OQUARE

A SQUaRE-based Quality Evaluation Framework for Ontologies

Astrid Duque-Ramos

Jesualdo Tomás Fernández-Breis

Robert Stevens

Nathalie Aussenac-Gilles

Ontology Summit 2013: Ontology Evaluation Across the Ontology Lifecycle

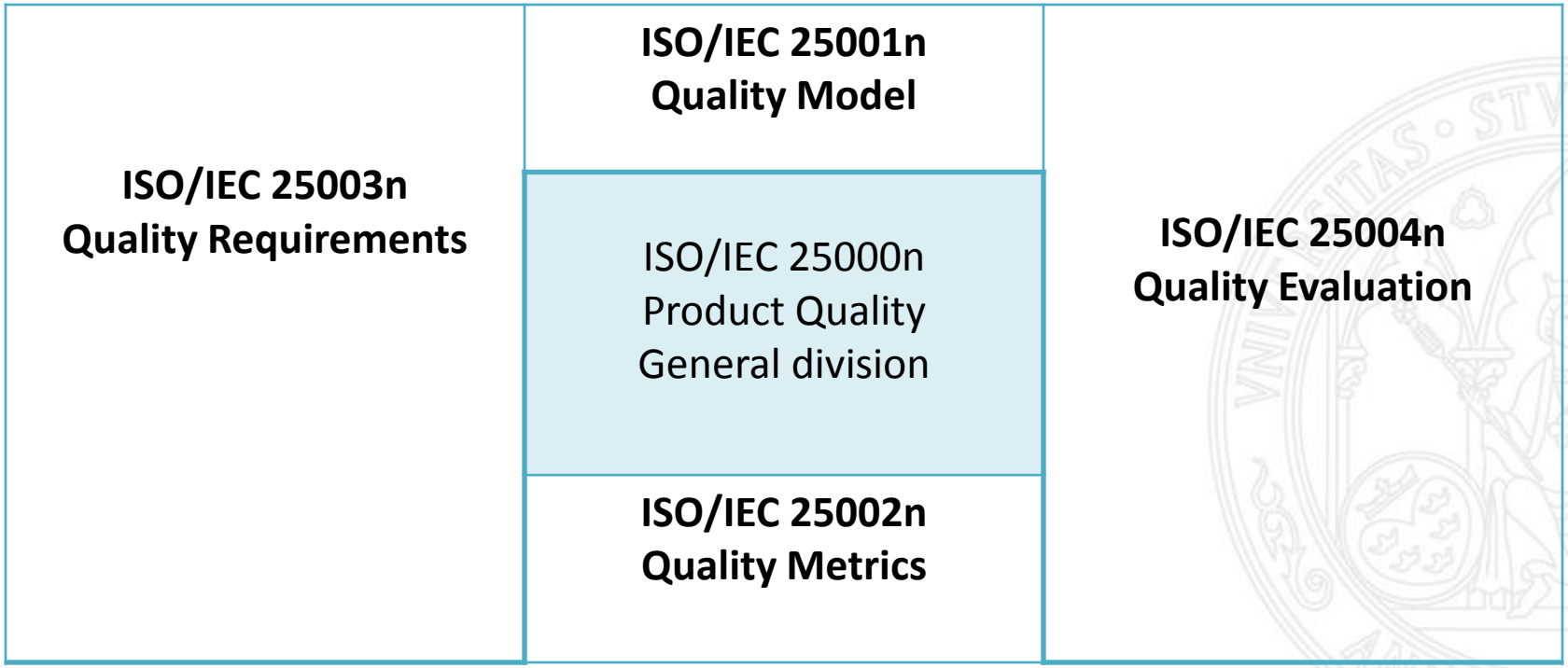
January, 31th, 2013

UNIVERSIDAD DE MURCIA

SQuaRE: Standard for software product Quality Requirements and Evaluation (ISO 25000)

- Comprehensive specification and evaluation model
- Common language for specifying user requirements
- It is based on observation
- It makes quality evaluation reproducible

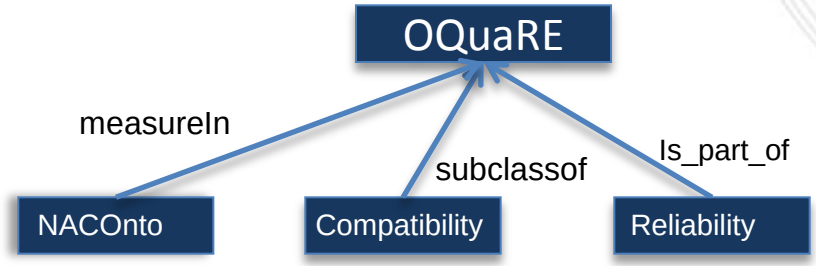
UNIVERSIDAD DE MURCIA



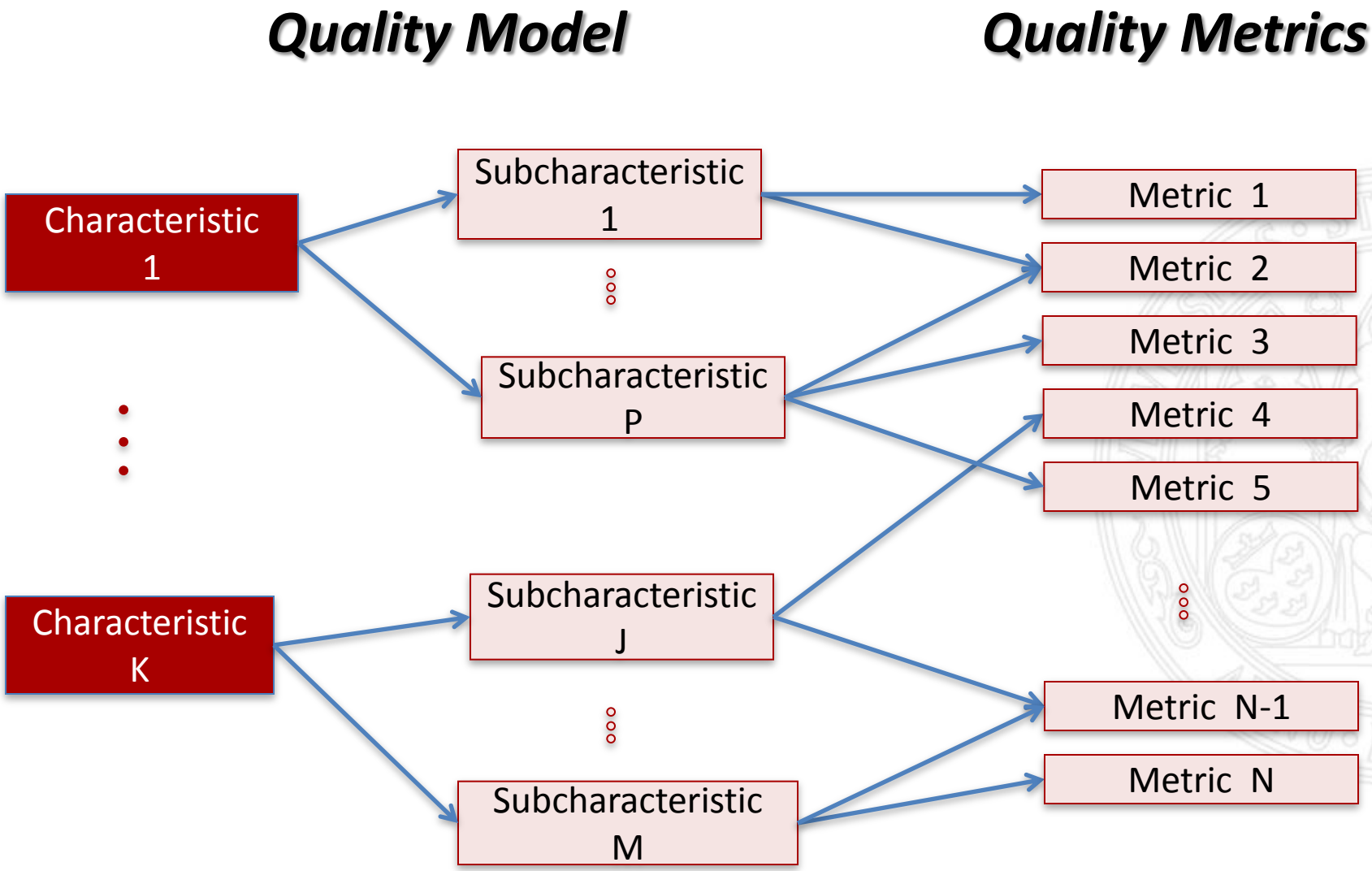
OUR GOAL

UNIVERSIDAD DE MURCIA

- Adapting SQuaRE to ontology evaluation
  - Identifying strengths and flaws of the ontologies
  - Supporting users and developers in making informed decisions



Outline of Quality Model and Quality Metrics



OQUARE
Quality Model

UNIVERSIDAD DE MURCIA

Detailed information: http://miuras.inf.um.es/evaluation/oquare

Origin of the quality metrics

- Adaptation from software metrics
  - Coupling between objects
  - Weighted method count
- Reuse of ontology metrics
  - Cohesion (Yao, Orme, and Etzkorn (2005))
  - Metrics from Tartir and Arpinar (2007)

UNIVERSIDAD DE MURCIA

- Notation
  - C1;C2; …Cn: Classes in the ontology.
  - R_{C1};R_{C2}; …R_{Ck}: Relationships of each class Ci.
  - P_{C1}; P_{C2}; …P_{Cz}: Properties of each class Ci.
  - I_{C1}; I_{C2}; …I_{Cm}: Individuals of each class Ci.
  - Sup_{C1};Sup_{C2}, ... ,Sup_{Cm},: Direct superclasses of a given class C.
  - Thing: Root class of the ontology.

UNIVERSIDAD DE MURCIA

Some adapted software metrics

Coupling Between Objects: $CBOnto = \sum \left| Sup_{Ci} \right| / \sum (|C_i| - \left| R_{Thing} \right|)$

Depth of Inheritance Tree: $DITOnto = Max \sum \left| D_{Ci} \right|$

Weighted Method Count: $WMCOnto = \left(\sum \left| R_{Ci} \right| + \sum \left| R_{Ci} \right| \right) / \sum \left| C_i \right|$

Number of Ancestor Classes: $NACOnto = \sum \left| Sup_{leafi} \right| / \sum \left| C(leaf)_i \right|$

UNIVERSIDAD DE MURCIA

Some reused ontology metrics

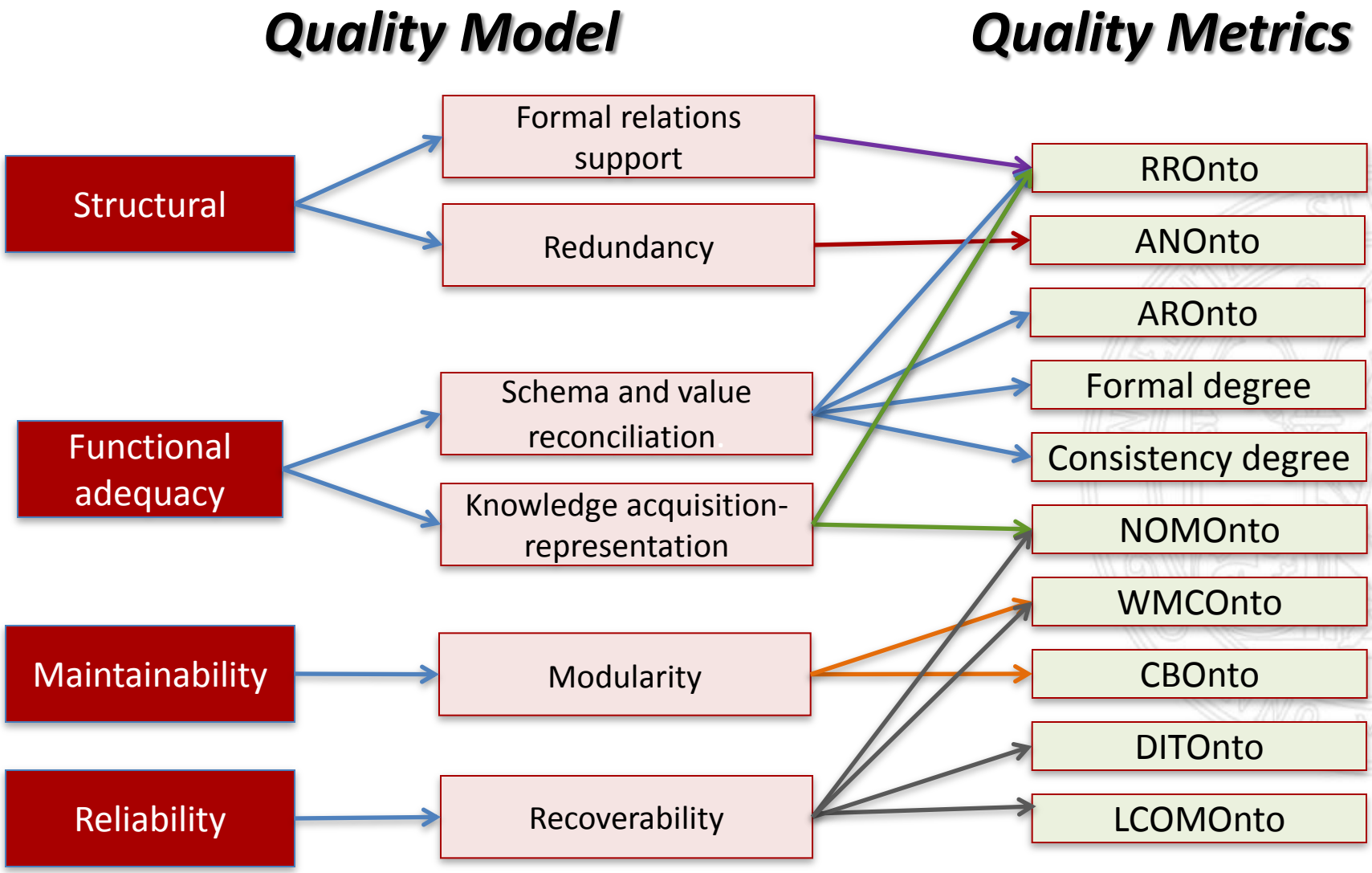
Attributes Richness: $AROnto = \sum |Att_{Ci}| / \sum |C_i|$

Relationships per class: $INROnto = \sum |R_{Ci}| / \sum |C_i|$

Number of properties: $NOMOnto = \left(\sum |P_{Ci}|\right) / \sum |C_i|$

Annotations Richness: $AnOnto = \left(\sum |An_{Ci}|\right) / \sum |C_i|$

Association between Quality Model and Quality Metrics



Getting scores from the value of the metrics

- SQuaRE scores are in the range [1,5]
  - *1: not acceptable*
  - *3: minimally acceptable*
  - *5: exceeds the requirements*
- Values of the metrics are mapped onto [1,5]
- Higher values do not always mean higher quality

UNIVERSIDAD DE MURCIA

Definition of the value mappings following best practices

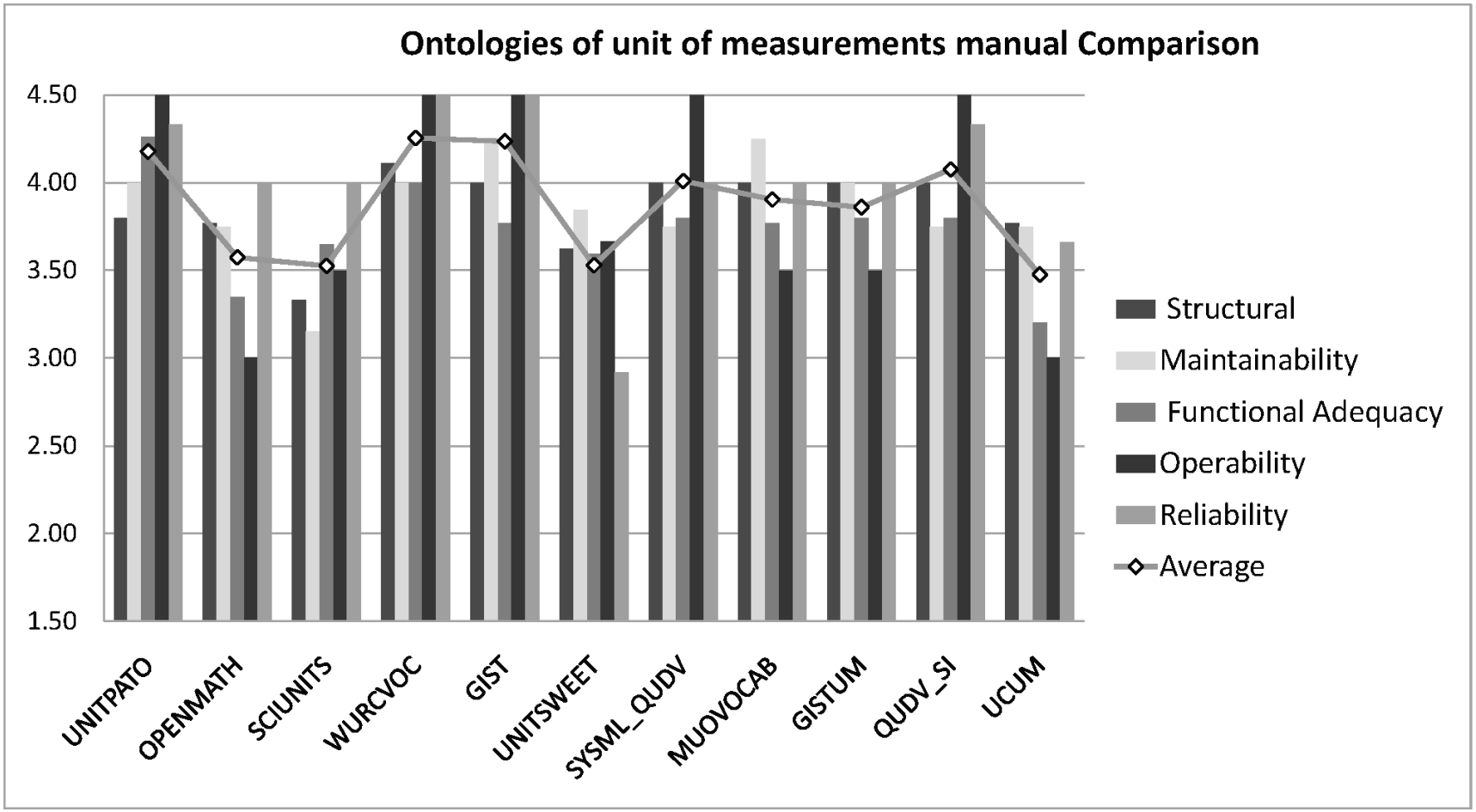
Scale / Metric	1	2	3	4	5
LCOMOnto	> 8	(6-8]	(4,6]	(2, 4]	<=2
WMCOnto	> 15	(11,15]	(8,11]	(5,8]	<=5
DITOnto	> 8	(6-8]	(4,6]	(2, 4]	[1,2]
NACOnto	> 12	(8-12]	(6,8]	(3,6]	[1,3]
RROnto	[0,20]%	(20-40]%	(40-60]%	(60-80]%	> 80%
AROnto	[0,20]%	(20-40]%	(40-60]%	(60-80]%	> 80%
INROnto	[0,20]%	(20-40]%	(40-60]%	(60-80]%	> 80%

UNIVERSIDAD DE MURCIA

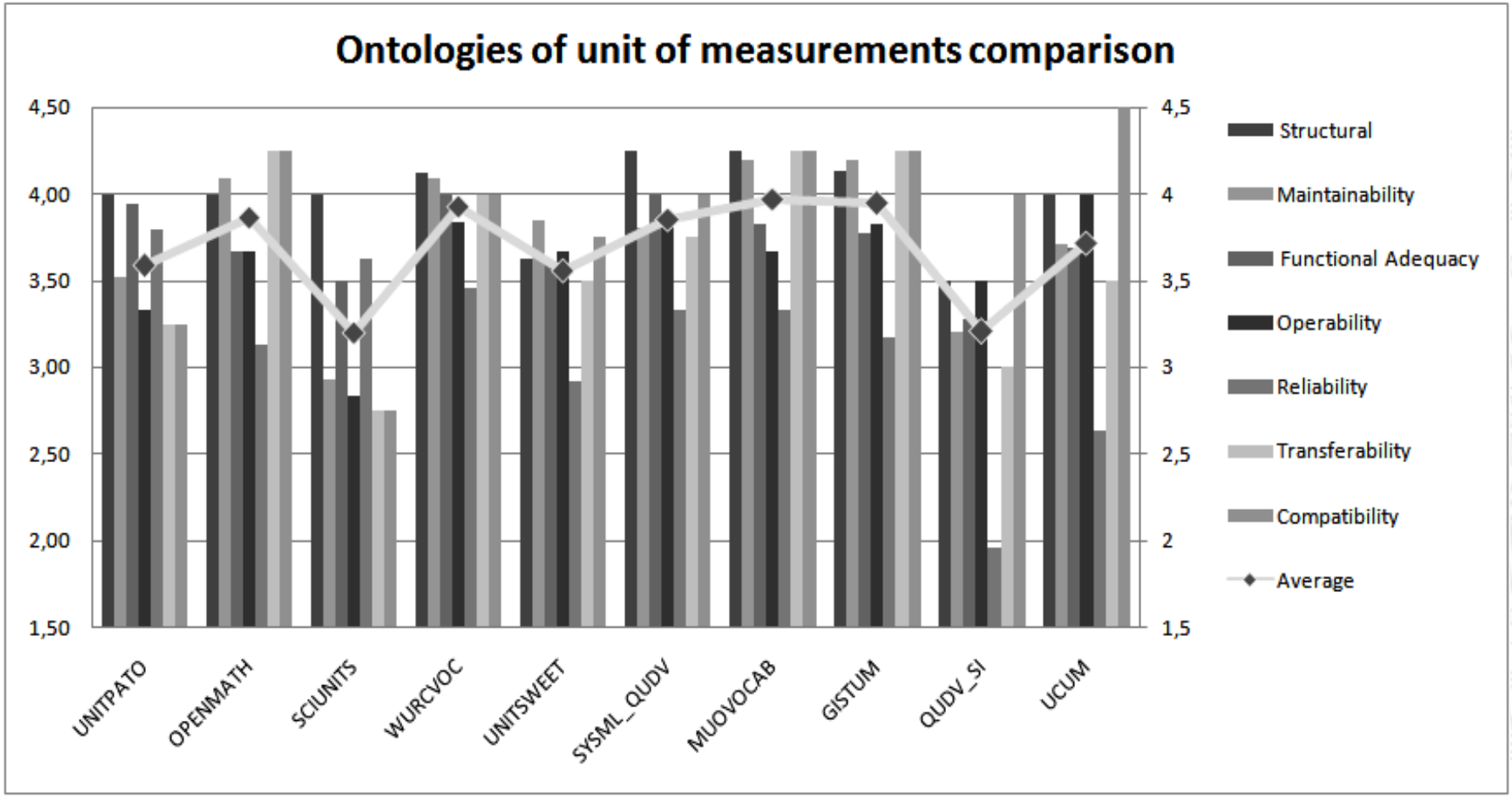
- **Cell type ontology**: Two versions of CTO
- **Units of Measurements:** Ten Unit of Measurements Ontologies

Main results of each case study available at http://miuras.inf.um.es/evaluation/oquare

Manual evaluation of Unit Masurement



Automatic evaluation of Unit Masurement



UNIVERSIDAD DE MURCIA

- Similar scores in both evaluations

- Findings about the ontologies
  - Highest score has been obtained for the structural and functional adequacy characteristics
  - Lowest score for reliability and operability.
  - ontologies require more effort to be used, understood and learnt

EVALUATION OF THE FRAMEWORK

UNIVERSIDAD DE MURCIA

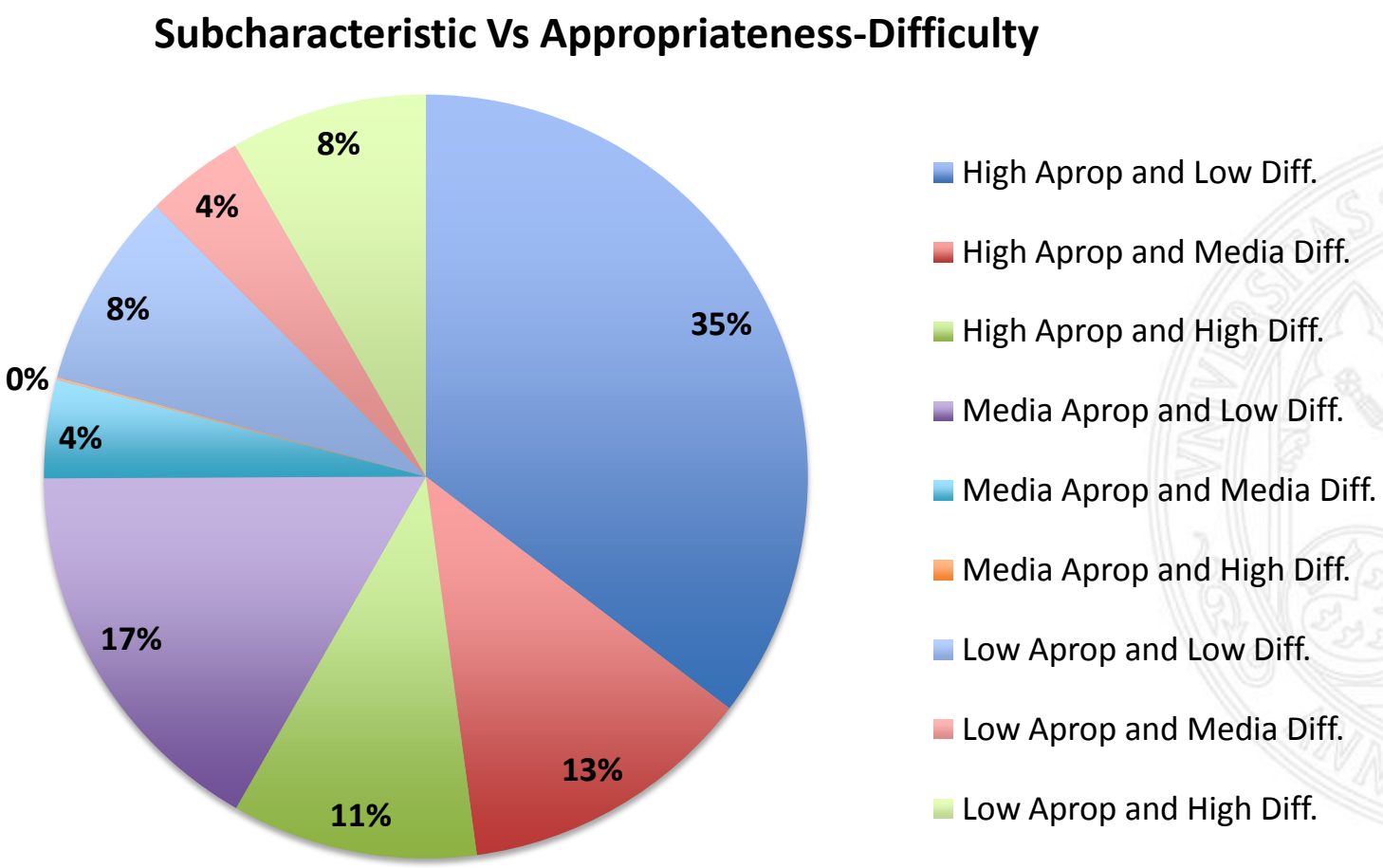
- Preliminary assessment on OQuaRE:
  - Positive and negative aspects of the current version of OQuaRE
  - Completeness and usefulness of the quality metrics
  - Independent experts on biomedical ontologies: Stefan Schulz, Michel Dumontier, Mikel Egaña

UNIVERSIDAD DE MURCIA

- Step 1) Manual evaluation
  - Difficulty in understanding some subcharacteristics
  - Need for knowing the intended context of use

- Step 2) Manual evaluation with the support of OQuaRE metrics
  - Difficulty in understanding some metrics because of their definition in an OWL-independent way.
  - Metrics provided additional information to the experts contributing to a more precise understanding of the subcharacteristics.

UNIVERSIDAD DE MURCIA



EVALUATION OF THE FRAMEWORK
Recommendations from the experts

UNIVERSIDAD DE MURCIA

- To define new metrics or new associations between metrics and subcharacteristics
- To have a limited number of metrics per subcharacteristic.
- To distinguish between context dependent and independent metrics
- To divide the structural accuracy into subcharacteristics.

COMMUNITY ACTIONS

UNIVERSIDAD DE MURCIA

- Agreement on subcharacteristics and metrics
- Agreement on interpretation of values of metrics
- Need for metrics for some quality subcharacteristics
- Contributions are welcome
  - http://miuras.inf.um.es/oquarewiki/
  - https://docs.google.com/spreadsheet/viewform?fromEmail=true&formkey=dFlsZGpkbjlHaEk1d0l0RU1oYzVwN0E6MQ

FUTURE WORK

UNIVERSIDAD DE MURCIA

- Adjusting OQuaRE by increasing interaction with the ontology engineering community
- Definition of the quality requirements module for determining potential contexts of use
- Finishing the development of an online tool for ontology evaluation based on OQuaRE

OQUARE

A SQUaRE-based Quality Evaluation Framework for Ontologies

Astrid Duque-Ramos astrid.duque@um.es

Jesualdo Tomás Fernández-Breis jfernand@um.es

Robert Stevens robert.stevens@manchester.ac.uk

Nathalie Aussenac-Gilles aussenac@irit.fr

Ontology Summit 2013: Ontology Evaluation Across the Ontology Lifecycle

January, 31th, 2013