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COLLEGE of BUSINESS

Chair in
Information and Service Systems

Effects of External Conceptual Models and Verbal Explanations on Shared Understanding in Small Groups

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Agenda

Conceptual Models

Conceptual Modeling Languages

Study

- Focus
- Research question
- Design
- Results

Summary and Open Questions

Conceptual Models

- **Conceptual model (CM)**
  - Abstracts the real world by focusing on key entities/concepts and relationships [1].
  - Used to discuss a design problem [8]
  - Provide critical means for shared understanding in an IS development team [2, 3].
    - If CMs accurately represent application domain

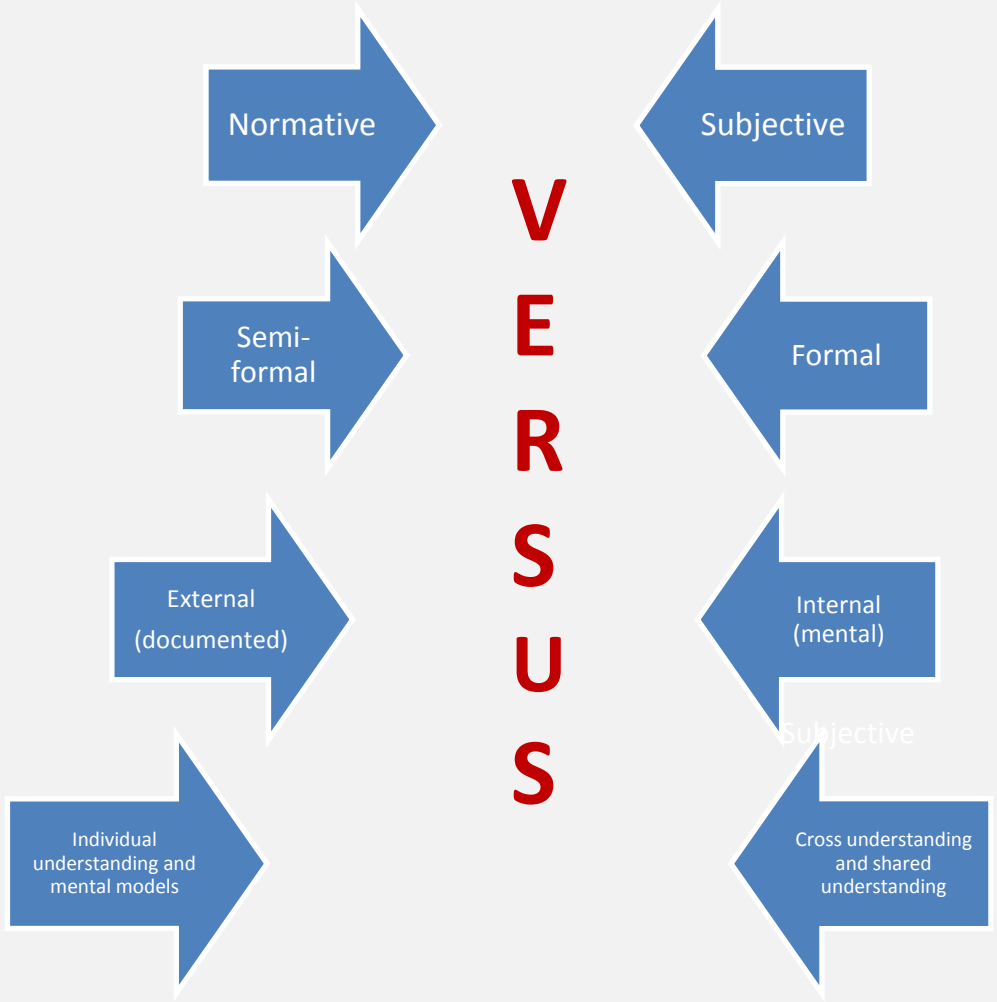
- **Conceptual modeling**
  - Clarification of meaning of various terms
  - Ensures problems with different interpretations do not occur
  - Involves collaboration between requirements engineering (RE) participants where knowledge regarding the system requirements is shared, absorbed, and constructed
  - Process of “collaborative sense-making and knowledge transfer that results in the convergence of diverse mental models” [2].

- **Conceptual Modeling Languages (CML)**

  UML or OMT for object modeling,

  IE or IDEF1X for entity-relationship models [9].

Conceptual models -- *complex knowledge structures*



Conceptual Modeling Languages

CML Focus

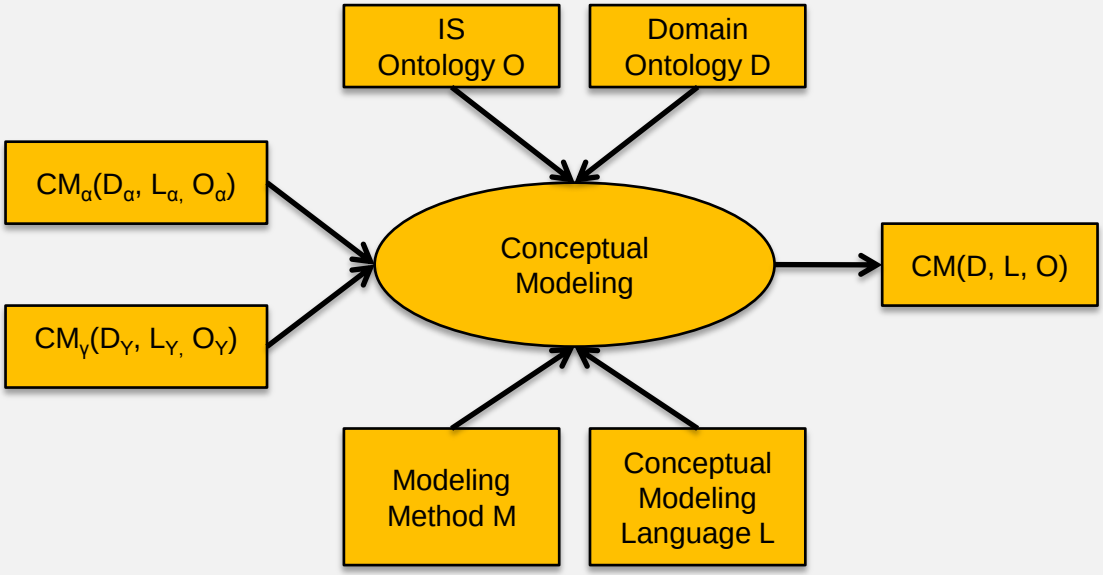
- business process modeling
- general software engineering
- semantic data models
- meta-data models and computational ontologies

CMLs Grammars

- ontologies for defining fundamental entities and structures that should be the focus of CMs

Generic Model of Conceptual Modeling

- CM -- subjective conceptualization of a domain created by an individual
- CM language (CML) -- translates subjective CM into external CM for knowledge transfer and sharing



Normative vs. Non-Normative Use of CM

Normative use of CM

Principal-agent settings between preceptors and receptors

Normative CMs

- explained to receptors by the creator of this external CM or by trained preceptors (indirect knowledge transfers)
- **indirect knowledge transfers of normative conceptual models without additional explanations by preceptors has been the core focus of empirical studies (e.g., [16]).**

Theoretic assumption of knowledge transfers based on normative CMs contradict reality of requirements elicitation

- "chaotic and non-linear"
- non-deterministic

Hypothesis

- *Additional explanations given by a preceptor might provide additional cues that allow receptors to directly gain an understanding of the creator's subjective CM*

Shared Understanding by CM

- Information systems projects failures
  - Mis-understanding among team members
  - Incompatible languages for expressing ideas / understandings of envisioned information system
- Lack of empirical studies
  - Understanding communication problems in terms of the social processes associated with conceptual modeling
  - Understanding how different conceptual modeling languages (CML) support shared understandings within modeling teams.
- CMs created loosely for transferring individual understandings of subjective CM to another team member.

Open research question:

How do non-experts use various CML for creating CMs and then use these CMs for creating a shared understanding with other non-experts?

Objective:
Examine the subjective side of understanding the conceptual modeling process with emphasis on supporting shared understanding amongst information systems non-expert modelers.

Research Focus:
Whether / how different types of CML with additional verbal explanations can assist small groups of non-experts in a shared understanding of domain concepts in order to create effective conceptual models

Research Questions

- How do different CML affect individual understanding and shared understanding?
- How do textual explanations of external CM affect individual and shared understanding?
- Is shared understanding on CM affected by different types of information systems?

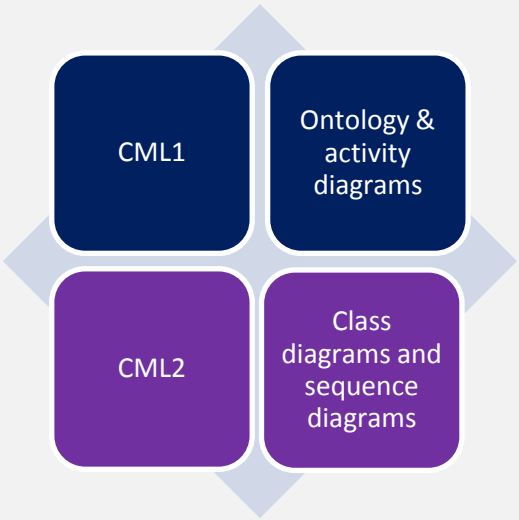
Research Setting

- How do external conceptual models support a shared understanding in *non-normative situations* with *low heterogeneity* of prior modeling knowledge between members of small teams?
- How do additional verbal explanations affect this shared understanding (same moderating factors).

Study Design: Laboratory Study

Teams – 2 person

Task -- create CM using CML for describing concepts/relations and interactions



Online IS:
Michael is overweight and suffers from hazelnut allergy. Today he wants to order at his preferred online restaurant FirstMeal that supports him during his diet program. Due to his profile a series of salads and several vegetarian dishes, including such vegetarian pizza and potato dishes, are proposed. He opts for a vegetarian pizza and chooses an additional tofu topping from a list. Because he has met his last week's training program, he is awarded to choose a complimentary dessert from a menu. He opts for a smoothie with mango-coconut flavor from the category of lactose-free desserts.

Ubiquitous IS:
Anna gets site-specific weather information when she is brushing her teeth in the bathroom. Based on weather information and her calendar, free-time event suggestions are given, e.g. "Today, 8 p.m. - Miss Marple Night at CinemaOne. Do you want to order tickets?

3-Step Study Design

Model a situation with a particular CML (cross-wise different IS-CML combinations in each team) [30 min. with pen and paper]

Each team member evaluates the other's CM [questionaire 1: unambiguity, consistency and understandability]

Creator of a CM explains it to his/her teammate [questionaire 2: unambiguity, consistency and understandability]

		Type of Information System	
		Online IS	**Ubiquitous IS**
Type of Conceptual Modeling Language (CML)	**CML1:** Ontology & UML activity diagram	Group 1 (n=9)	Group 2 (n=9)
	CML2: UML use case diagram & sequence diagram	Group 3 (n=8)	Group 4 (n=8)

Results: Unambiguity, Consistency, Comprehensibility

Construct	Mean (SD) MO	Mean (SD) M+E
Unambiguity: I think this model of type [CML1/2] accurately represents Situation [1/2].		
UNA9: Total (n=34)	**5.88 (0.88)**	**5.97 (0.72)**
Consistency: I think that this model of type [CML1/2] is consistent as such with regard to Situation [1/2].		
CON4: CML2 + Ubiquitous IS (n=8)	5.13 (0.84)	5.75 (1.04)*
CON6: Total CML2 (n=16)	5.25 (1.13)	5.62 (1.50)*
CON8: Total Ubiquitous IS (n=17)	5.47 (1.07)	6.00 (0.94)*
CON9: Total (n=34)	**5.53 (1.05)**	**5.79 (1.23)**
Comprehensibility: I think this model of type [CML1/2] is easy to understand with regard to Situation [1/2].		
COM5: Total CML1 (n=18)	6.11 (0.96)	6.56 (0.62)*
COM6: Total CML2 (n=16)	6.00 (1.01)	6.63 (0.62)*
COM7: Total Online IS (n=17)	6.18 (0.73)	6.53 (0.72)*
COM8: Total Ubiquitous IS (n=17)	5.94 (1.25)	6.65 (0.49)*
COM9: Total (n=34)	**6.06 (1.01)**	**6.59 (0.61)****

Explanations significantly increased comprehensibility

High mean values on unambiguity and comprehensibility
→ CM sufficient basis for deriving an internal CM of high quality

Consistency: no change; CML2(UC/SD)/UIS increased

Results: Extrinsic Power of CML

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Extrinsic power of CML for individual understanding (EPIU): I think that this model of type [CML1/2] made it easy for me to create an individual understanding of the conceptual model regarding Situation [1/2].	
EPIU9: Total (n=34)	**5.53 (1.44)**
Extrinsic power of CML for a shared (team) understanding (EPSU): I think that, in general, the external conceptual model of type [CML1/2] supports a shared understanding in our team with respect to Situation [1/2].	
EPSU9: Total (n=34)	**6.03 (1.06)**

Extrinsic Power of CML for individual understanding (EPIU):

- All models perceived important for creating internal conceptual models
- Only UC diagrams / sequence diagrams (CML2) provide less support (4.88 MV/2.03 SD)

No influence of IS type and CML on extrinsic power of a CML for individual understanding or for a shared (team) understanding

- But: higher requirements for individual understanding than for shared understandings!

Summary:

- Advantages exist of some CML types for particular types of IS (e.g., CML1 - UIS).
- Differences between extrinsic power of CML combinations for individual and shared understanding indicate that CML play different roles on individual and group levels.
- Not important which grammar is used provided it provides basic diagrammatic elements.

Open Issues

- Relationship between mental representations and CM
- Effects of explanations, e.g., switching and reassurance effects

Questions