Towards a Total Quality Management in WE

Speaker:
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Outline

- WQA: State of the art
- The SMM
- Empirical Validation of QM
- An Integrated TQM Approach
- WE TQM Automation
- Conclusions

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WQA: State of the Art

SOME FACTS

- Web Engineering is gaining momentum among the research community
  - RIA interfaces, process management, security, architecture, etc. are concerns that have been introduced in the WE community in the last couple of years
- There are mature methodology proposals that come together with stable tools (OO-H, WebML)
  - DEMO WebRATIO

WQA: State of the Art

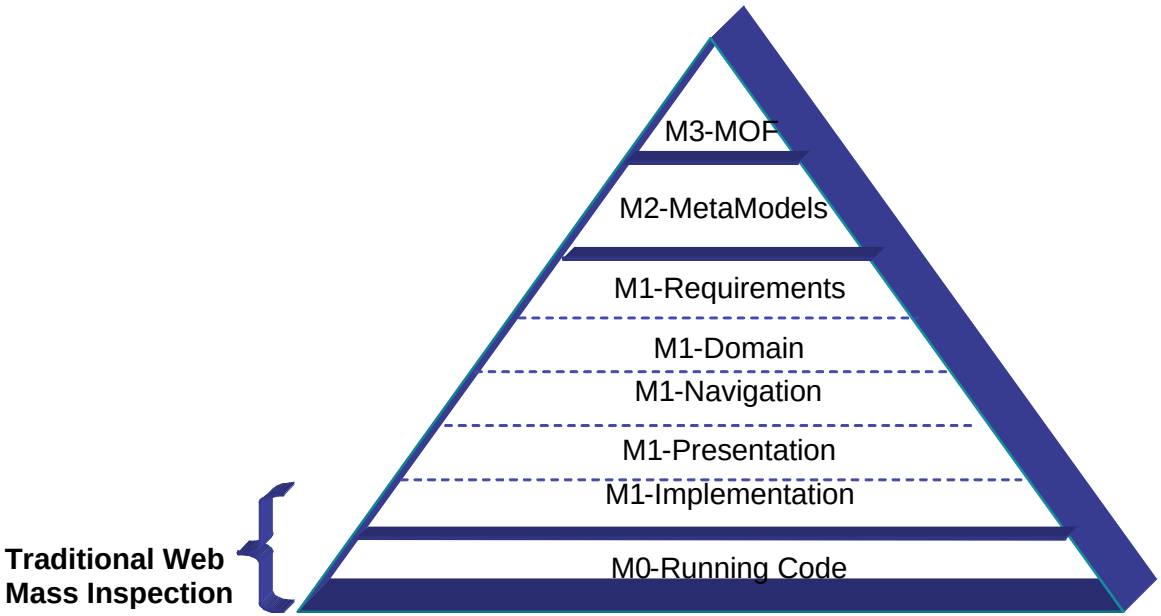
SOME FACTS

- However, the use of WE methodologies and tools is scarce in industry (Lang 2005)
- In addition to learning curve and lack of communication between both communities, we do think that the WE community is **failing to 'prove**' practitioners that the use of methodologies bring in fact advantages in terms of cost and **quality** of the deployed application
  - WE proposals have paid little attention to **Quality in Use** concerns, despite the fact that they are a continuous concern for Web developers, due to the necessity for this kind of applications to keep the audience coming back to the site [Fraternally and Paolini 2000].
    - **Quality in use [ISO 9126]:** efficiency, productivity, security and satisfaction with which users use the application to satisfy specific goals under specific conditions.

WQA: State of the Art

SOME FACTS

- This goes in accordance with the traditional Web Quality assessment perspective, which consists on performing it once the WebApp has already been deployed (mass inspection, automated measures)
  - Before the advent of WE that was only logical, as creative approaches do not provide intermediate products



WQA: State of the Art

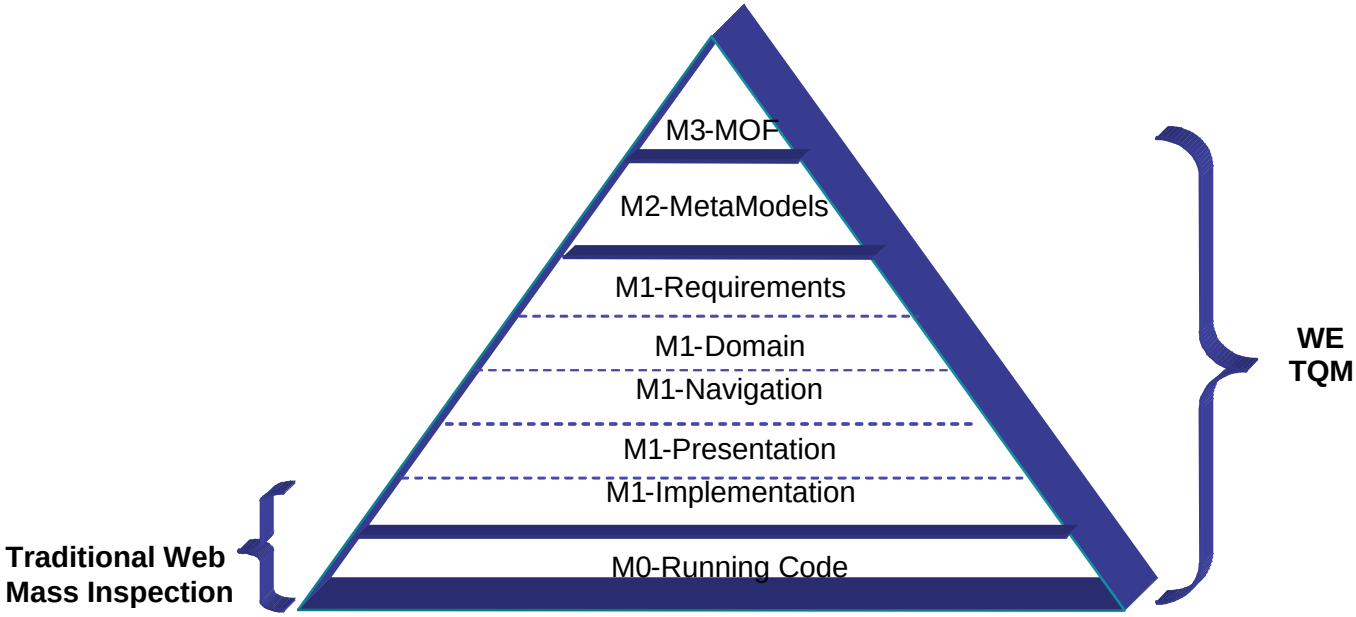
SOME FACTS

- BUT…
  - The cost associated with fixing detected usability problems once the application has already been deployed can be up to 170 times greater than the cost of fixing the same problem had it been identified during the requirements phase [Moody 2003].
- So, can we change this late assessment approach?
  - According to ISO and some empirical evidence, we can.
    - ISO: Several internal characteristics of the Web application are bound to influence this end-user quality perception, namely usability, functionality, reliability and efficiency
      - We leave out maintainability and portability, relevant for other kinds of stakeholders
    - [Ivory and Hearst, 2001]: Quality assessment of Web interfaces with the help of internal measures on implementation artifacts (web pages) matches in some cases up to 80% of the results based on expert evaluation of the same Web pages

WQA: State of the Art

SOME FACTS

- WE artifacts permit to assess quality at higher levels of abstraction
  - From requirements to implementation
  - Such assessment could even be extended to meta-model constructs



WQA: State of the Art

- In order to perform such early quality assurance, we need to know **why**, **what**, **how** and **when** measuring at each level of abstraction... we need a WE Quality Model (QM) and a Quality Evaluation Process
  - Quality Model [ISO 9126]: set of characteristics and the relationships between them which provide the basis for specifying quality requirements and evaluating quality
  - Software Quality Evaluation Process [ISO 14198]: set of activities that must be carried out in order to evaluate software quality, together with the evaluation modules that help in the process

WQA: State of the Art

- There are many standards that may help us to define a Quality Model to evaluate software products
  - Product quality assurance: ISO 9126, ISO 9248, ISO 14102
  - Some well-known quality models that make use of the ISO 9126 standard include
    - Bertoa and Vallecillo (2002): evaluation of COTS components.
    - QUINT2 (Niessink, 2002): evaluation of software architectures
    - Franch and Carvallo (2003) : evaluation of email systems
    - Botella et al. (2003): ERP systems selection
    - Díaz et al. (2004): Portlets usability
    - ...
  - However, most Quality Models specially devoted to the Web define their set of characteristics and subcharacteristics from scratch
    - WQM (Calero et al), PQM (Moraga et al), PDQM (Caro et al), BPQM (Cordoba et al.)

WQA: State of the Art

- Existing QM proposals present some problems
  - Terminology inconsistencies
  - Missing elements
    - **e.g. decision criteria, measure scales and units, …**
  - Tangled coverage of concepts
    - **Different stakeholders and different types of products not explicitly distinguished**.
  - Too cumbersome to apply (too many concepts and measures)
  - Interdependencies between quality factors and/or measures not empirically established
    - coupling vs cohesiveness, learnability vs efficiency, ...
  - Disregard for process quality
  - Lack of integration with current WE practices
  - Lack of tool support

WQA: State of the Art

PARTIAL SOLUTIONS TO QM PROBLEMS

- There is no silver-bullet:
  - Terminology inconsistencies
  - Missing elements
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WE-QM as instantiations of an Ontology-based Software Measurement Meta-Model with additional restrictions…

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… one of such additional restrictions being that WE-QM must be devoted to a single stakeholder, another being that in WE-QM each EntityClass (type of product) represents a different WE artifact

WQA: State of the Art

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QM must be empirically validated to
✓ assure necessity, sufficiency and independence of QM concepts
✓ assure necessity, sufficiency and minimality of measures
✓ assess measures interdependences

WQA: State of the Art

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Specific QM issues should be considered at every stage of the WE process (both intermediate and final product quality assessment)

WQA: State of the Art

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Automation of the approach should be provided (also to maintain the semi-automatic nature of the WE process): follow the MDE paradigm

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The Software Measurement Meta-Model

SOLVING PROBLEMS

- A WE-SMM helps us to reduce:
  - Terminology inconsistencies
  - Missing elements
    - **e.g. decision criteria, measure scales and units, …**
  - Tangled coverage of concepts
    - **Different stakeholders and different types of products not explicitly distinguished**.
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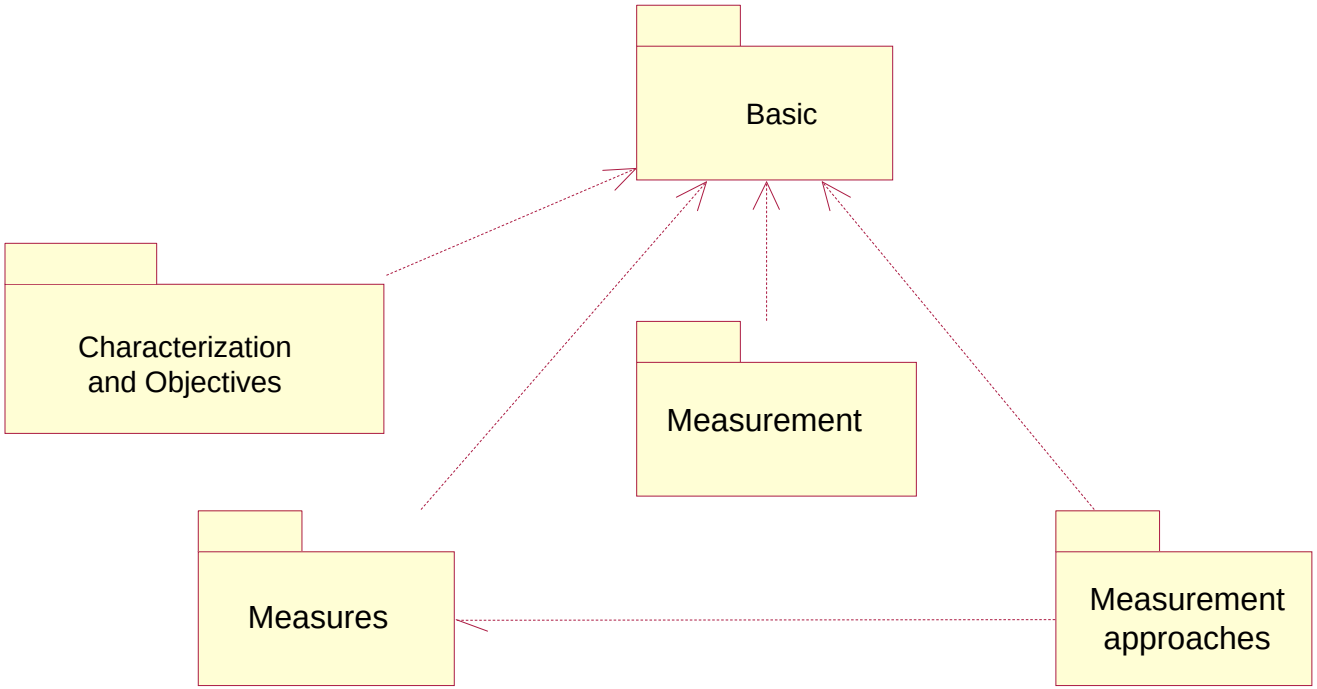
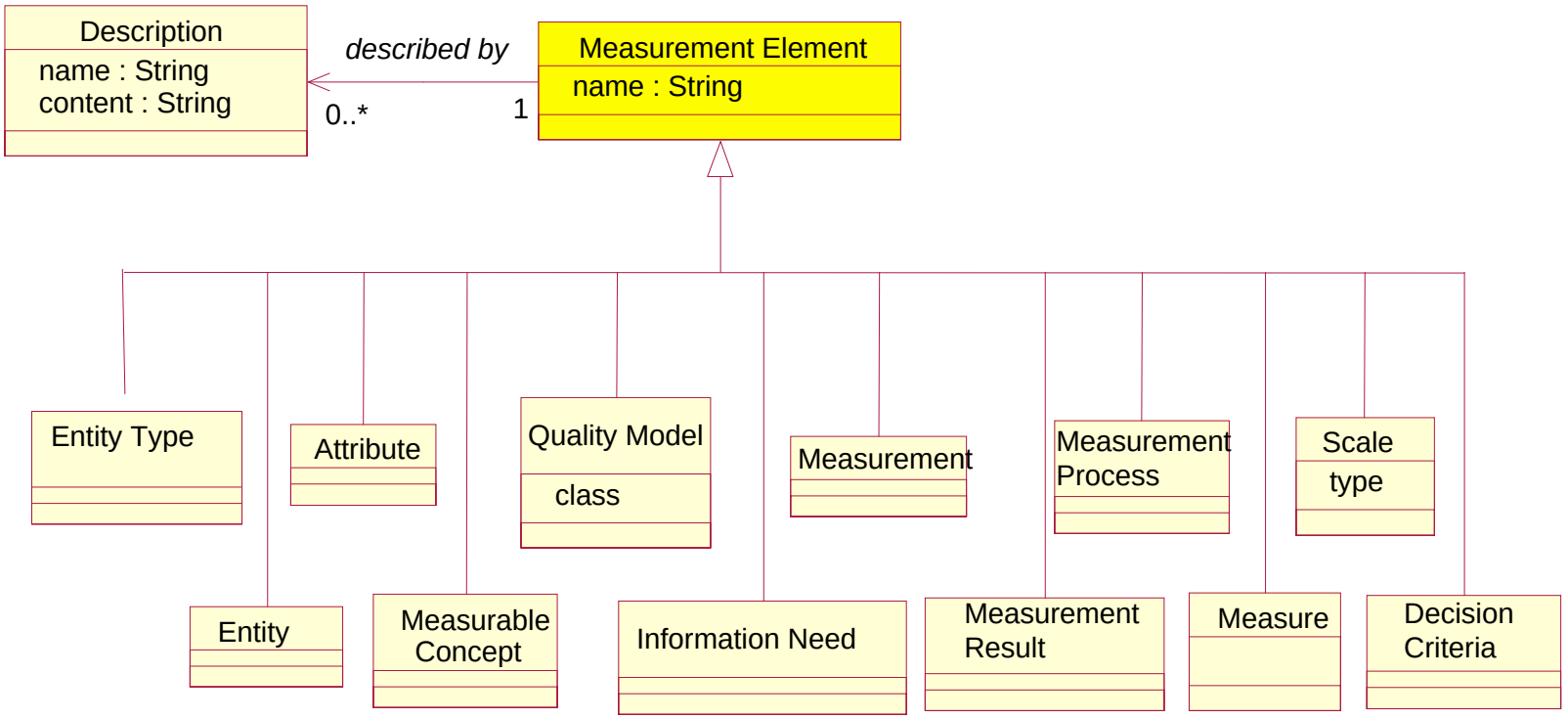
The Software Measurement Meta-Model

GENERAL OVERVIEW



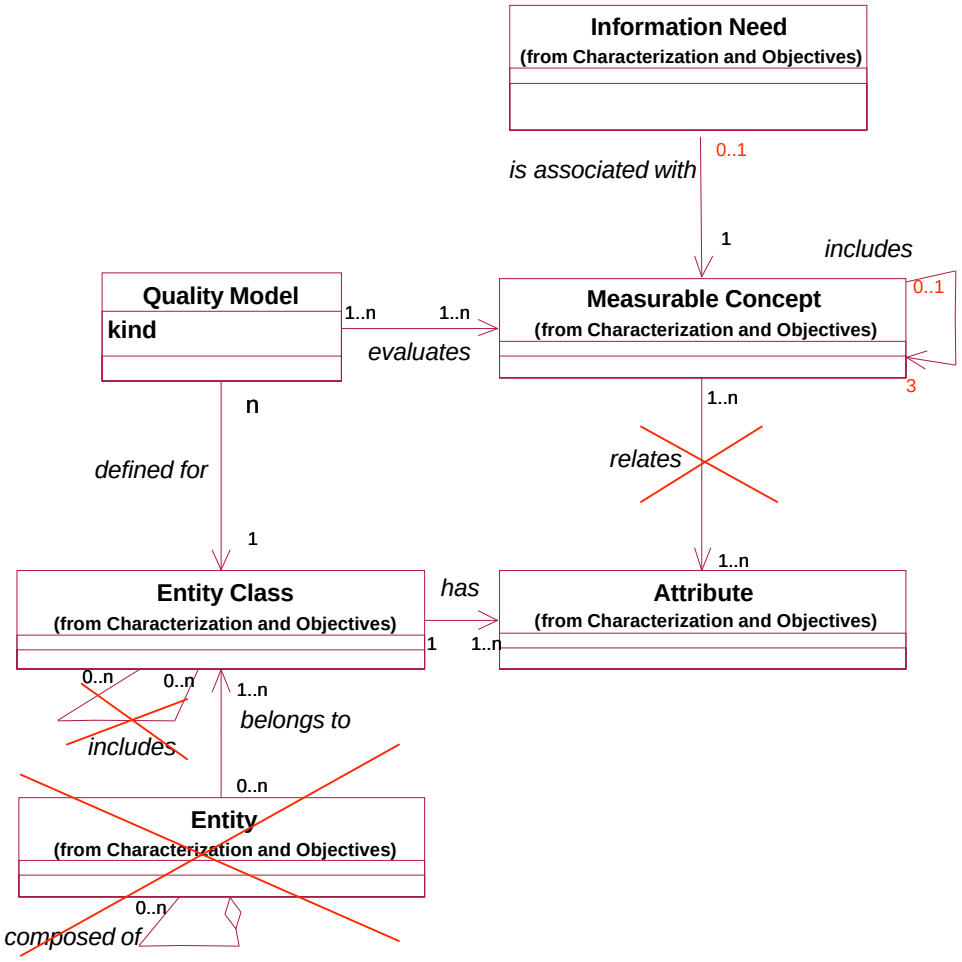
The Software Measurement Meta-Model

BASIC PACKAGE



The Software Measurement Meta-Model

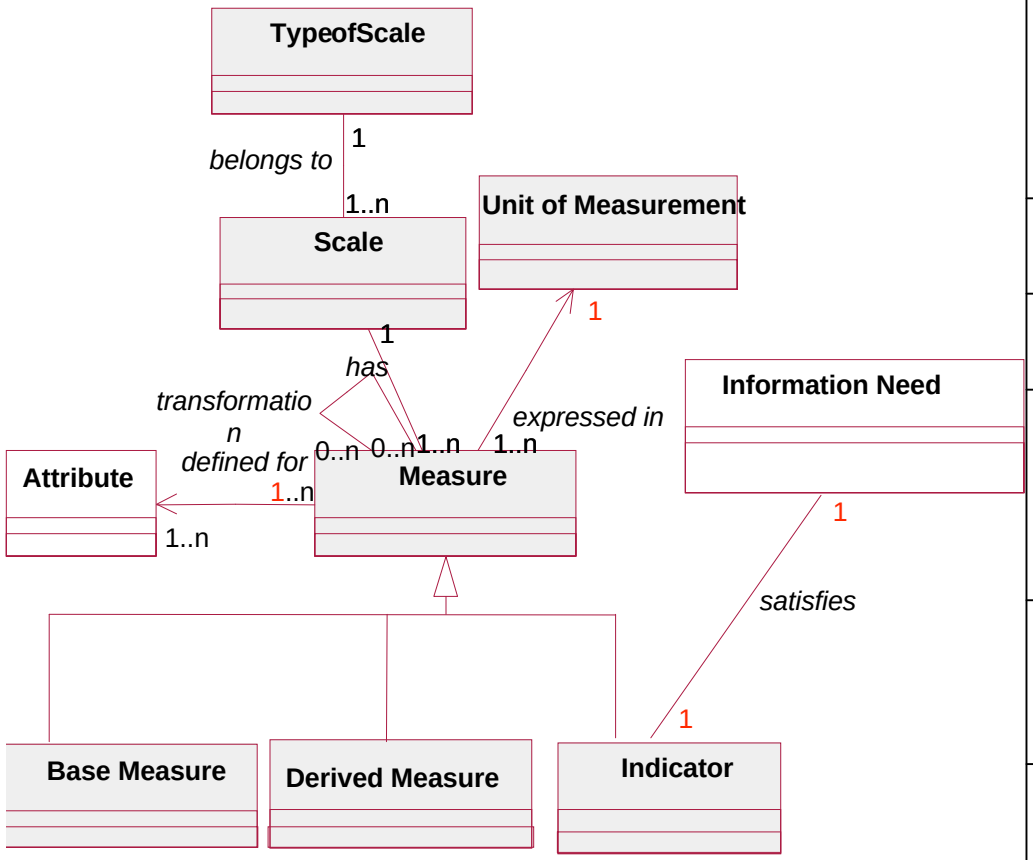
CHARACTERIZATION AND OBJECTIVES



Term	Definition
Information Need	Insight necessary to manage objectives, goals, risks, and problems
Measurable Concept	Abstract relationship between attributes of entities and information needs
Entity	Object that is to be characterized by measuring its attributes
Entity Class	The collection of all entities that satisfy a given predicate
Attribute	A measurable physical or abstract property of an entity, that is shared by all the entities of an entity class
Quality Model	The set of measurable concepts and the relationships between them which provide the basis for specifying quality requirements and evaluating the quality of the entities of a given entity class

The Software Measurement Meta-Model

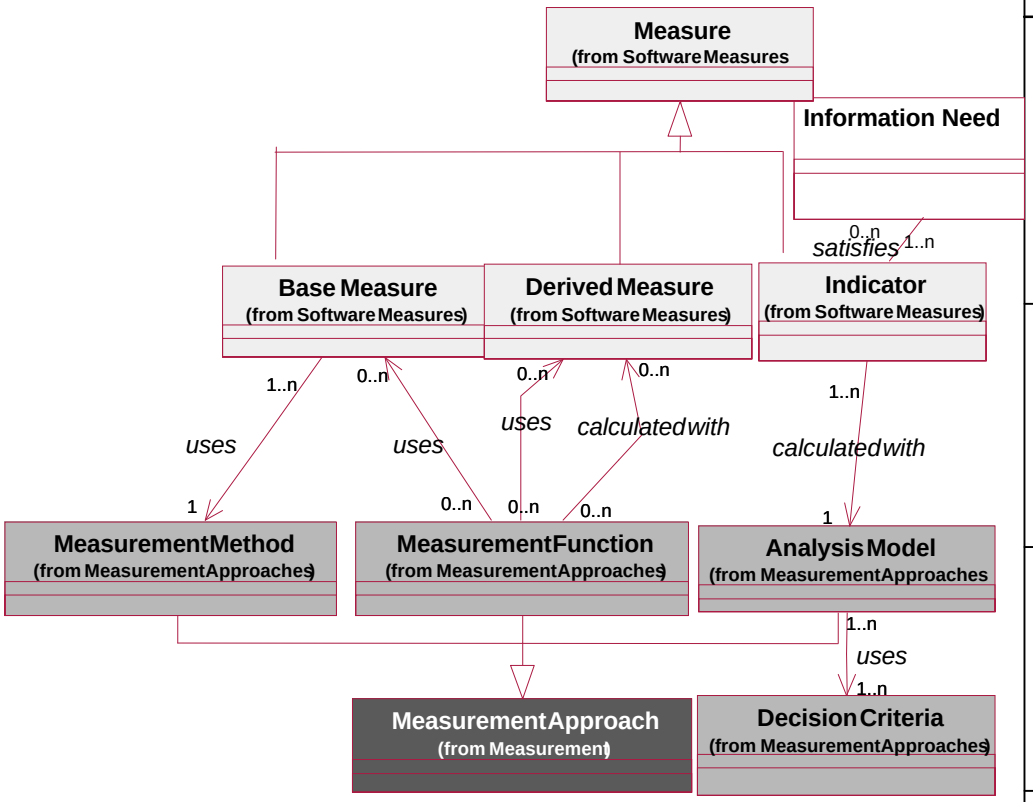
SOFTWARE MEASURES



Term	Definition
Measure	The defined measurement approach and the measurement scale. (A measurement approach is either a measurement method, a measurement function or an analysis model)
Scale	A set of values with de fined properties
Type of Scale	The nature of the relationship between values on the scale
Unit of Measurement	Particular quantity, de fined and adopted by convention, with which other quantities of the same kind are compared in order to express their magnitude relative to that quantity
Base Measure	A measure of an attribute that does not depend upon any other measure, and whose measurement approach is a measurement method
Derived Measure	A measure that is derived from other base or derived measures, using a measurement function as measurement approach
Indicator	A measure that is derived from other measures using an analysis model as measurement approach

The Software Measurement Meta-Model

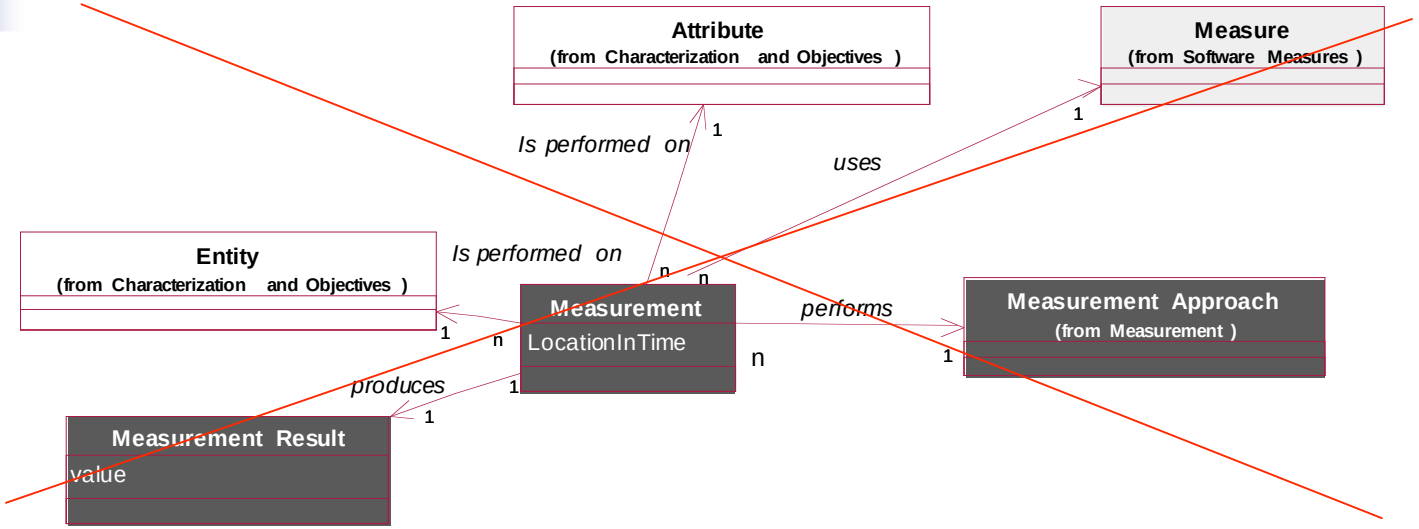
MEASUREMENT APPROACHES



Term	Definition
Measurement Method	Logical sequence of operations, described generically, used in quantifying an attribute with respect to a specified scale. (A measurement method is the measurement approach that defines a base measure)
Measurement Function	An algorithm or calculation performed to combine two or more base or derived measures. (A measurement function is the measurement approach that defines a derived measure)
Analysis Model	Algorithm or calculation combining one or more measures with associated decision criteria. (An analysis model is the measurement approach that defines an indicator)
Decision Criteria	Thresholds, targets, or patterns used to determine the need for action or further investigation, or to describe the level of confidence in a given result

The Software Measurement Meta-Model

MEASUREMENT



Term	Definition
Measurement Approach	Sequence of operations aimed at determining the value of a measurement result. (A measurement approach is either a measurement method, a measurement function or an analysis model)
Measurement	A set of operations having the object of determining the value of a measurement result, for a given attribute of an entity, using a measurement approach
Measurement Result	The number or category assigned to an attribute of an entity by making a measurement

The Software Measurement Meta-Model

WE ADDITIONAL RESTRICTIONS

- Additional Restrictions on QM for WE
  - **Need: Avoid missing concepts**
    - Solution example:
      - Every measure must have a unit of measurement

The Software Measurement Meta-Model

WE ADDITIONAL RESTRICTIONS

- Additional Restrictions on QM for WE
  - **Need: Keep the Quality Model simple and focused**
  - Solutions:
    - One WE QM for each stakeholder
      - **Customers (quality as fulfillment of needs: end product)**
      - **Analysts/Designers (quality as conformance to specification: intermediate products- WE models)**
      - **Developers/Maintainers (quality as conformance to specification: intermediate products- App code)**
      - **Final Users (quality as fulfillment of needs: end product)**
    - Each stakeholder-dependent WE QM divided into WE QM for each WE artifact (Product Type).

The Software Measurement Meta-Model

WE ADDITIONAL RESTRICTIONS

- Additional Restrictions on QM for WE
  - **Need: Keep the Quality Model simple and focused**
  - More Solutions:
    - Only two levels of abstraction permitted in measurable concepts related to a given WE QM.
      - Plus one ‘context’ level that serves to establish the general goal of the quality model by means of the GQM template [Basili Rombach 2003].
    - Attributes for the different models with unique names
      - Name convention: attribute name=initials of model on which it is being measured (RM,DM, etc.)+attribute.
        - E.g. NM_StructuralComplexity
    - Every measurable concept connected to 0..1 information need.
    - Each information need satisfied by a single indicator.
    - Only measurable concepts of 1st level associated to information needs.
    - ...

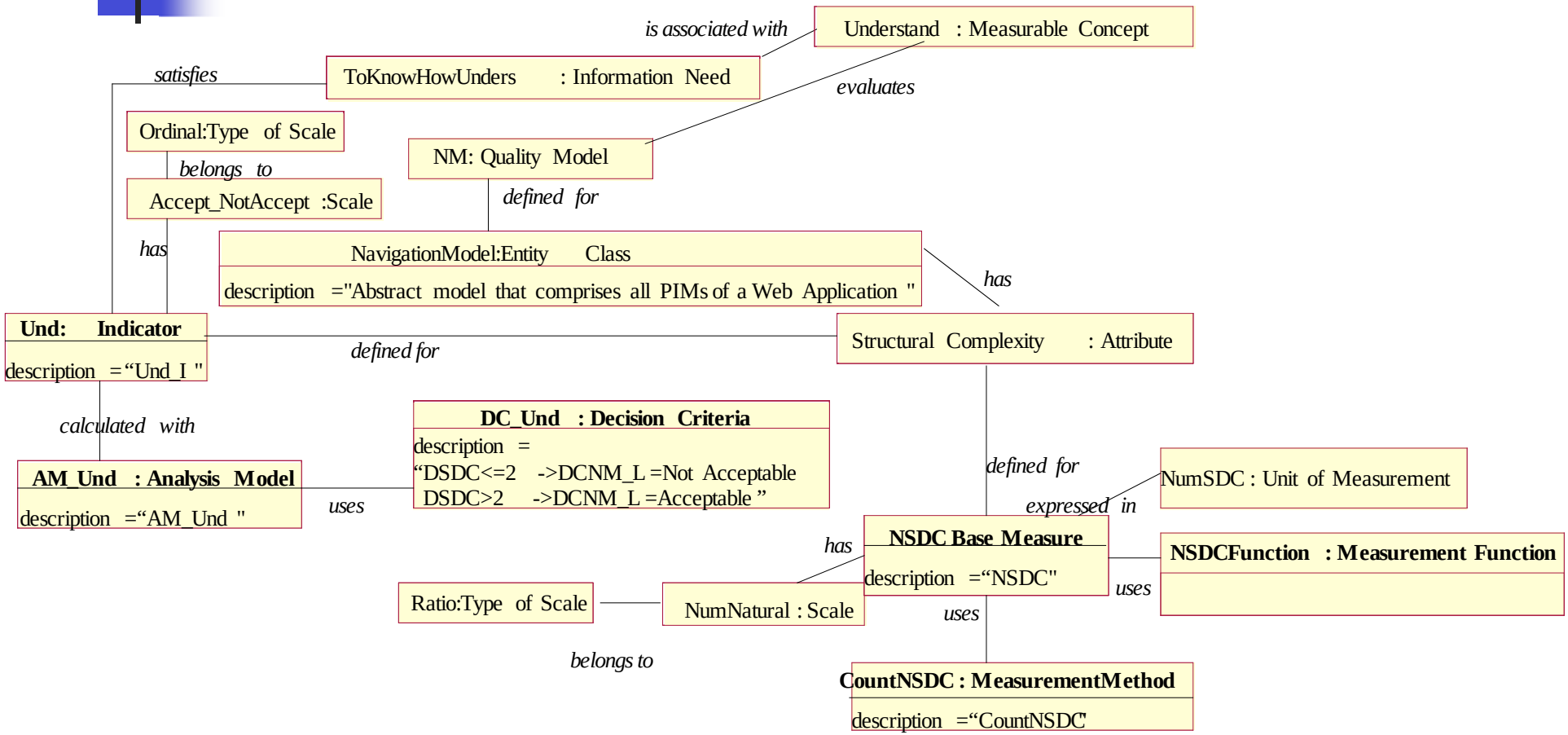
The Software Measurement Meta-Model

EXAMPLE: NAVIGATION USABILITY MODEL

			Navigation Model Attributes				
Characteristic	**Subcharacteristic**	**SubsubCharacteristic**	**Structural Complexity**	**Consistency**	**Semantic Correctness**	**Grouping Density**	**Grouping Cohesiveness**
Usability	**Understandability**	**Readability**	NO	NPC (Navigational pattern coherence)	Number of racing conditions in automatic links	Number of abstract pages	% of origin links that are supported by an structural filter
		Completeness of Description (iso 9126-3	NSDC: Number of supporting domain classes	NO	NO	NO	NO
		Familiarity	**Number of links with Structural Filters**	NO	NO	NO	% of origin links that are supported by an structural filter
		Brevity	Depth of a Navigational Map	NO	NO	Number of links in origin	NO
	Learnability	**Predictability**	Number of links with Structural Filters	NPC (Navigational pattern coherence)	Number of racing conditions in automatic links	NO	% of origin links that are supported by an structural filter
		Memorability	Number of links with Structural Filters	NPC (Navigational pattern coherence)	Number of racing conditions in automatic links	Number of links in origin	% of origin links that are supported by an structural filter
	Operability	**Controllability**	NO	Operation consistency	Number of manual service links	NO	NO
		Capability of Personalization (adaptability/adaptivity)	Number of links with adaptation rules	NO	NO	NO	NO

WE TQM Automation

EXAMPLE: SMM INSTANTIATION



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Empirical Validation of QM

VALIDATION NEEDS

- Measurable Concepts and Attributes in the WE QM must be sufficient, necessary and independent
- Measures in the WE QM must be empirical validated
- Measures must be sufficient, necessary and minimal
- There must be empirical evidence of the connections among concepts and/or between concepts and measures
- There must be empirical evidence of the connections between the quality of intermediate products and the quality in use of the final product (running application)

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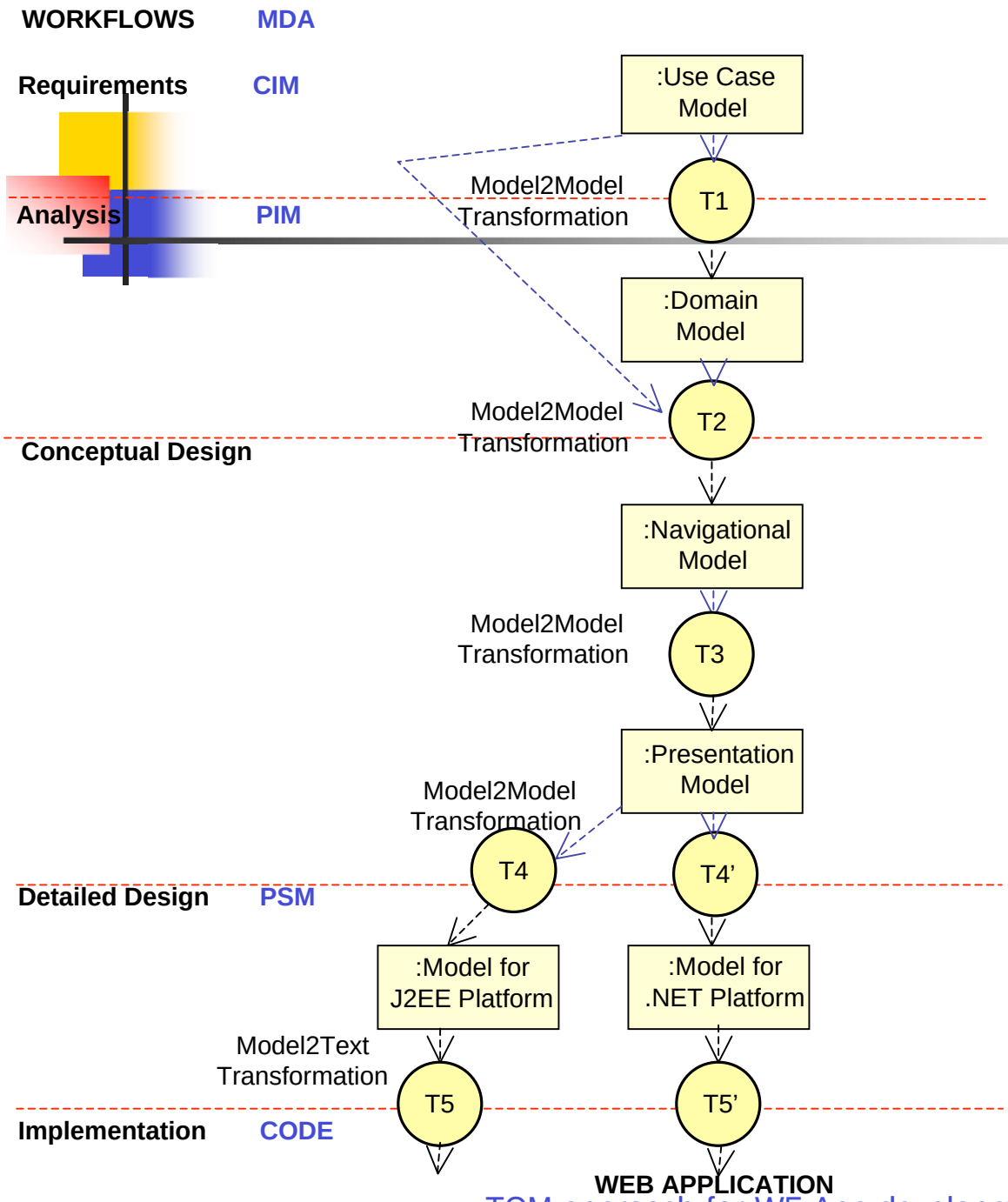
WORKFLOWS
MDA
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PIM
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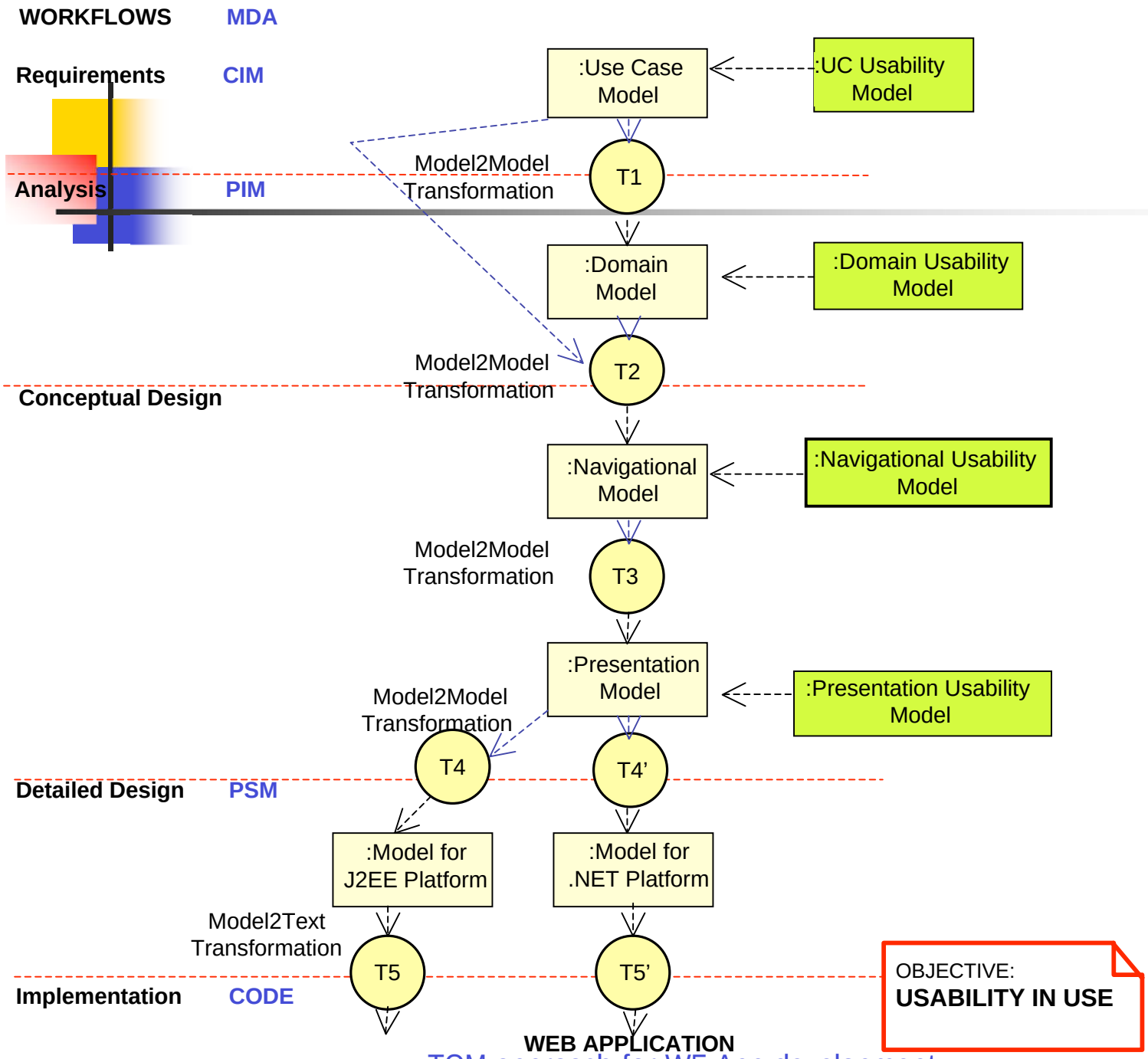
WEB APPLICATION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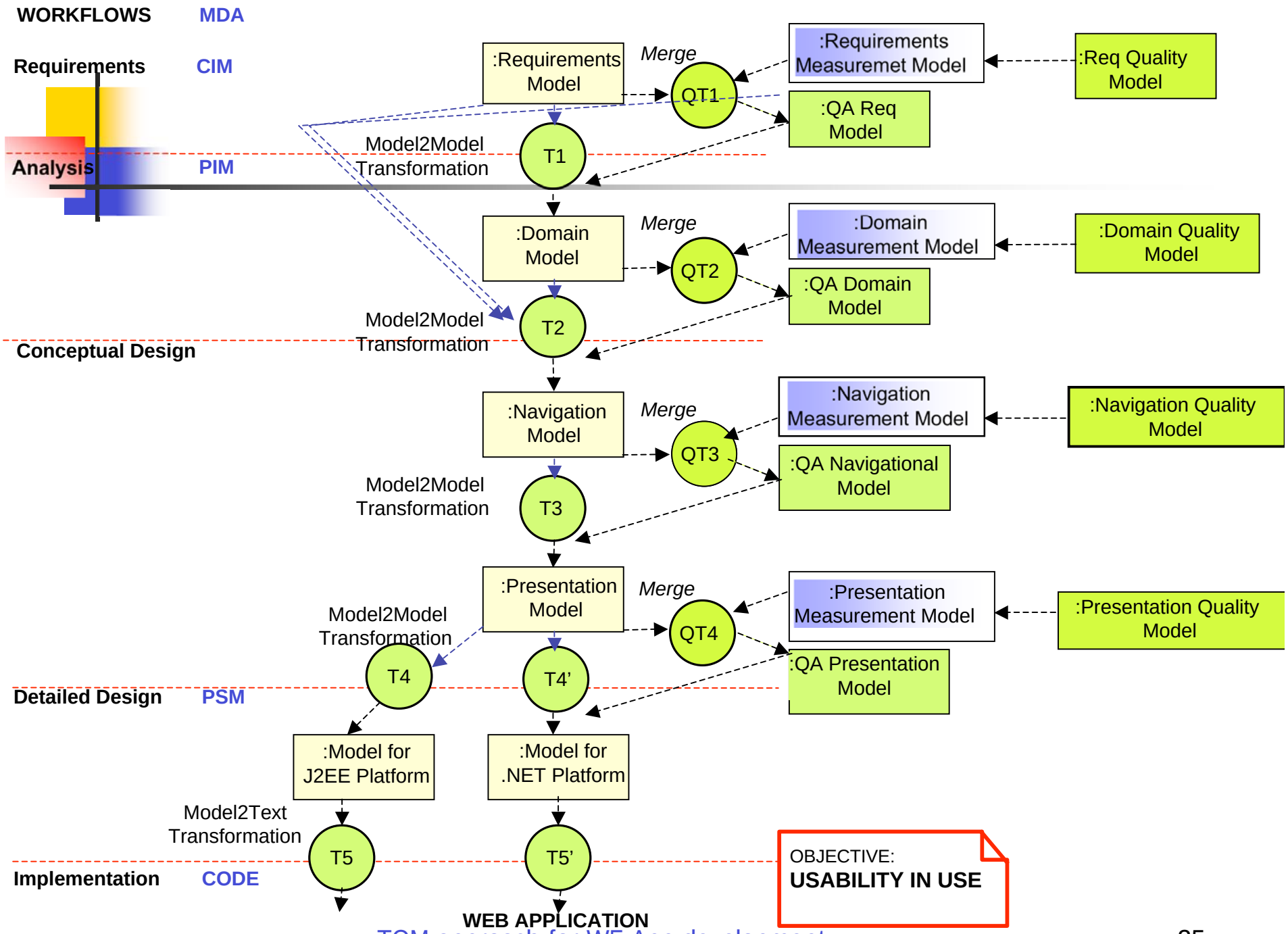
OBJECTIVE:
USABILITY IN USE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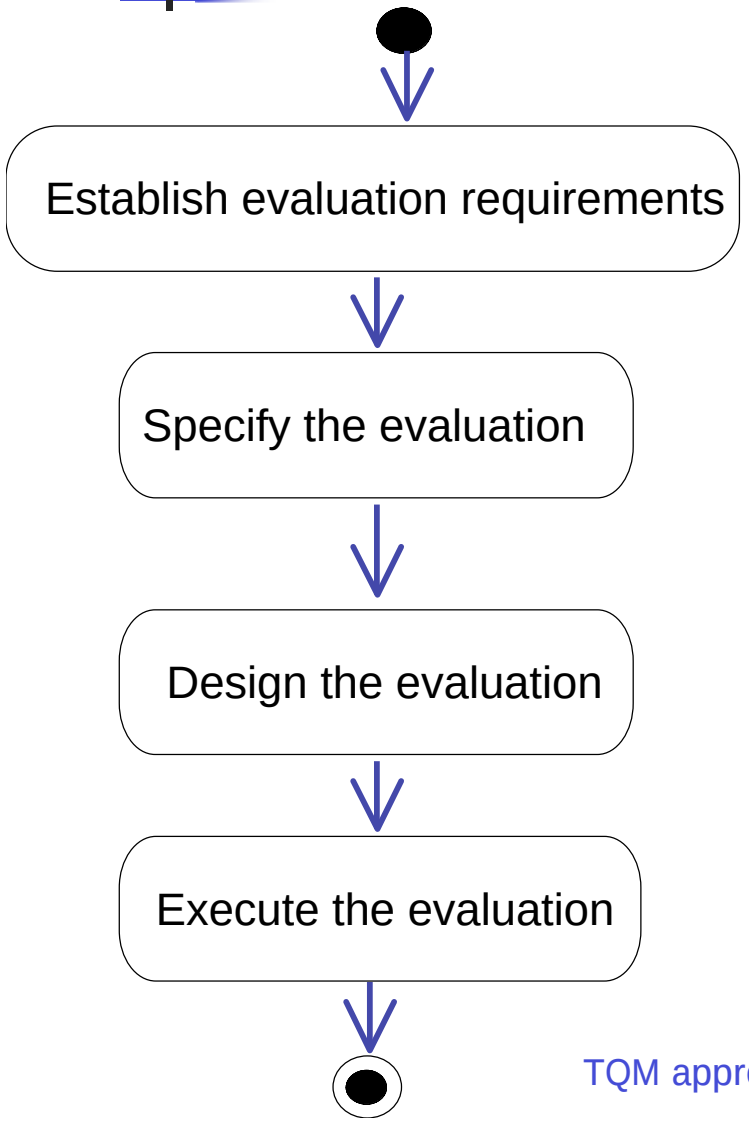
An Integrated TQM Approach

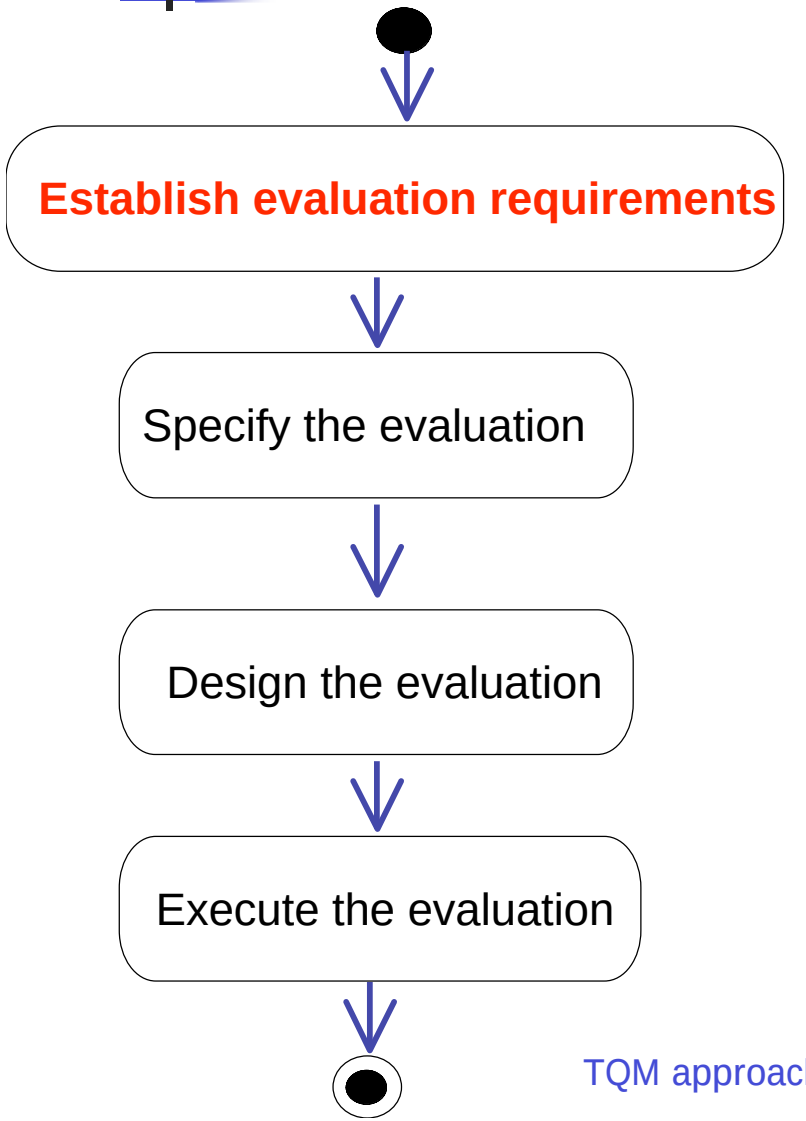
CORRELATION BETWEEN ISO 14598 AND WE TQM PROCESS

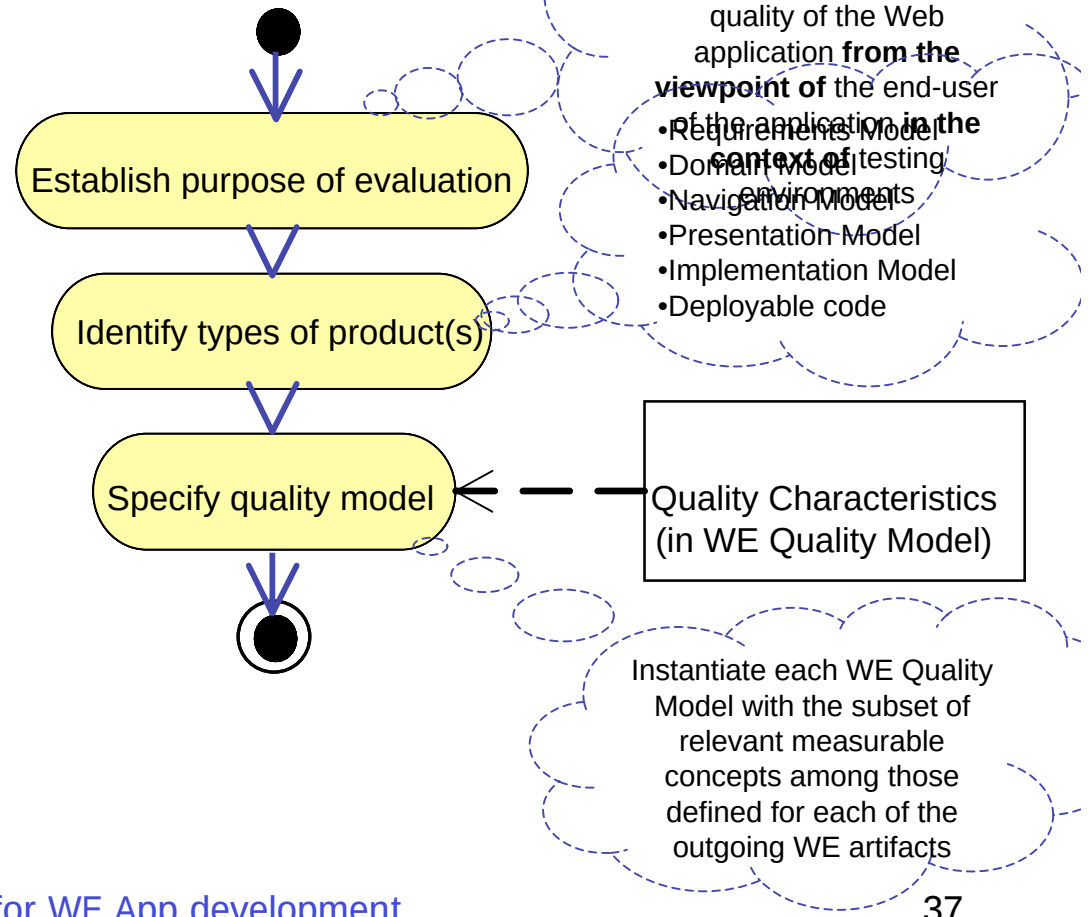


- Additional advantage: our approach complies with ISO 14598-1 standard
  - Specification and evaluation of software conforms to ISO 14598 if it uses the process in clause 6 and a Quality Model...

An Integrated TQM Approach

CORRELATION BETWEEN ISO 14598 AND WE TQM PROCESS





An Integrated TQM Approach

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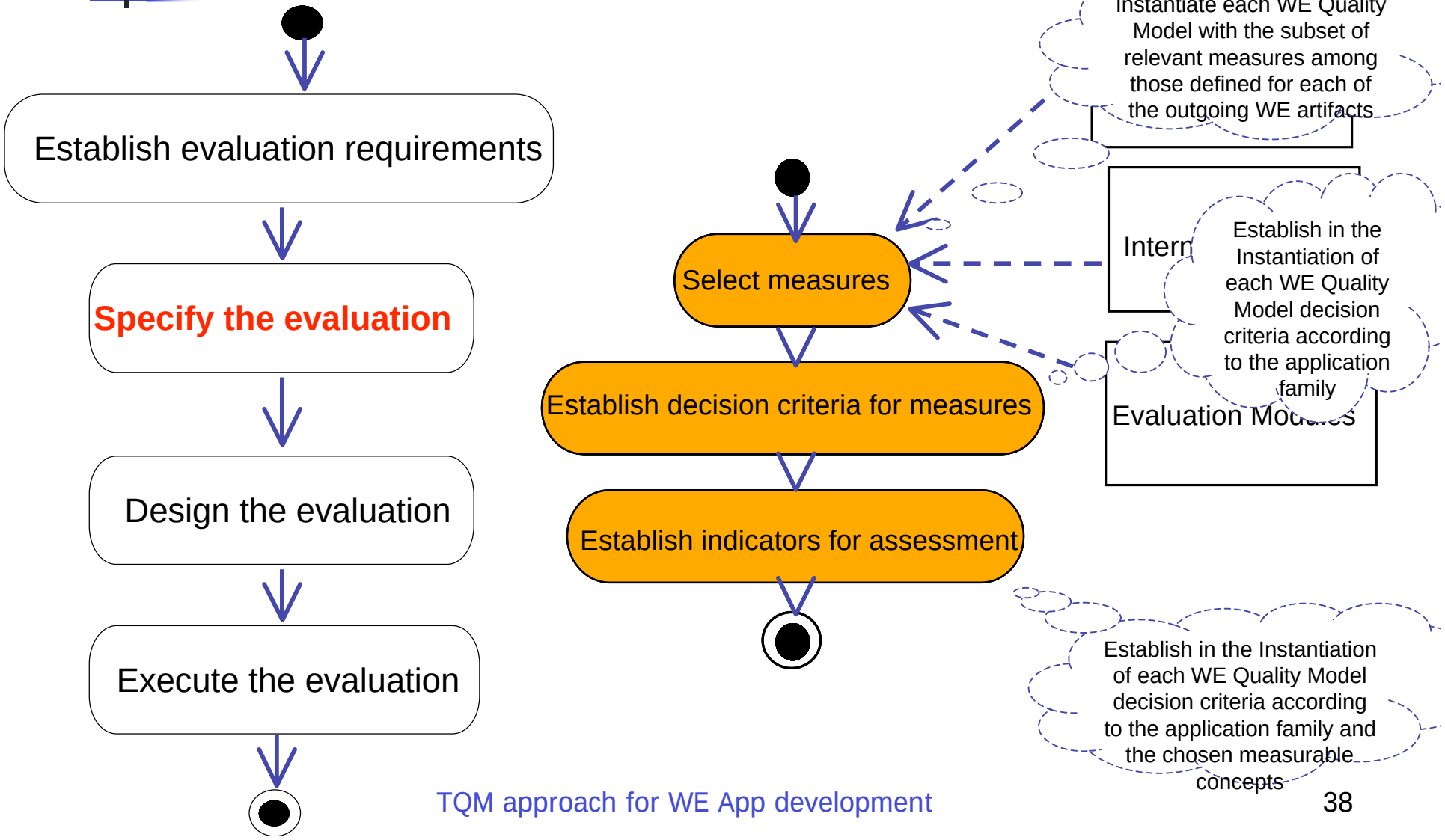

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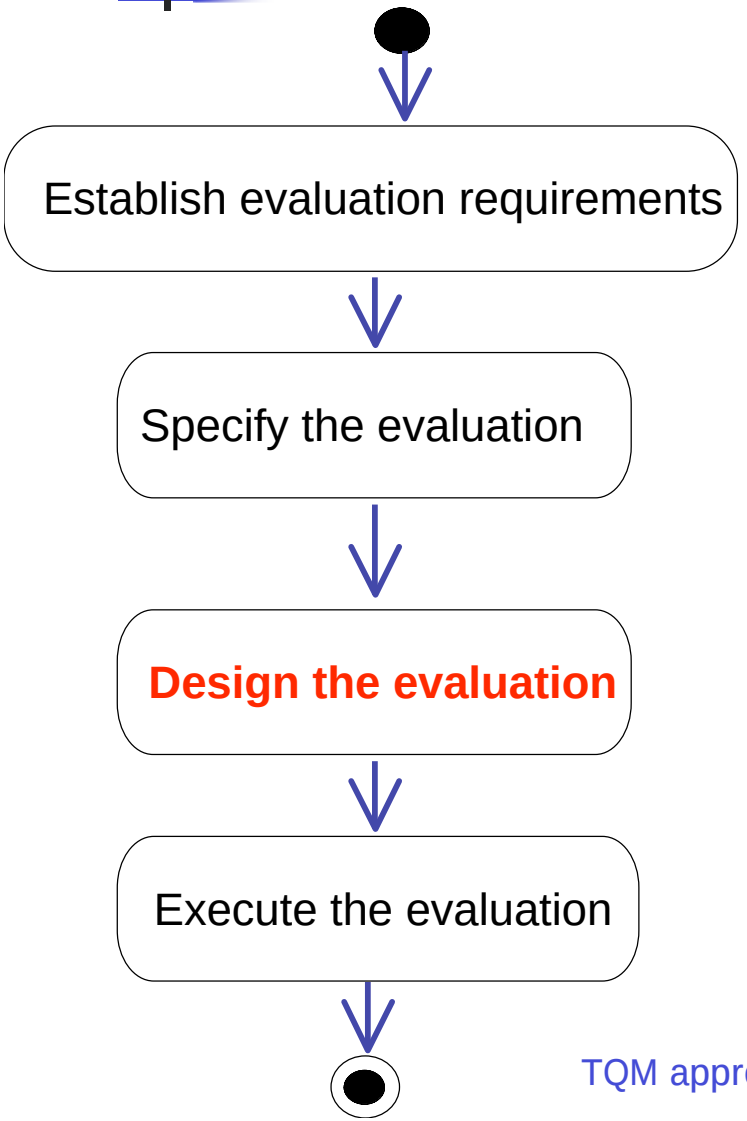

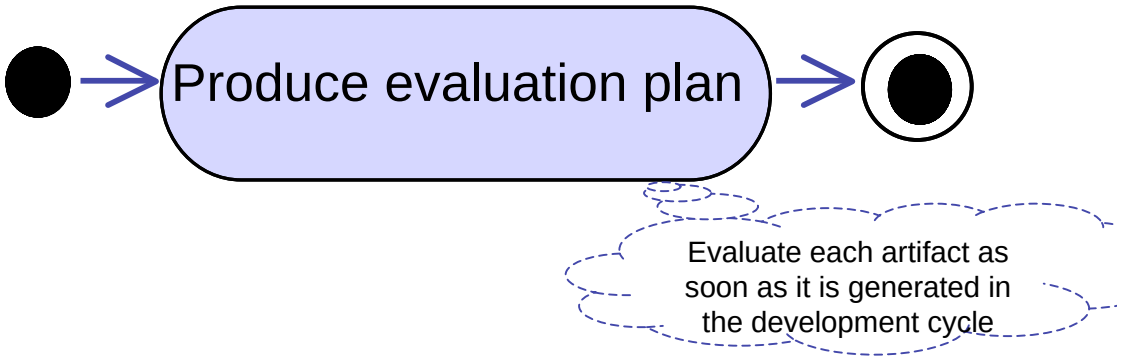

An Integrated TQM Approach

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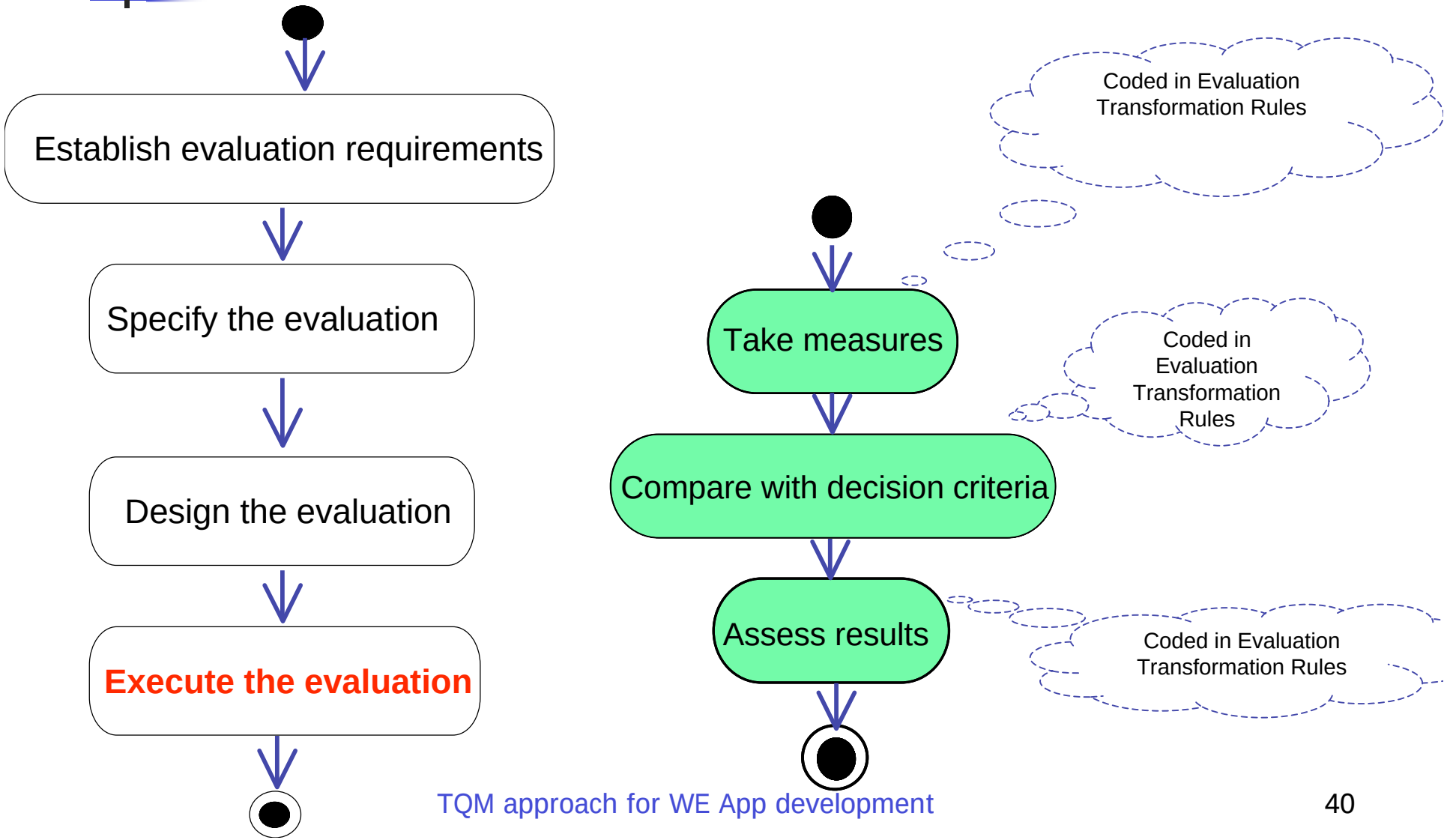

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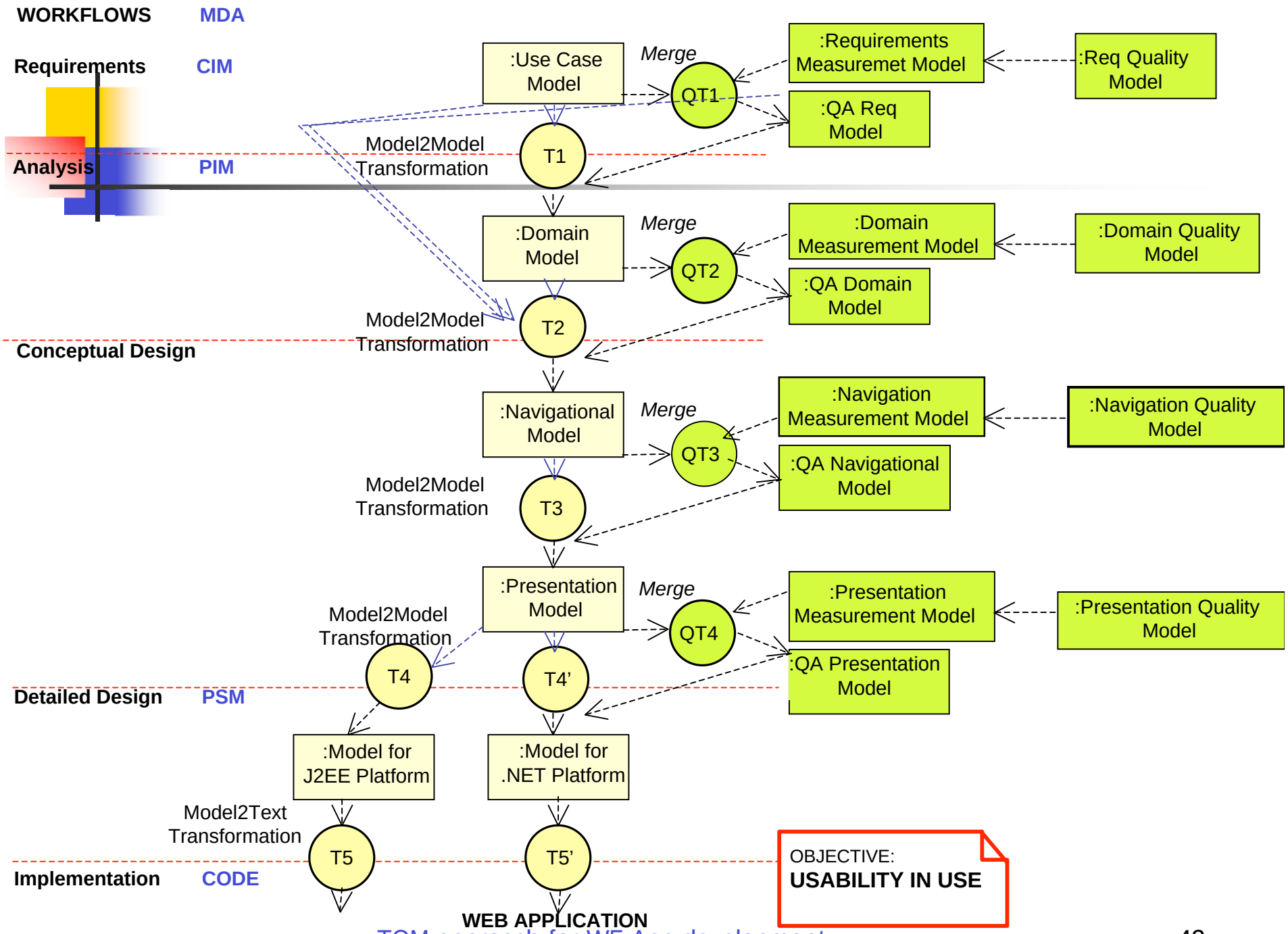
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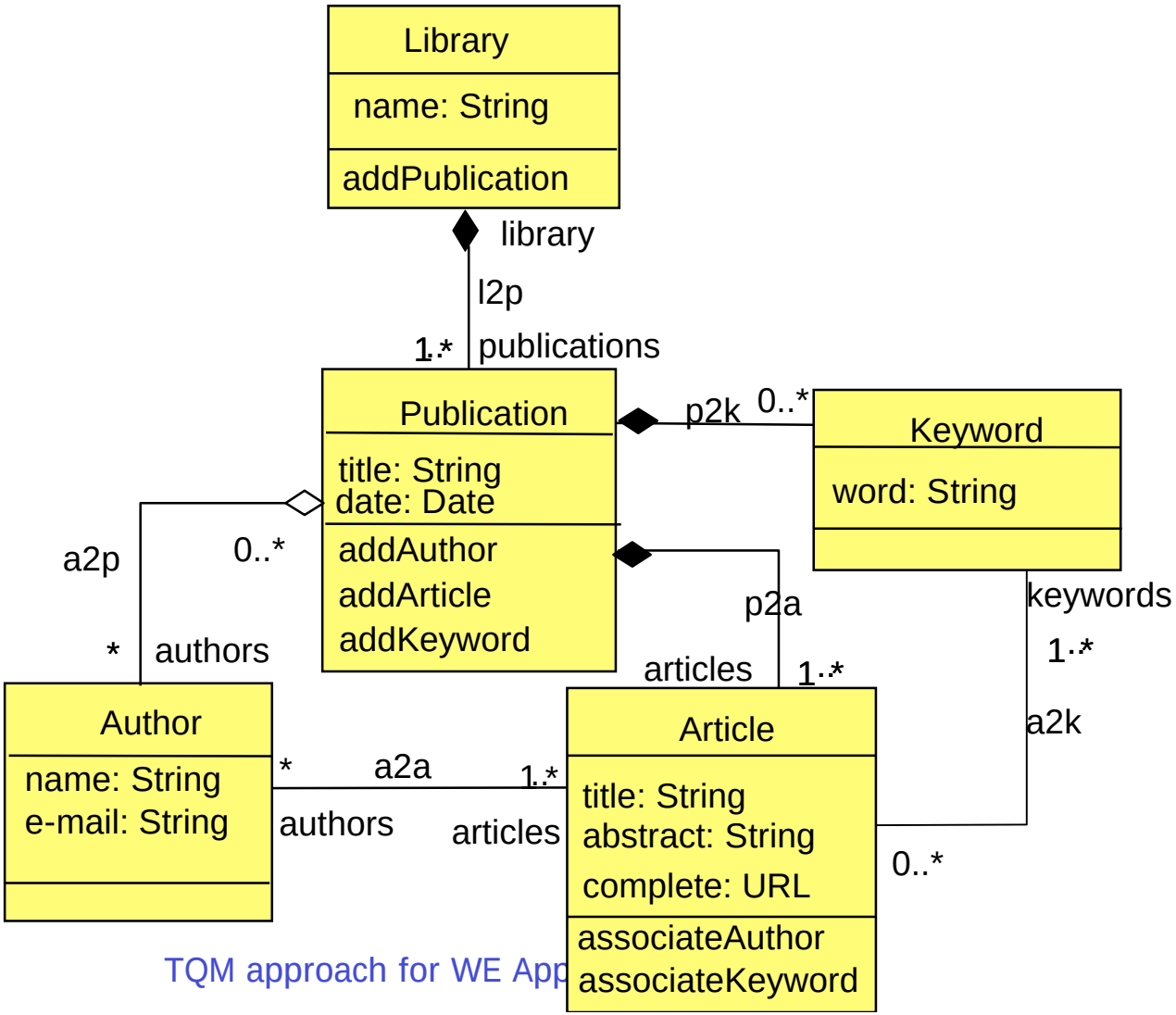
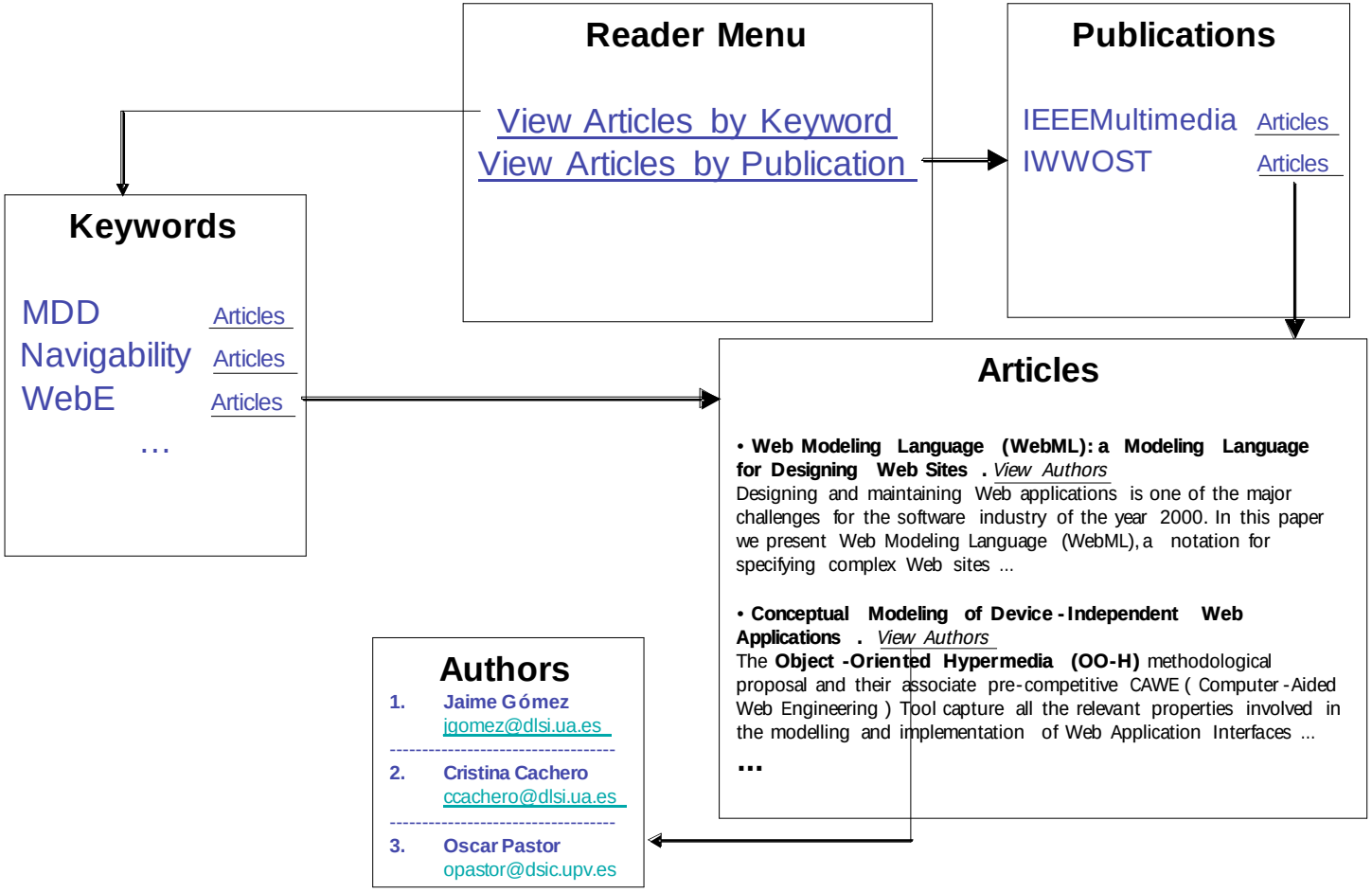
WEB APPLICATION
OBJECTIVE:
USABILITY IN USE

EXAMPLE: OO-H DOMAIN MODEL



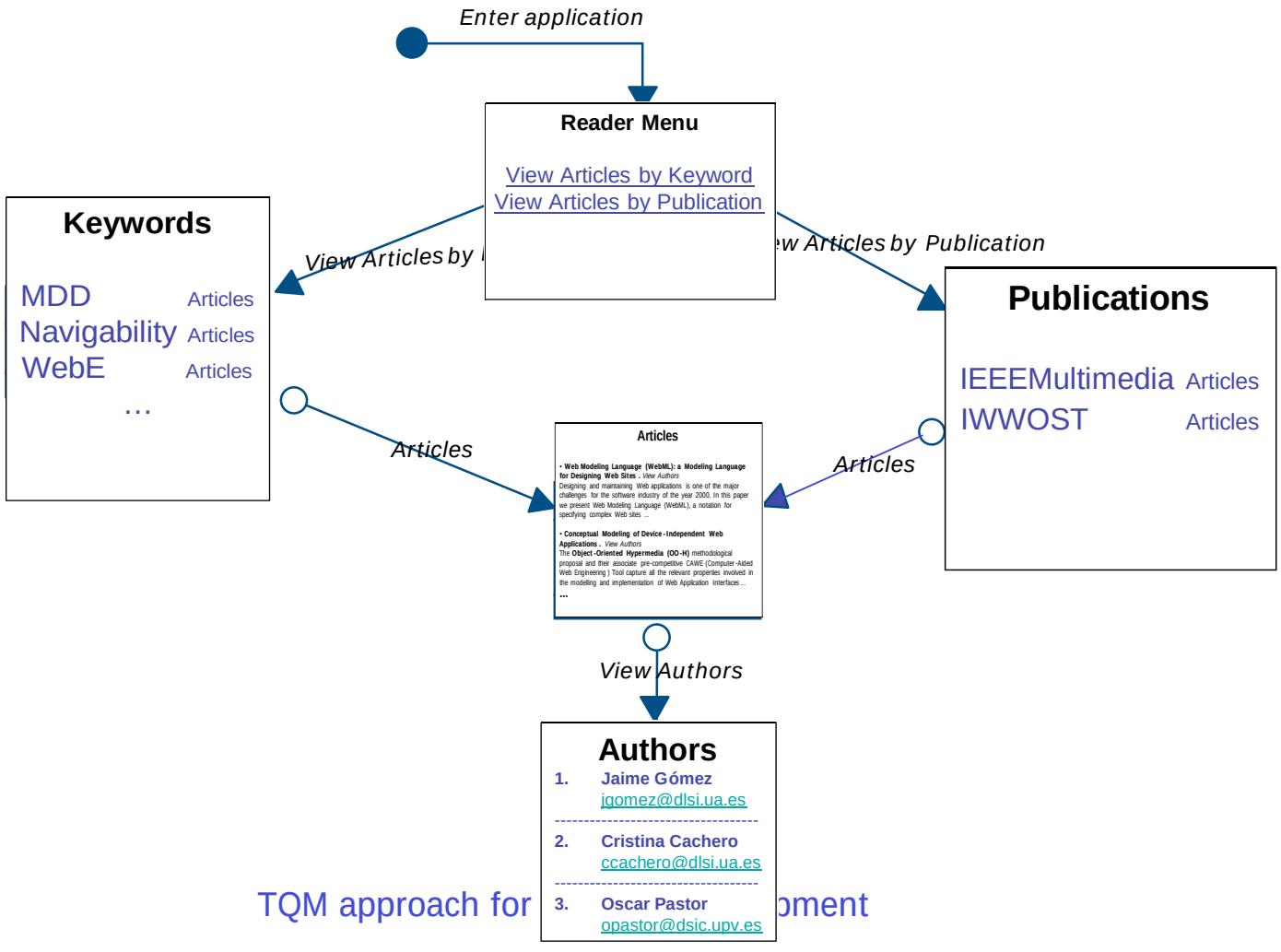
WE TQM Automation

EXAMPLE: INTENDED SUBSYSTEM STORYBOARD



WE TQM Automation

EXAMPLE: OO-H NAVIGATION MODEL



EXAMPLE: OO-H NAVIGATION MODEL

- Imagine that we have empirically validated that the DCNM measure is a valid indicator of the final usability of the navigation structure of the Web Application
  - *Percentage of domain relationships which, having already been defined as the conceptual relationships in which a certain user type is interested, can in actual fact be navigated by such a user.*
  - Users may expect to find in the Web application the same relationships that exist among concepts in the problem space
    - Not finding these relationships in the application may therefore diminish their general satisfaction with the application.
    - Users are likely to describe this phenomenon as a problem with the navigability of the application.

The Software Measurement Meta-Model

EXAMPLE: NAVIGATION USABILITY MODEL

			Navigation Model Attributes				
Characteristic	**Subcharacteristic**	**SubsubCharacteristic**	**Structural Complexity**	**Consistency**	**Semantic Correctness**	**Grouping Density**	**Grouping Cohesiveness**
Usability	**Understandability**	**Readability**	NO	NPC (Navigational pattern coherence)	Number of racing conditions in automatic links	Number of abstract pages	% of origin links that are supported by an structural filter
		Completeness of Description (iso 9126-3)	NSDC: Number of supporting domain classes	NO	NO	NO	NO
		Familiarity	**DCNM**	NO	NO	NO	% of origin links that are supported by an structural filter
		Brevity	Depth of a Navigational Map	NO	NO	Number of links in origin	NO
	Learnability	**Predictability**	Number of links with Structural Filters	NPC (Navigational pattern coherence)	Number of racing conditions in automatic links	NO	% of origin links that are supported by an structural filter
		Memorability	Number of links with Structural Filters	NPC (Navigational pattern coherence)	Number of racing conditions in automatic links	Number of links in origin	% of origin links that are supported by an structural filter
	Operability	**Controllability**	NO	Operation consistency	Number of manual service links	NO	NO
		Capability of Personalization (adaptability/adaptivity)	Number of links with adaptation rules	NO	NO	NO	NO

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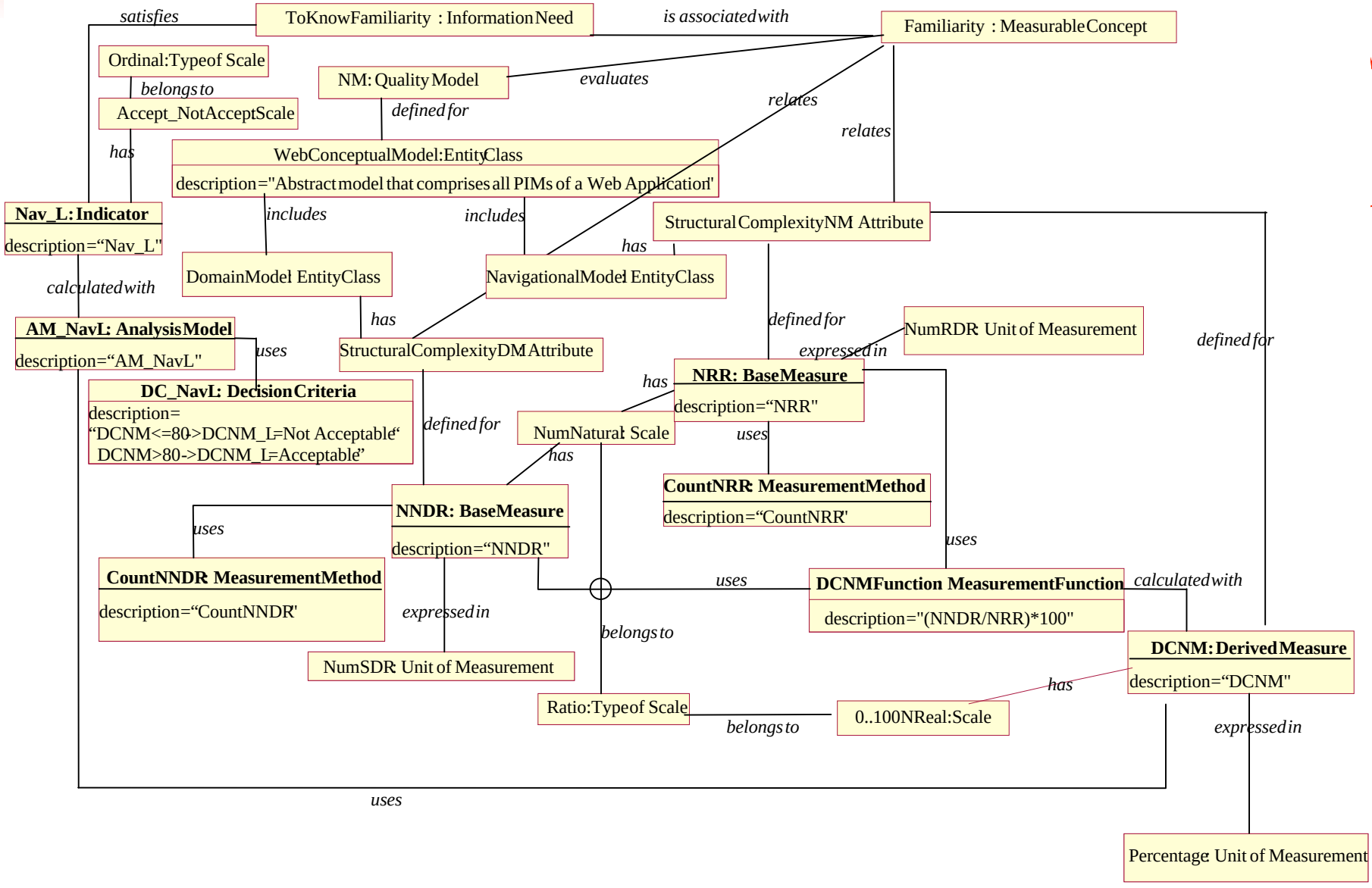
EXAMPLE: SMM INSTANTIATION



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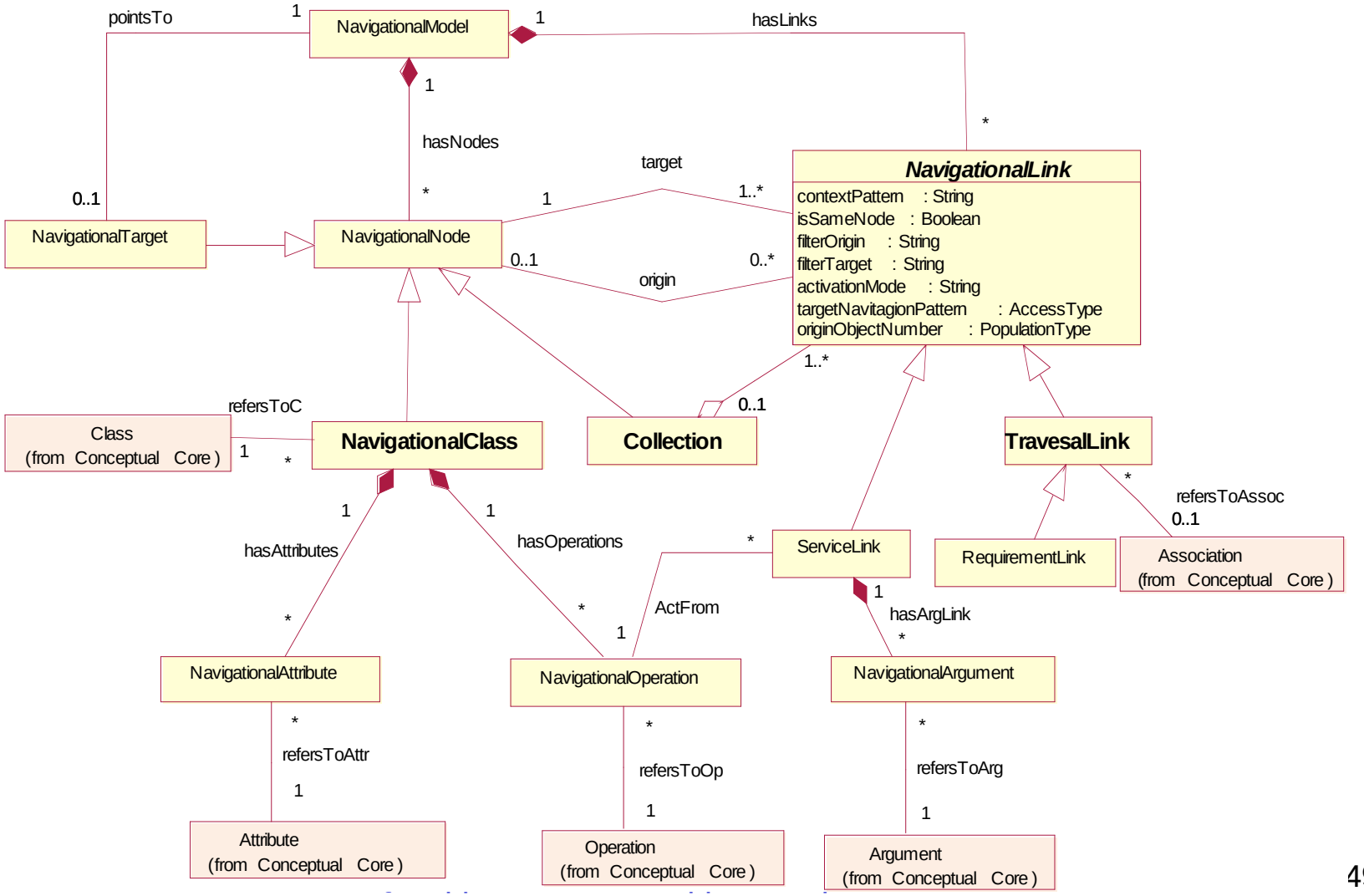
EXAMPLE: MEASURING ON THE OO-H WE META-MODEL



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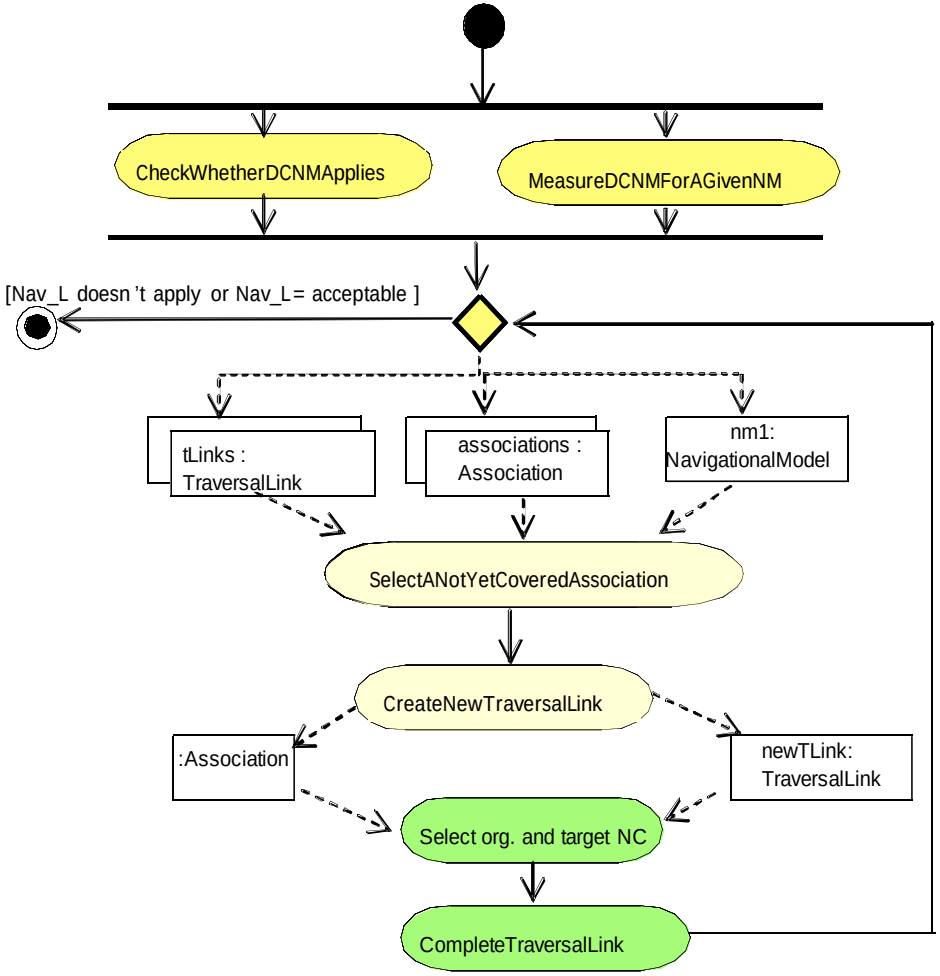
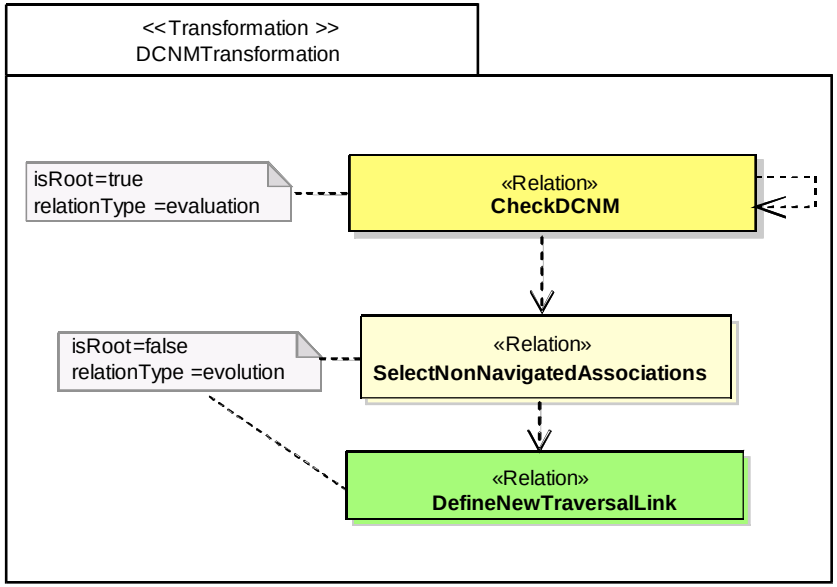
EXAMPLE: MEASURE AUTOMATION STEPS (0/3)





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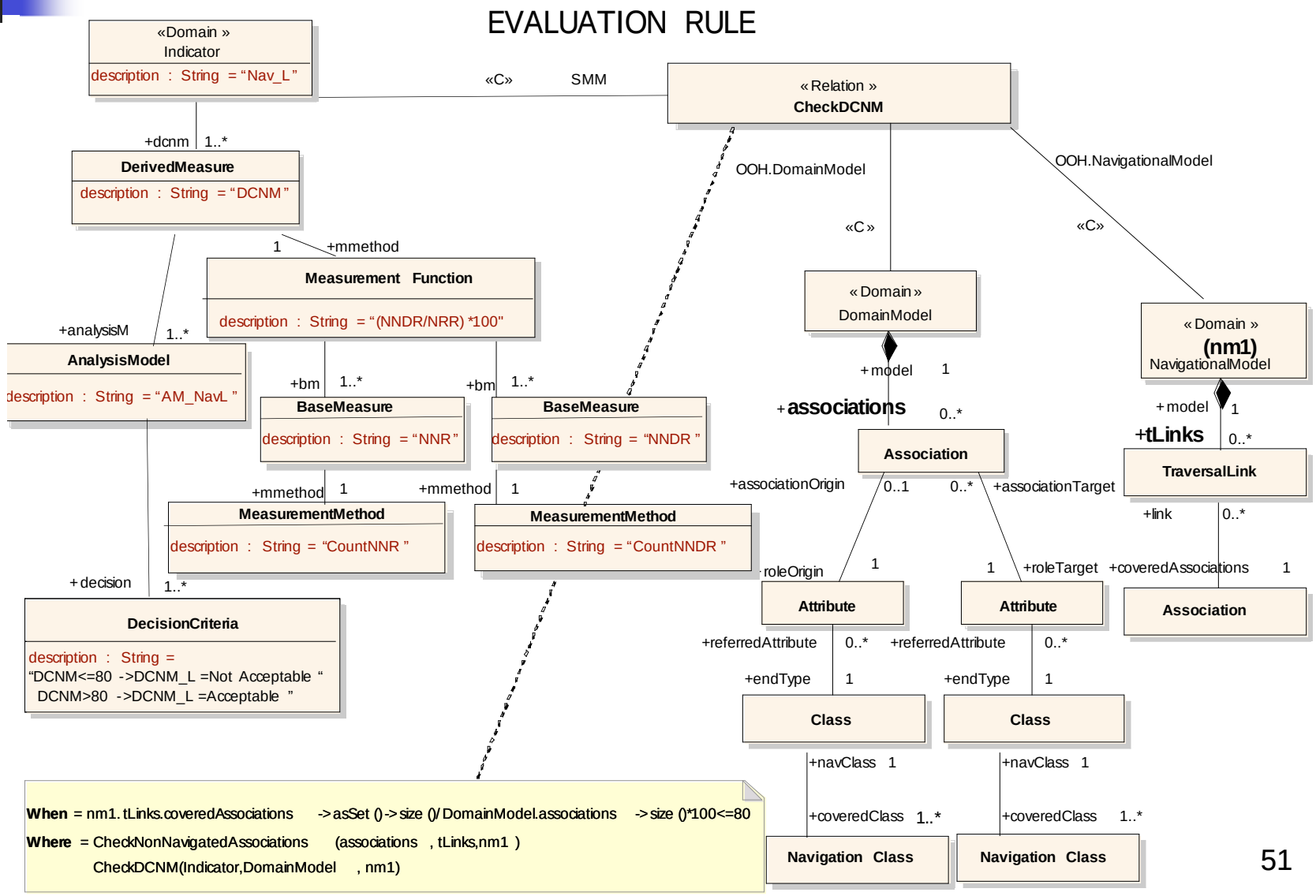
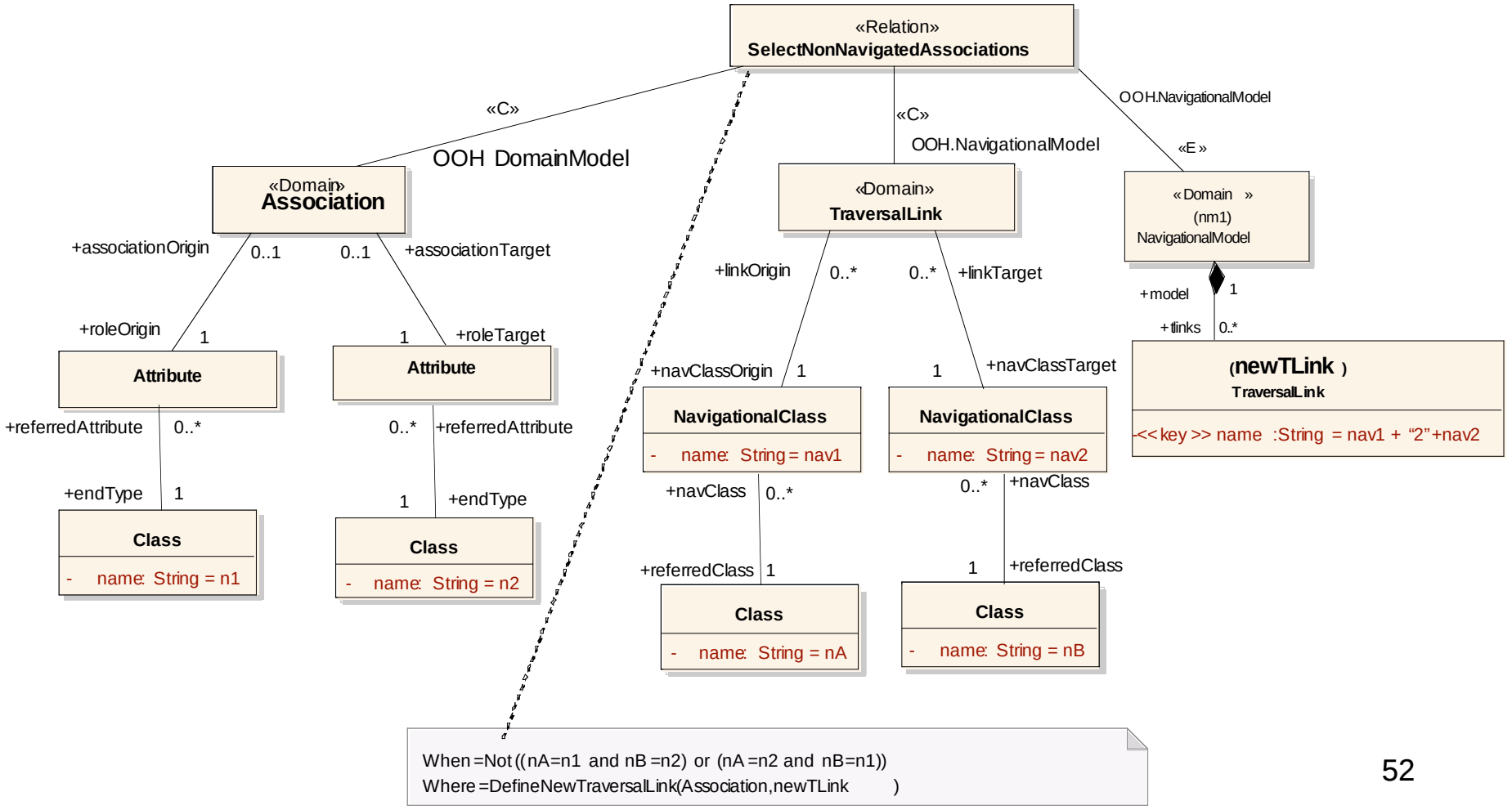
EXAMPLE: MEASURE AUTOMATION STEPS (1/3)



EXAMPLE: MEASURE AUTOMATION STEPS (2/3)

EVOLUTION RULE (I)



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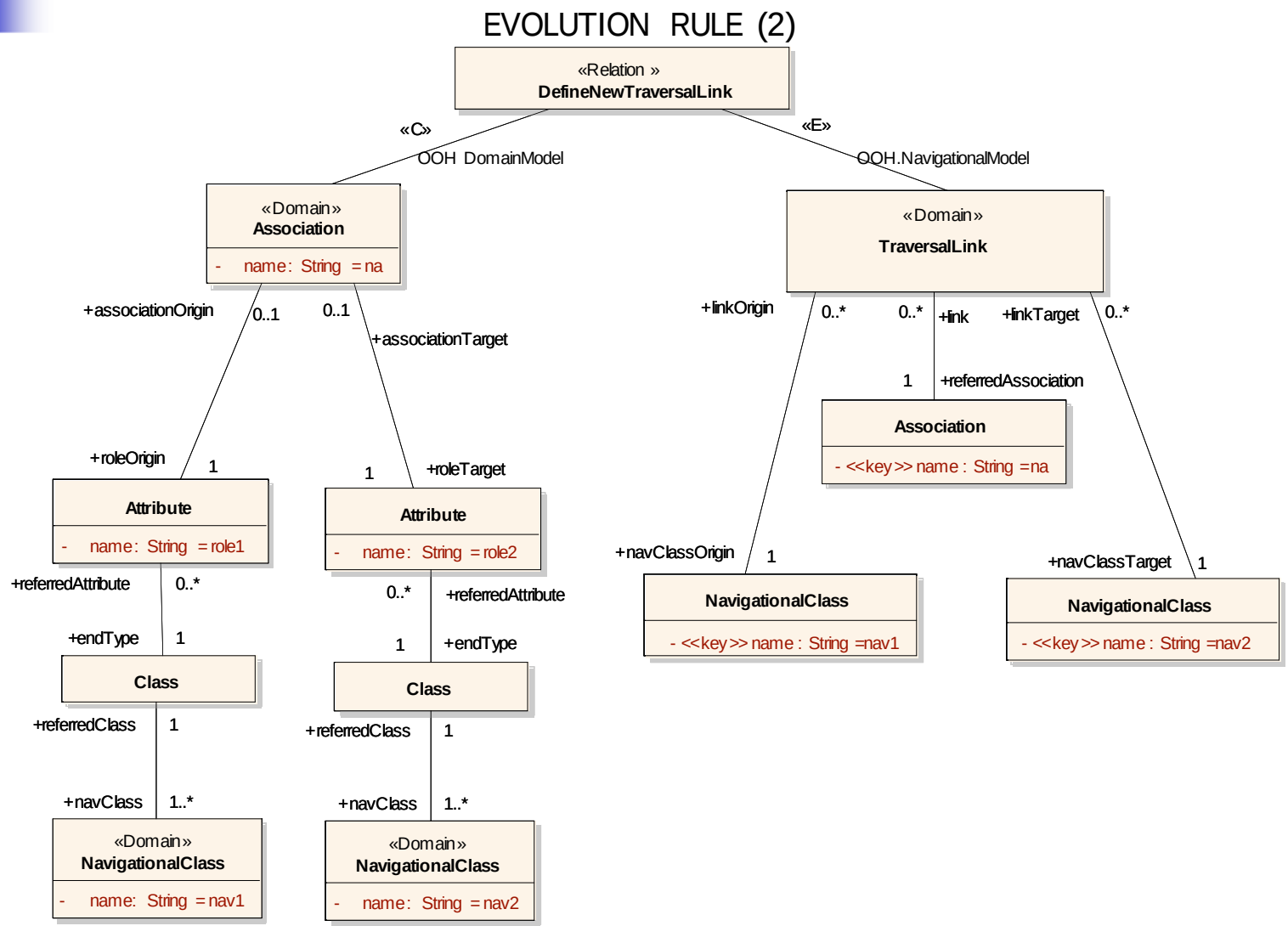
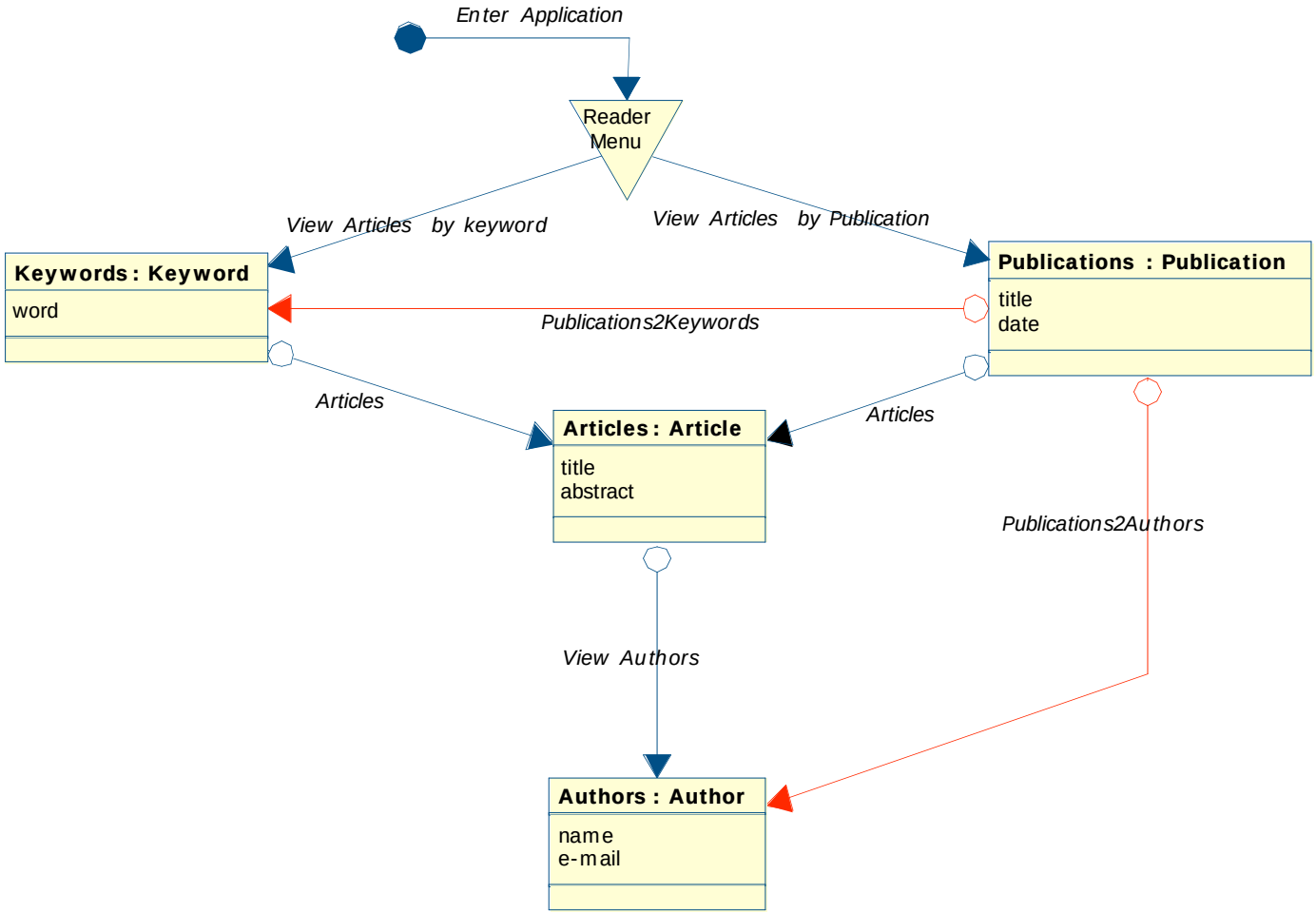
EXAMPLE: MEASURE AUTOMATION STEPS (3/3)



EXAMPLE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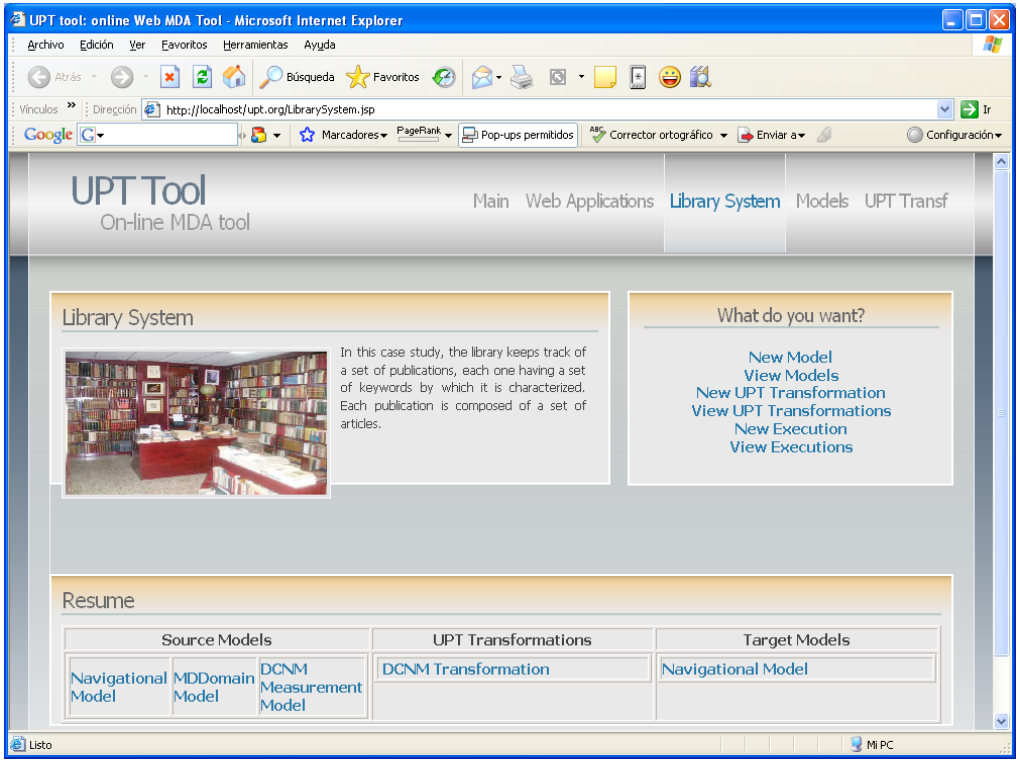
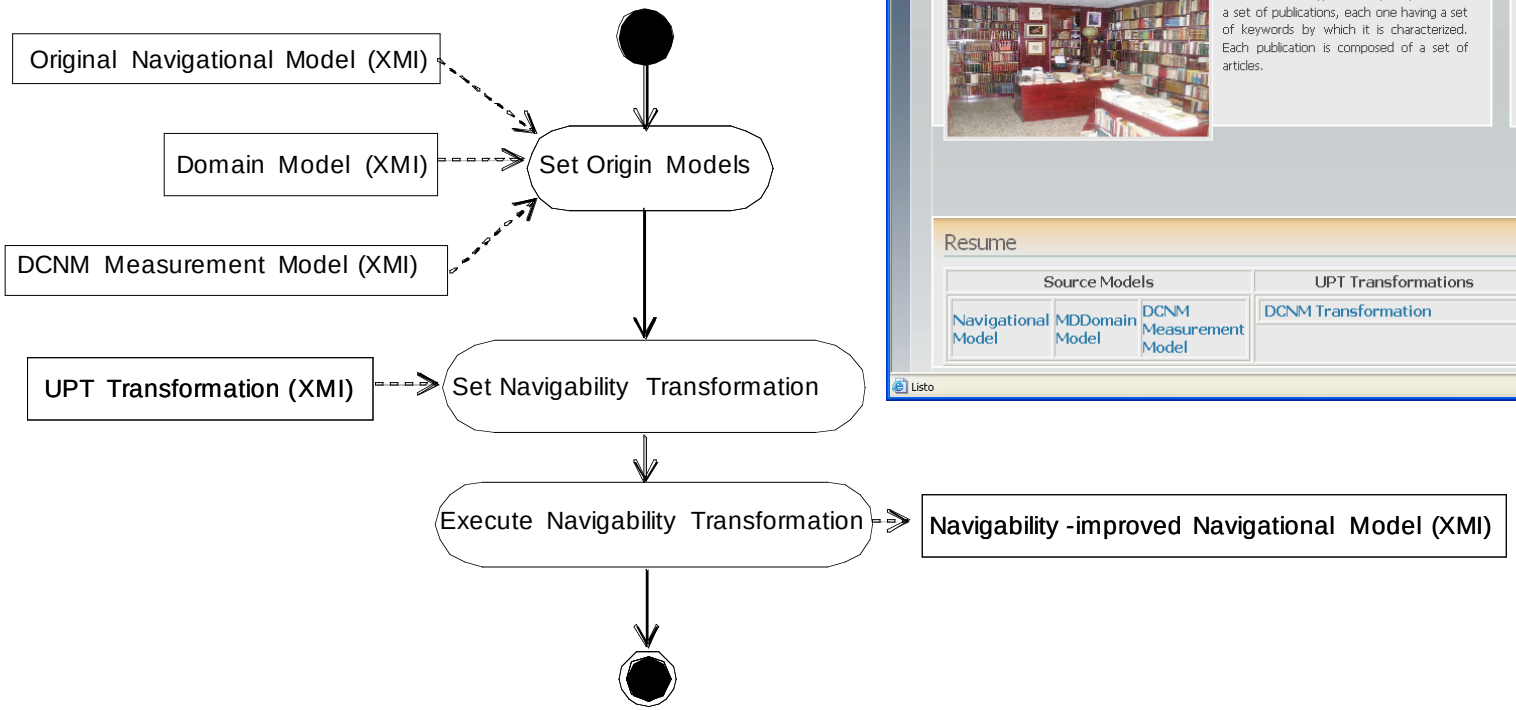
EXAMPLE: TOOL SUPPORT





Outline

- WQA: State of the art
- The SMM
- Empirical Validation of QM
- An Integrated TQM Approach
- TQM Automation
- Conclusions

Conclusions

SUMMARIZING...

- We have provided all the elements that make up a Quality Evaluation Process in Web Engineering (ISO 14598)
  - A Quality Model
  - A Method of Evaluation
  - A Software Measurement Process
  - Supporting Tools
- Every step is reusable among WE methodologies
- Every Quality Artifact (except for specific transformations) is reusable among WE methodologies
  - Even such transformations could be reused if we agreed on a common meta-model for each level of abstraction

Conclusions

NEW OPPORTUNITIES FOR WE RESEARCH

- QM proposals for each level of abstraction
- Empirical Validation of assumptions traditionally made in WE methodologies
- MDE Standardized support for WE processes (including evaluation issues)
- Agreement on common meta-models for WE
- Empirical validation of semantic equivalences/differences among WE proposals

Towards the TQM in WE

Thank you very much for your attention!

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