOR CS DEFECTS

- 226 reported defects were identified and classified in 100 different defects.



What do we know about Defect Types detected in Conceptual Models?

María Fernanda Granda, Nelly Condori-Fernández, Tanja E.J. Vos, Oscar Pastor

Mode	Defect ID	Description	Modelling Element	Diagram Level	Diagram Aspects	Diagram Type		View Type	Priority	Severity	Detection Technique	Type of detection technique	Technique Purpose	Detection Mechanism	Support Tool	References
						Structural Diagrams	Behavioral Diagrams									
MISSING	D1.1	Missing Class specification	Class	specification	Structural	CD	-	Single view	-	-	Verification	Static	Detect	Manual Inspection	-	[PS19]
	D1.2	Missing Constraint definition	Constraint	Specification	Behavioral	CD	SD, AD, ComD	Single view	-	-	Validation	Static	Detect, resolve	checking OCL constraints, analysis of the Dependency Graph + reasoning procedure based in logic, Automated Inspection	EinaGMC, Design Advisor	[PS1], [PS23], [PS6]
	D1.3	Missing flow	link	specification	Structural	-	AD	Single view	-	-	Verification, Validation	Dynamic	detect	testing by model simulation	ADSim	[PS28]
	D1.4	Missing Attribute specification	Property	specification	Structural	CD	-	Single view	-	-	Verification	Static	Detect	manual inspection	-	[PS19]
	D1.5	Missing Association specification	Association	specification	Structural	CD	-	Single view	-	-	Verification, Validation	Static	Detect	manual inspection	-	[PS19]



REVIEW RESULTS

- **RQ1:** What defects in UML-based CSs are reported in the literature?

Classification of defect types based on quality goals

Mode		Sub modes		Affected Quality Goal
MISSING	= 18 defects	Missing	= 18 defects	Completeness Comprehensibility
WRONG	= 182 defects	Inconsistent	= 75 defects	Correctness Consistency Comprehensibility Confinement
		Incorrect	= 95 defects	Correctness Comprehensibility
		Ambiguous	= 12 defects	Correctness Consistency
UNNECESSARY	= 26 defects	Redundant	= 20 defects	Confinement
		Extraneous	= 6 defects	Confinement Changeability
TOTAL	226 defects		226 defects	

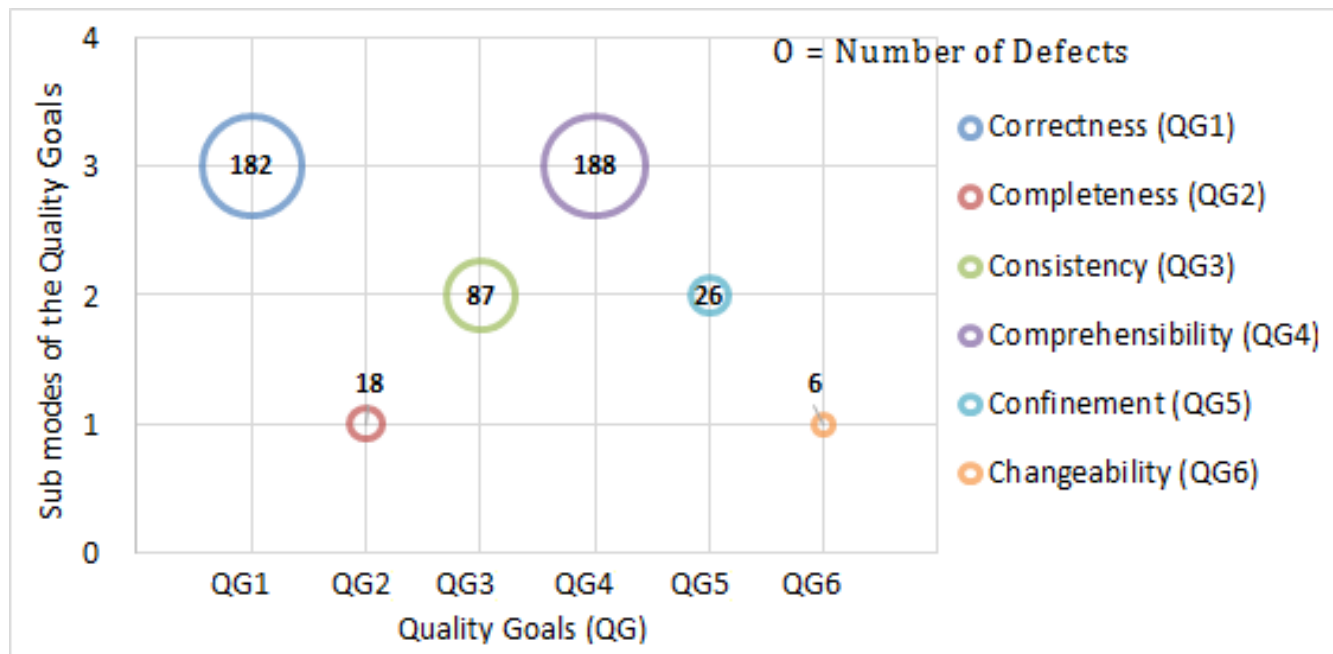
Most commonly reported defect is the “**Wrong**” type (81%).

Most frequently reported sub-modes are: **Incorrect** (42%) and **Inconsistent** (33%).

REVIEW RESULTS

- **RQ1:** What defects in UML-based CSs are reported in the literature?

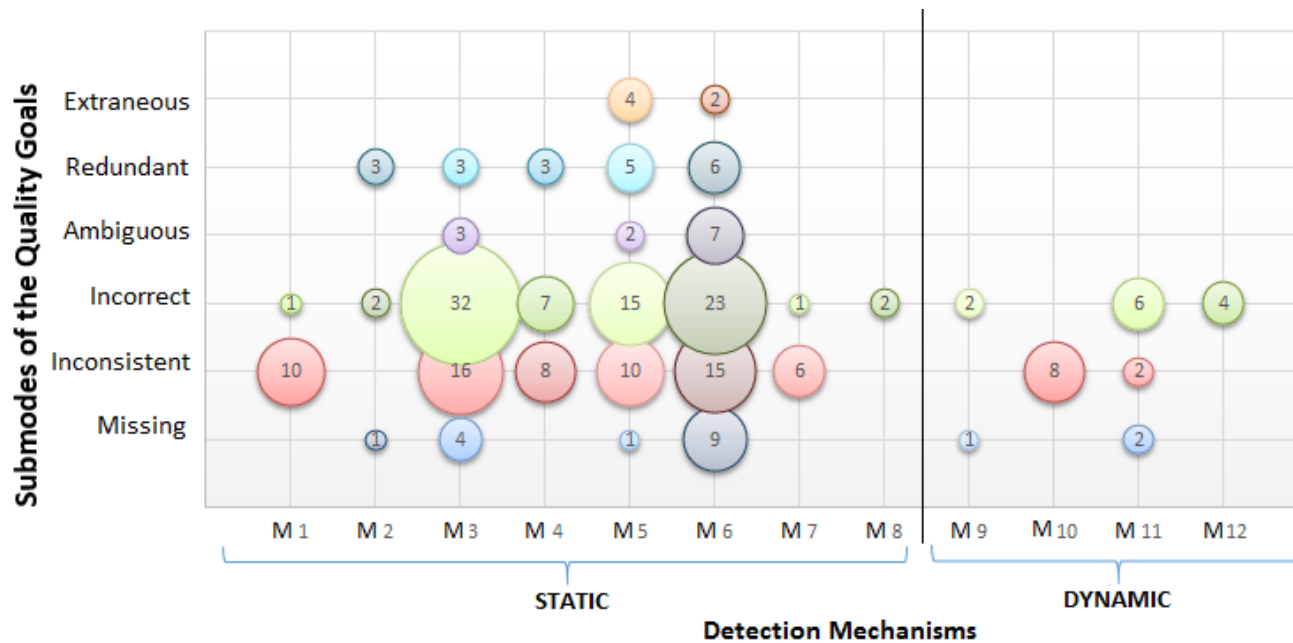
Classification of defect types based on quality goals



Correctness (QG1) and **Comprehensibility (QG4)** are the quality properties with most types of identified defects in the mapping study.

REVIEW RESULTS

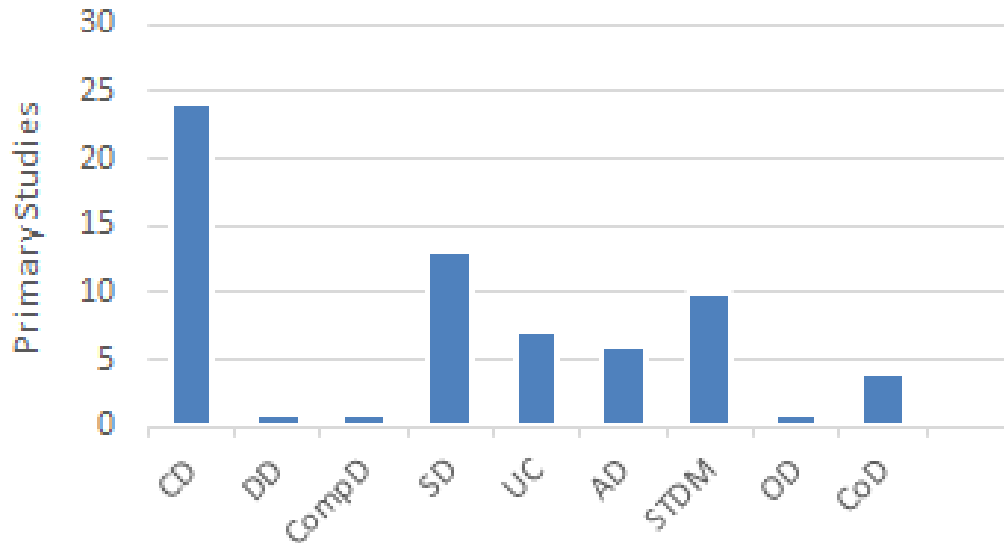
- **RQ2:** How and where have these defects been detected?



Most of the defects (**82%**) were detected by **static techniques**. From the static techniques that were used, **61%** were **automated by tools**.

REVIEW RESULTS

- **RQ2:** How and where have these defects been detected?



UML diagrams used in the Conceptual Schemas

Class diagram (CD) is used in most primary studies (86%)

Structural part of the CS is the part most often used for detecting defects.

- 100 different elements founded.
- **Generalization, Property and Class** elements are the most affected modelling elements (12 defects, 11 and 10 defects).

CONCLUSIONS

RQ1: What defects in UML-based CSs are reported in the literature?

- Tendency is to report defect types “**Wrong**” (e.g. incorrect) rather than the “Missing” or “Unnecessary” types.

RQ2: How and where have these defects been detected?

- Mainly use of techniques based on **static analysis**, (specification analysis).

Complete, well-documented and evaluated list of defect types at the CS level is still lacking.

Our classification scheme (submodes, attributes, process) is highly usable and complete.

FUTURE WORK

- This paper is a **part of a more extensive research work (testing solution)**.
 - Clarify **which defect types** can be found **with testing techniques**.
 - Know which **parts of a CS** are **most defect-prone**.
 - **Prioritize defects**.



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