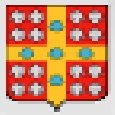

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A Collaborative User-centered Approach to Fine-tune Geospatial Database Design

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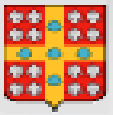

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Context

✓ The success of a software system depends on how well it fits the needs of its users and its environment

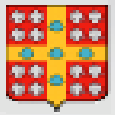
✓ Fitness For Use:
- ➢Stakeholders: experts in the application domain, software and geomatics engineers, designers
- ➢Intentions of use
- ➢Contexts

→The result may fit for the use of some users but may be inappropriate for others

→ Are the intentions of use of the end-users taken into account ?

✓ Experts in the application domain:
- ➢holders of the knowledge of what is needed
- ➢Representatives of the community of users

→ Are the needs exhaustive ?



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Requirement Engineering Overview (1/2)

✓ Requirement Engineering (defines the "What", the problem to solve)

≠

Software Engineering Activities (define the "How", a solution to the problem)

✓ Requirement Engineering literature defines 5 Requirement tasks:

1. Requirements Elicitation
2. Requirements Modeling
3. Requirements Analysis
4. Requirements Validation
5. Requirements Management

Requirement Engineering Overview (2/2)

✓ Experts in the application domain usually communicate with a small number of end-users:

Consequences:

✓ Some usage intentions related to specific contexts may remain uncaptured or assumed
✓ Existing or potential problems with existing data or with the new DB design may go unnoticed
✓ Ill-defined specifications
✓ Undermine the fitness-for-use
✓ Lead to inappropriate use of the data

Objectives

What?

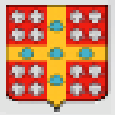
➢ Presenting a collaborative user-centered approach that improves system requirements collection and description

Why?

➢ Aims to reduce the risks of inappropriate data usage

How?

➢ Through a more active involvement of users in the design process



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User Involvement in GIS Design (1/2)

➢ In spatial DB design, there is typically an intended purpose to be considered because intended purpose has immediate impacts on the representation of objects and phenomena on maps in terms of:

- ✓ level-of-detail
- ✓ precision
- ✓ topological properties of geometry

➢ A lack of adequate understanding of the users' purposes during the design may lead to choices about the definition of the geometric properties (i.e. the semantics of the geometry)

- → impacts on the types of spatial analyses to be performed
- → impacts on the quality of the result

➢ Intentions of the user regarding his potential usages of the data are not systematically captured during the requirements elicitation stage

- → ≠ with RE guidelines
- → Exclusion of some needs and warnings from the scope of the GIS to be designed

User Involvement in GIS Design (2/2)

- If data is used for purposes different from the intended ones, inappropriate results may occur

- Still the role that users should play in each of the RE steps is usually ill-defined, misunderstood or ignored as it is the case in complementary approaches like prototyping and agile design

  → Missing requirements constitute the most common type of requirements defect

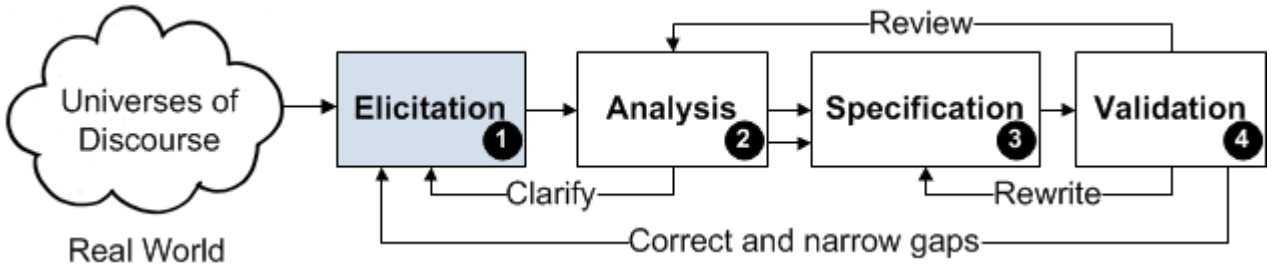
Analyzing Users' Roles in GIS Design (1/4)

Capturing the Purposes of Geospatial Data Usage

Elicitation of user intentions and his usage context is a prerequisite for the design process

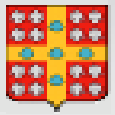
→For DB design, one should focus on the data needs rather than on the structure of data
However:

- ✓ Traditional design techniques typically do not address the usage purposes as a main issue
- ✓ Still a gap exists between the "universe of discourse" and the produced specifications



→ Capturing the usage context needs to be supported by an appropriate RE approach which is purpose-oriented rather than data structure-oriented.

→ Transformations performed throughout the requirement development process should maintain the link between the UoD and the models without disregarding usage purposes and intentions



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Analyzing Users' Roles in GIS Design (2/4)

Understanding the Contexts

➢ A context is what defines the scope of the end-user needs

➢ The state-of-the-art techniques for database design assert that design must consider users' possible activities, tasks and intentions. These aspects are part of the context

→ design must target two different realms: the application domain model and its underlying context

➢ Modeling the usage context using an appropriate design approach

✓ classical data models (e.g. conceptual models) are more suited to application domain design because they are rooted in traditional design approaches.
✓ the focus of traditional design approaches has primarily been on products (i.e. systems), operations (i.e. features) and entities (i.e. components) rather than on purposes.

→ goal-oriented paradigm could appropriately express the user intentions and overcome the limitation of traditional approaches

Analyzing Users' Roles in GIS Design (3/4)

Analyzing the Contexts

➢ According to the human selective cognitive perception, only a subset of interest is extracted among the whole set of the real-world entities. The extracted subset of "domain concepts" of interest is:

✓communicated by the application domain experts to the experts in geomatics and in GIS design.
✓ translated into specifications in order to be implemented.

➢ RE techniques suggest one should start from usage intentions (i.e. the usage context model), and derives from them functional and non-functional requirements through a systematic process.

✓ However, a number of entities of interest do not reach the specifications.
→ This constitutes a leak that may undermine the transformation from requirements to specifications and may lead to risky situations further.

➢ The reality of project realisation

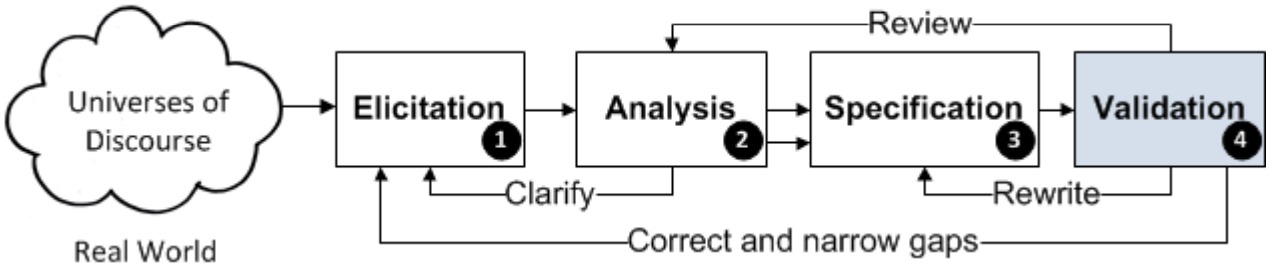
✓ Reusing the data from a previous project to reuse it « as is» may constitute a risky situation
✓Cost constraints could lead a project to downgrade his data quality expectations

Analyzing Users' Roles in GIS Design (4/4)

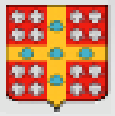
Validating Requirements

➢ Concerns and perspectives of system designers are typically different from those of experts in geomatics and also from those of end-users.

➢Consequently, the validation process is constrained because of inconsistency between the different expectations: in fact, the targeted design is not usually performed against a commonly defined set of expectations.



However, the awareness of the necessity to bridge this gap early in the design process has been raised and solutions proposed.



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Enriching GIS Design (1/3):
Collaborative Specification of Context

- The proposed approach is:
  - ✓ Iterative
  - ✓ Collaborative
  - ✓ Purpose-oriented
- The proposed approach is based on the following 2 components
  - ✓ The usage context and its structural elements:
    - ✓ Purposes
    - ✓ Domain concepts
    - ✓ Domain concepts mapping
  - ✓ The process that allows defining the usage context

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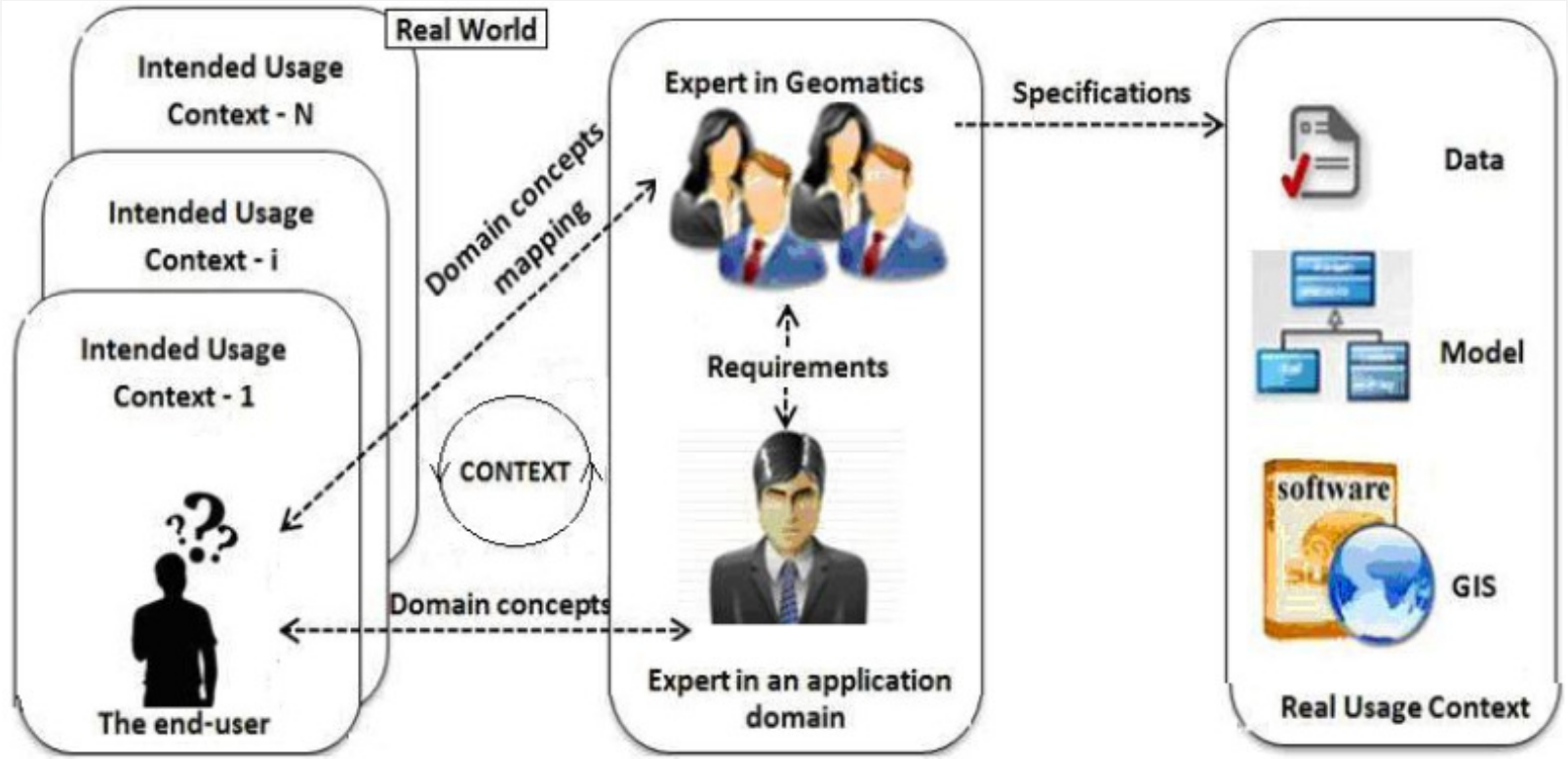
Enriching GIS Design (2/3):
Collaborative Specification of Context



Enriching GIS Design (3/3):
User-contributed Actions

α During the requirement elicitation, end-users contribute collaboratively with their application domain design team to describe satisfactory or/and unsatisfactory conditions and criteria specific to the usage context

β User-centered design tools (e.g. URN) would help understanding the intended usage context especially because they support expressing "intentional elements" such as goals, actors, links, tasks and properties. For instance, graphical symbols are understandable by end-users and facilitate the communication of their purposes. User-oriented graphical modeling tools (e.g. Perceptory, GRL) may be leveraged to elicit the usage intentions.

γ Recording information about the relationship between the intentions of use (provided by end-users and their representatives) and the quality attributes (understandable by experts in geomatics). What is proposed here is a possible modeling format of the proposed association index (e.g. XML schema or ontology). The index may be presented to end-users and stakeholders through an appropriate representation (i.e. graphical vs. formal) in respect to their expertise level.

RDP Steps	RE guidelines	User contributed actions
1. Elicitation	A. capturing the purposes of users.	α
	B. understanding the geospatial data context	β
2. Analysis 3. Specification	C. modeling, analyzing & negotiating requirements	γ
4. Validation	D. validation of requirements	

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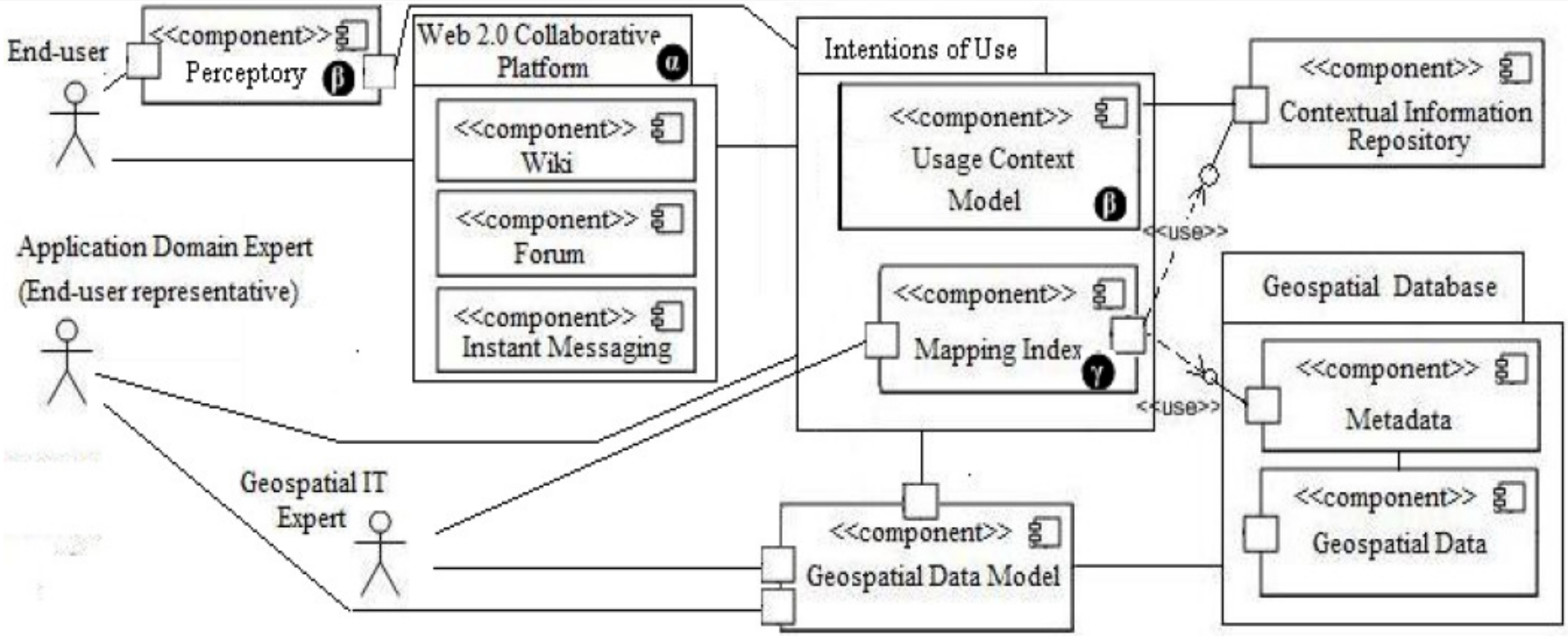
Implementation Example:

A Collaborative user-centered approach



Questions ?