



Analyzing Ontology as a Facilitator During Global Requirement Elicitation

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Agenda


- Motivation
- The framework
- Validation



- Global Software Development (GSD) projects
 - Stakeholders are distributed throughout many geographically distanced sites
- Distance between members affects interpersonal communication
 - Lack of face-to-face communication
 - Time separation
 - Cultural diversity
 - Language
 - Customs



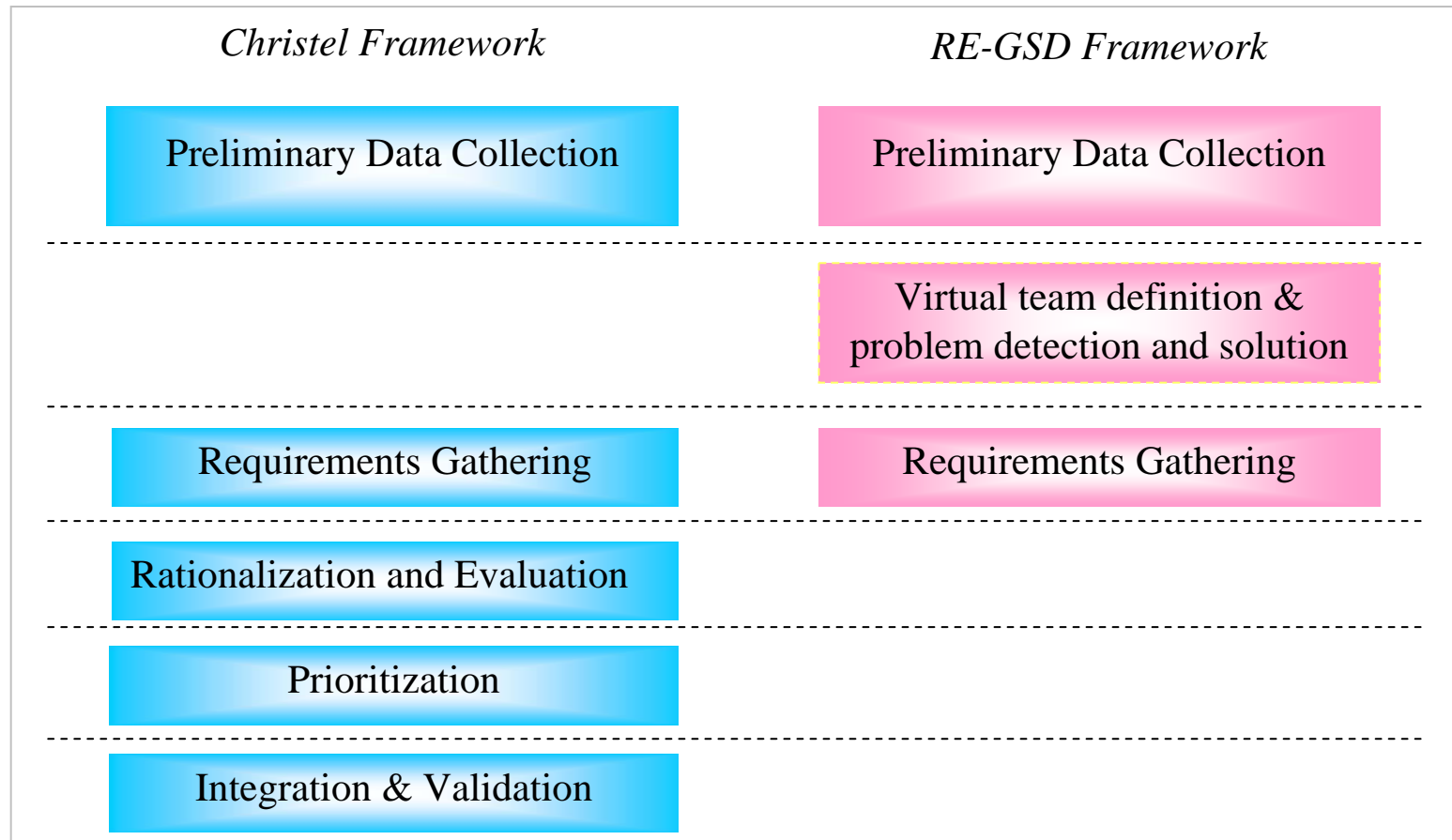
(Damian-Zowghi 2002, Richardson et al 2005)

The logo for ALARCOS is located in the top-left corner. It features a stylized blue and white archway with a person silhouette inside, set against a dark blue background with a grid pattern. The word 'ALARCOS' is written in white above the archway.

Defining a framework
for the Requirements Elicitation Process
in GSD projects,
considering stakeholders' features
in order to
detect problems and propose solutions
to decrease their influence and
improve the process
and the product quality



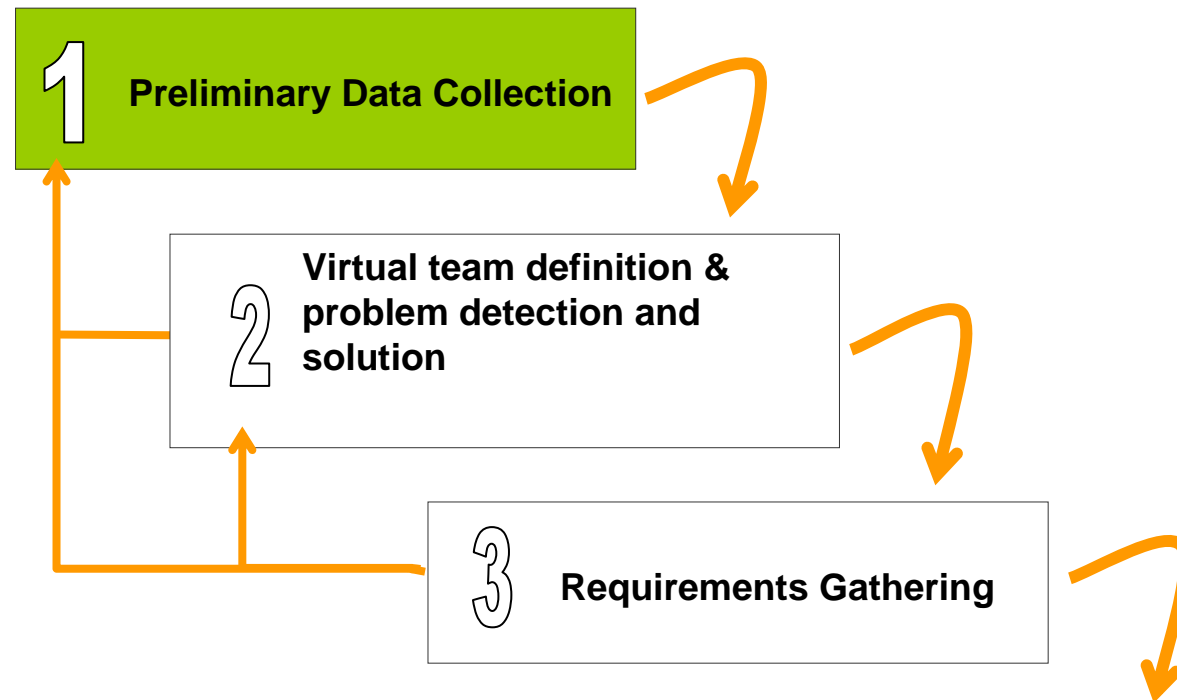
RE-GSD main phases



(Christel 1992)



Phase 1: Preliminary Data Collection



- Goal: knowing as much as possible about the requirements elicitation scenario



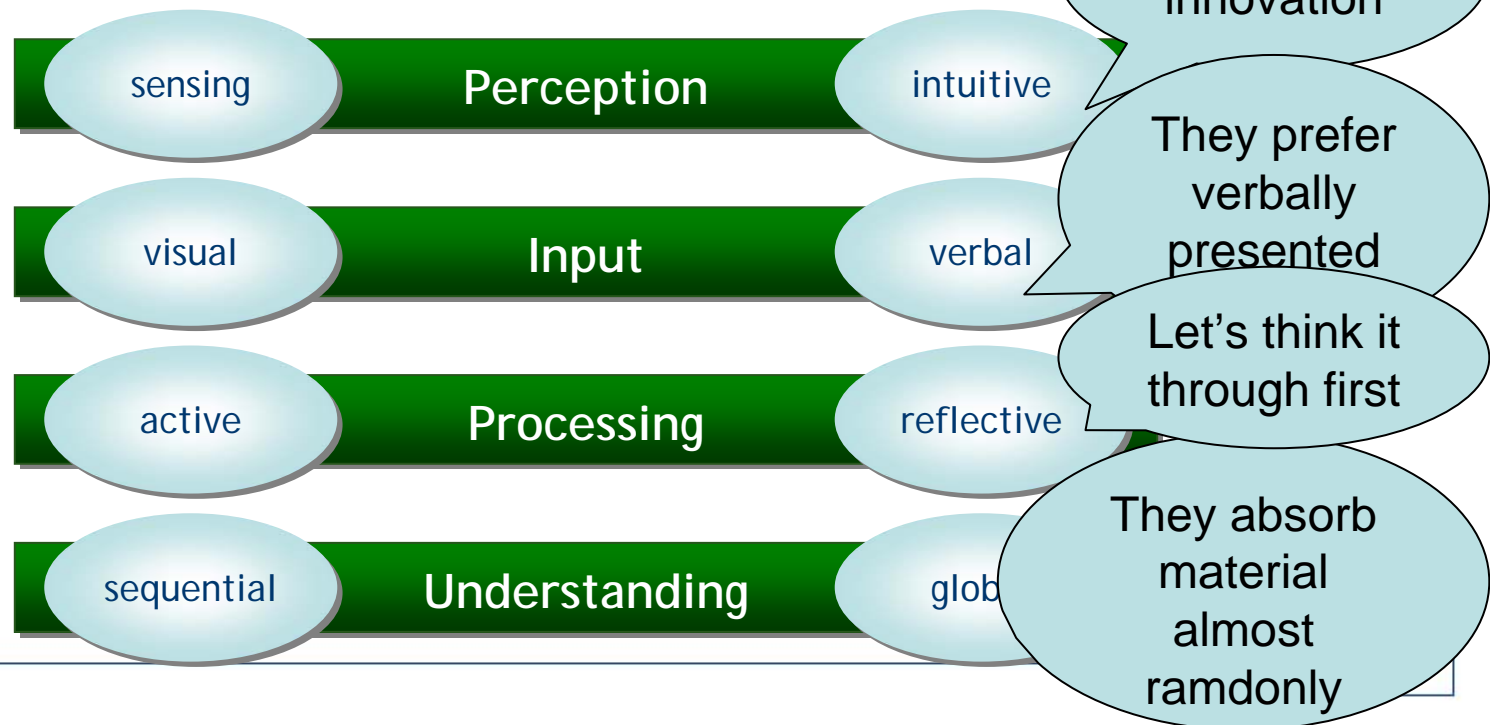
Requirements Engineering
“needs to be sensitive to how people
*perceive and understand
the world around them,*
how they interact, and how the sociology
of the workplace affects their actions”
(Nuseibeh, 2000)



Phase 1: Preliminary data collection

- Felder and Silverman Model
- Learning: Perception and Processing
- 4 categories - 2 subcategories
- Preferences: Strong – Moderate – Slight
- Multiple choice test

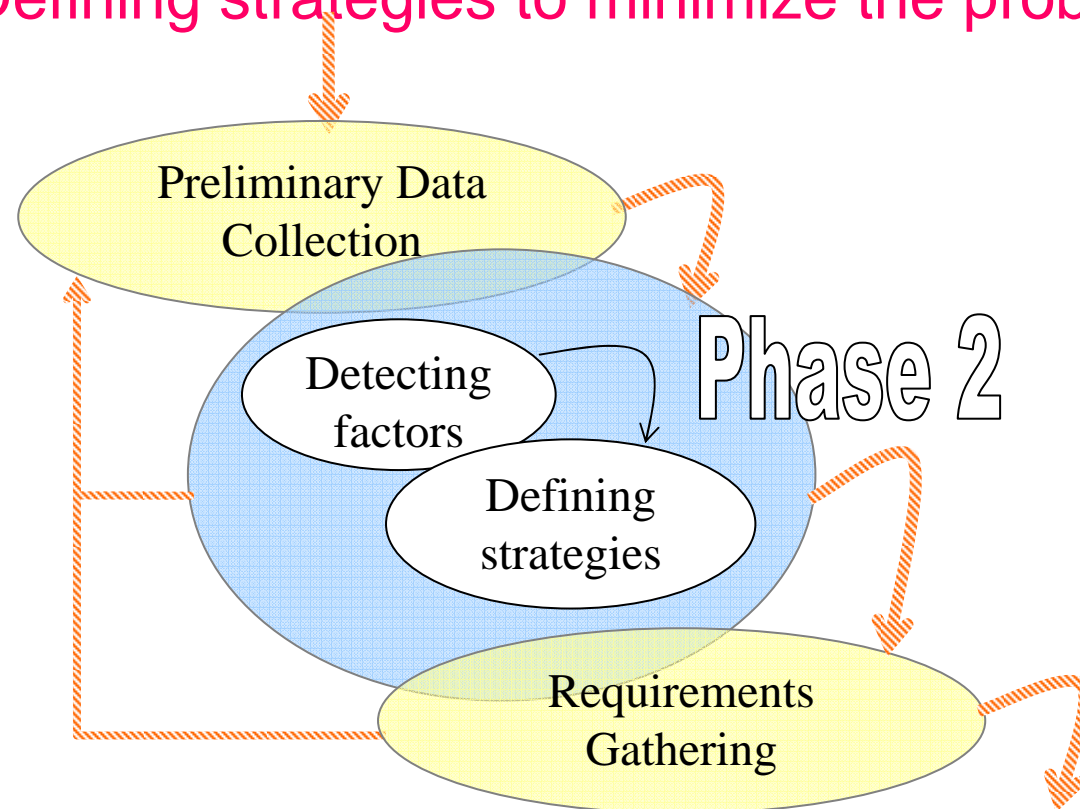
<http://www.engr.ncsu.edu/learningstyles/ilsweb/>





Phase 2: Problem Detection and Solution

- Main Goal:
 - Analyzing the data to detect problems
 - Defining strategies to minimize the problems





Phase 2: Problem Detection and Solution

- **Determining factors**
 - **Time overlap**
(high, intermediate, low)
 - **Language difference**
(high, high-intermediate, intermediate, low-intermediate, low)
 - **Cultural difference**
(high, intermediate, low)
 - **Group Cognitive Style**
(type1, type2, type3)

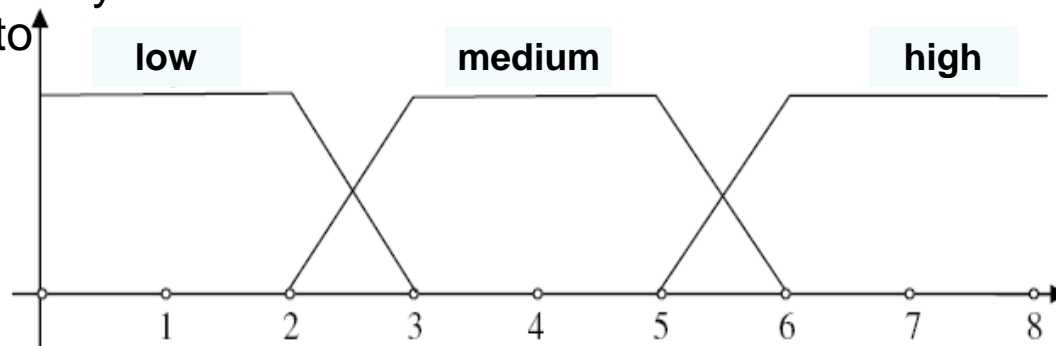


Phase 2: Evaluating time overlap (Task 1)

Form 4: Calculating overlap in daily working time

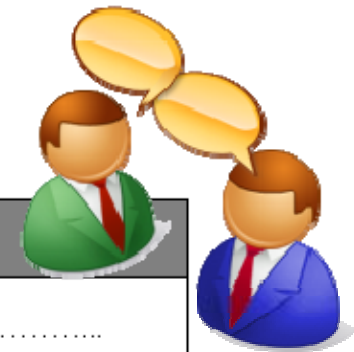
	Greenwich time																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
S1							■	■	■	■	■	■	■	■	■									
S2								■	■	■	■	■	■	■	■	■	■							
S3											■	■	■	■	■	■	■	■	■	■				
<i>Overlap</i>											■	■	■	■										

- Linguistic tags are easy to remember and to refer to.
- Can be reused in different projects.



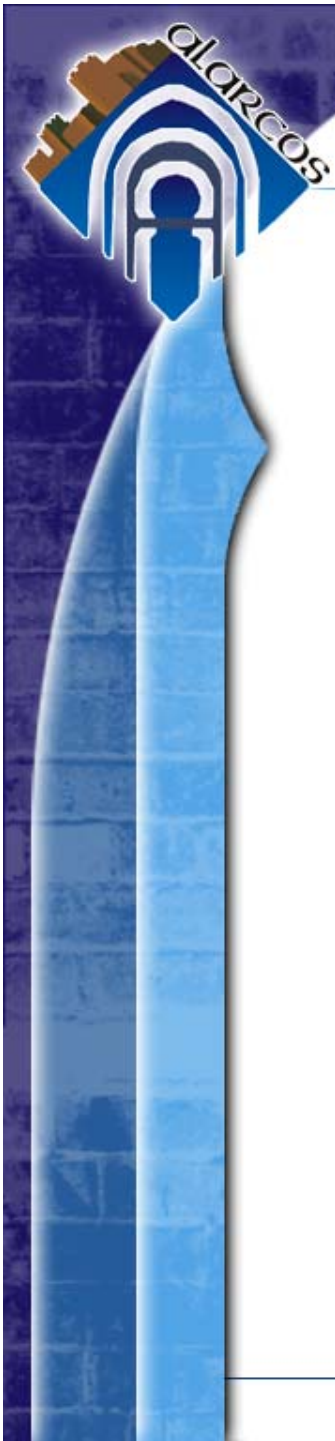


Phase 2: Evaluating Language Difference (Task 1)



Form 7: Degree of knowledge of a common language

Possible common language	Language:	
Choose the options closer to your virtual team	<input type="radio"/> All the stakeholders are from the same country <input type="radio"/> Stakeholders don't share the mother language but they have a high level of knowledge about the chosen common language.	High
	<input type="radio"/> Stakeholders share the mother language but they are from different countries. <input type="radio"/> Stakeholders don't share the mother language but they a high-intermediate level of knowledge about the chosen common language.	High-Intermediate
	<input type="radio"/> Stakeholders don't share the mother language but they have at least an intermediate level of knowledge about the chosen common language.	Intermediate
	<input type="radio"/> Stakeholders don't share the mother language but they have at least a low-intermediate level of knowledge about the chosen common language.	Low-Intermediate
	<input type="radio"/> Stakeholders don't share the mother language and all of them have a low level of knowledge about the chosen common language.	Low



Phase 2: Analyzing Cultural Difference (Task 1)

Hofstede model: Five dimensions

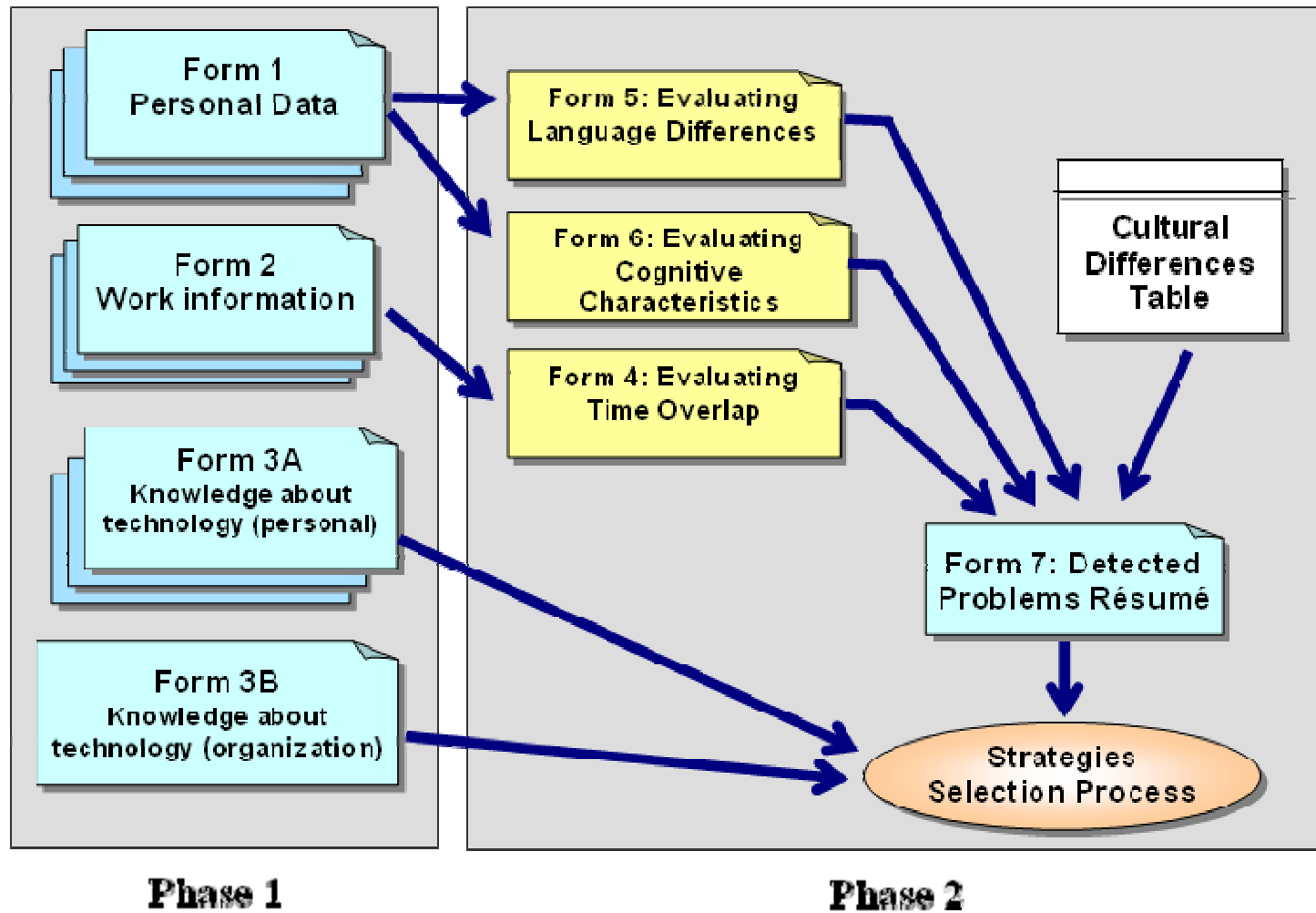
- *Power Distance Index (PDI)*
- *Individualism (IDV)*
- *Uncertainty Avoidance Index (UAI)*
- *Masculinity (MAS)*
- *Long-Term Orientation (LTO)*

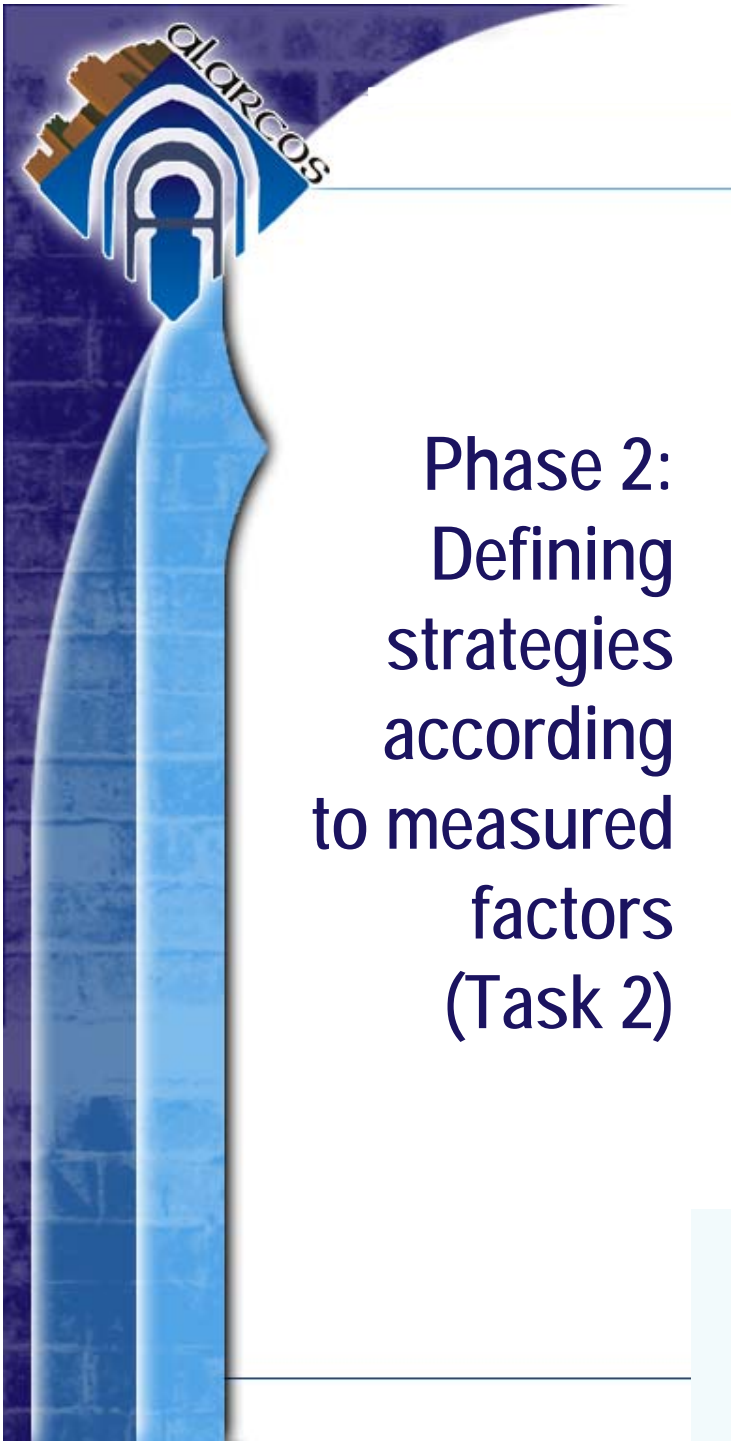
Country	PDI	IDV	UAI	MAS	LTO
Argentina	49	46	56	86	
Australia	36	90	61	51	31
Austria	11	55	79	70	
Belgium	65	75	54	94	
Brazil	69	38	49	76	65
Canada	39	80	52	48	23
Chile	63	23	28	86	
China					118
Spain	57	51	42	86	



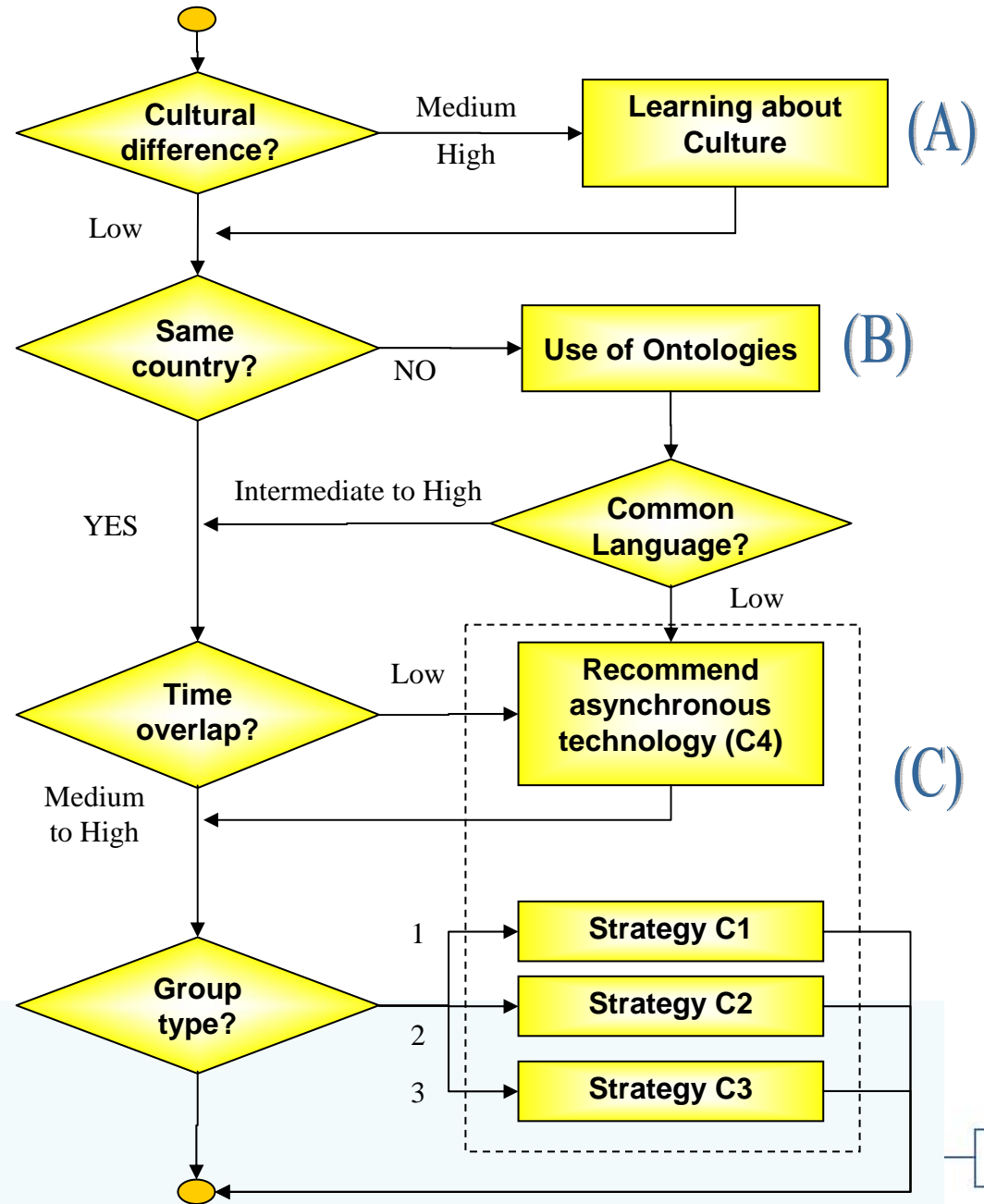
Stakeholders cognitive characteristics

- **Group types**
 - **Type 1**
No strong preferences in the team.
 - **Type 2**
There are strong preferences but not at the opposite ends of the same category.
 - **Type 3**
There are strong preferences at the opposite ends of the same category (conflict of preferences)





Phase 2:
Defining
strategies
according
to measured
factors
(Task 2)

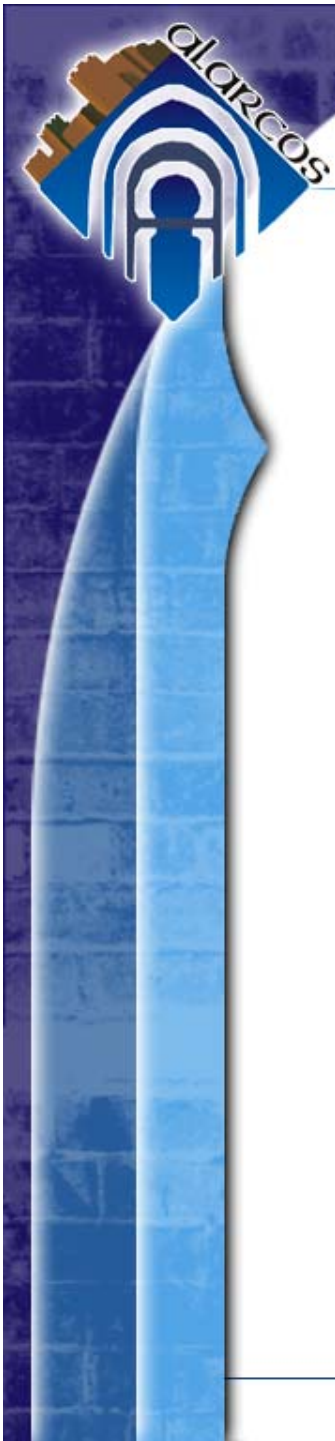




Strategies

- (A) Training to minimize cultural differences
- (B) Use of Ontologies
- (C) Technology Selection

	Inadequate communication	Time separation	Cultural diversity	Knowledge management
Minimizing cultural differences	✓		✓	
Use of Ontologies	✓		✓	✓
Technology selection	✓	✓	✓	



(B) Use of Ontologies

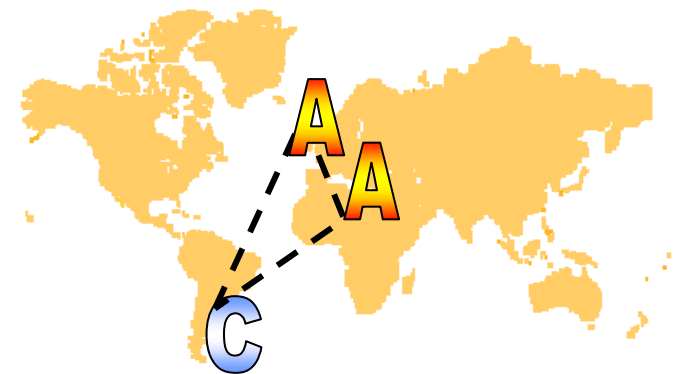
- Ontologies' importance during requirements elicitation processes
 - Clarify the structure of knowledge
 - Reduce conceptual and terminological ambiguities
- Using a domain ontology as part of the elicitation process helps stakeholders' communication
 - Sets the basic vocabulary
 - Clarifies meaning for each new word

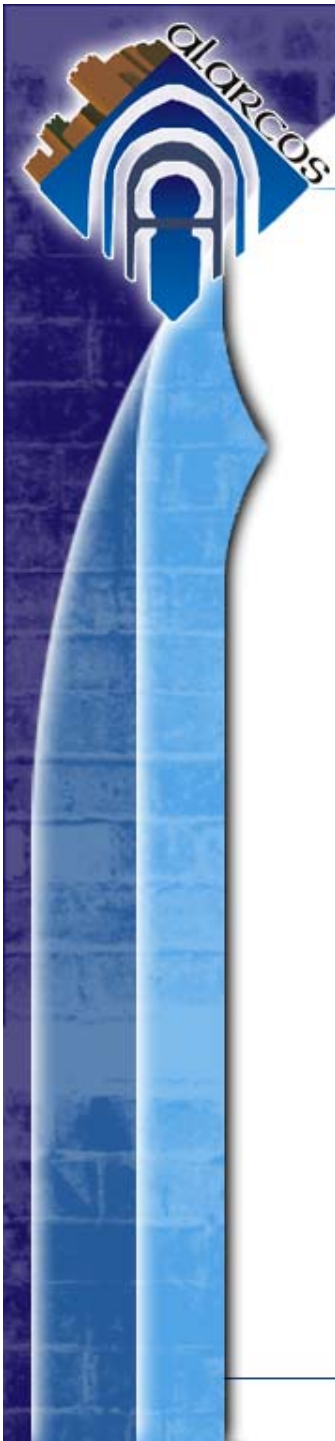


Empirical Validation

- 16 students from UCLM (Spain)
- 8 software engineers/researchers from UNCOMA (Argentina)
- Randomly distributed

	O ₊	O ₋
Gw ₊	G4 G8	G6 G3
Gw ₋	G1 G7	G2 G5





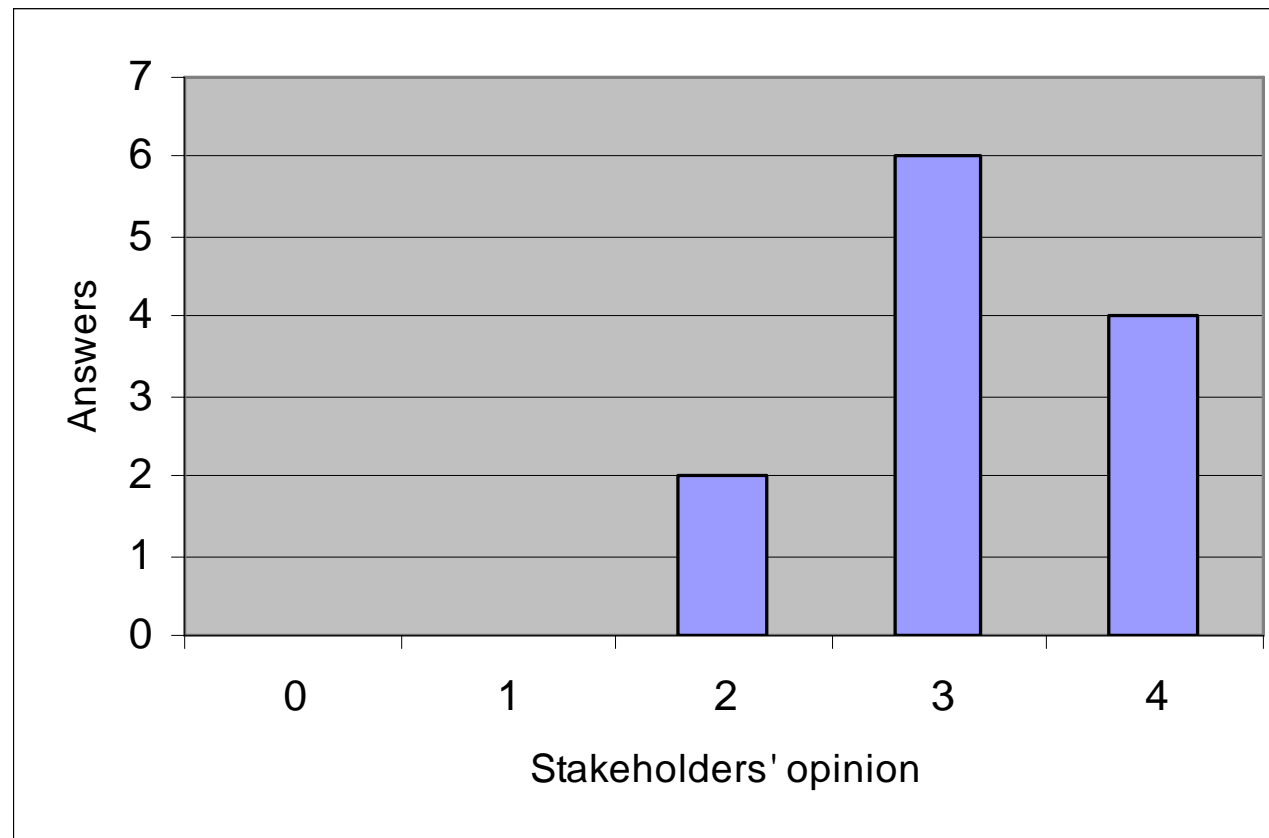
Empirical Validation

- 8 Teams = 2 analysts (Spain) + 1 client (Argentina)
- Problem: to obtain the requirements from the client
- 1 week to interact and write the **software requirement specification**
- We collected
 - Copies of emails and records of audio and chat conversations
 - Post-experiment questionnaire



Empirical Validation

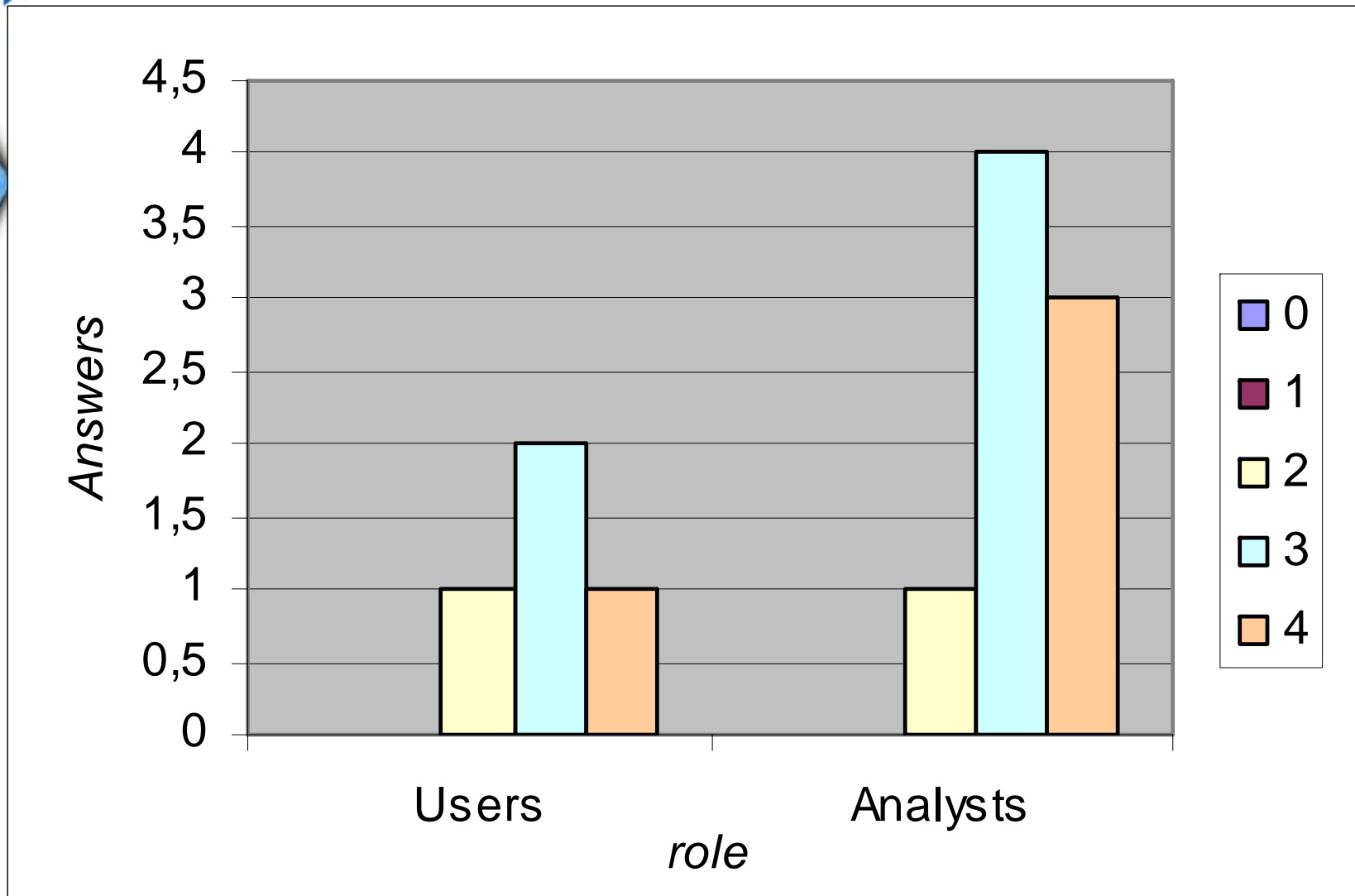
- *“Do you think the ontology was useful in improving communication in your team?”*



0 useless
1 slightly
2 indiffer.
3. Useful
4. very



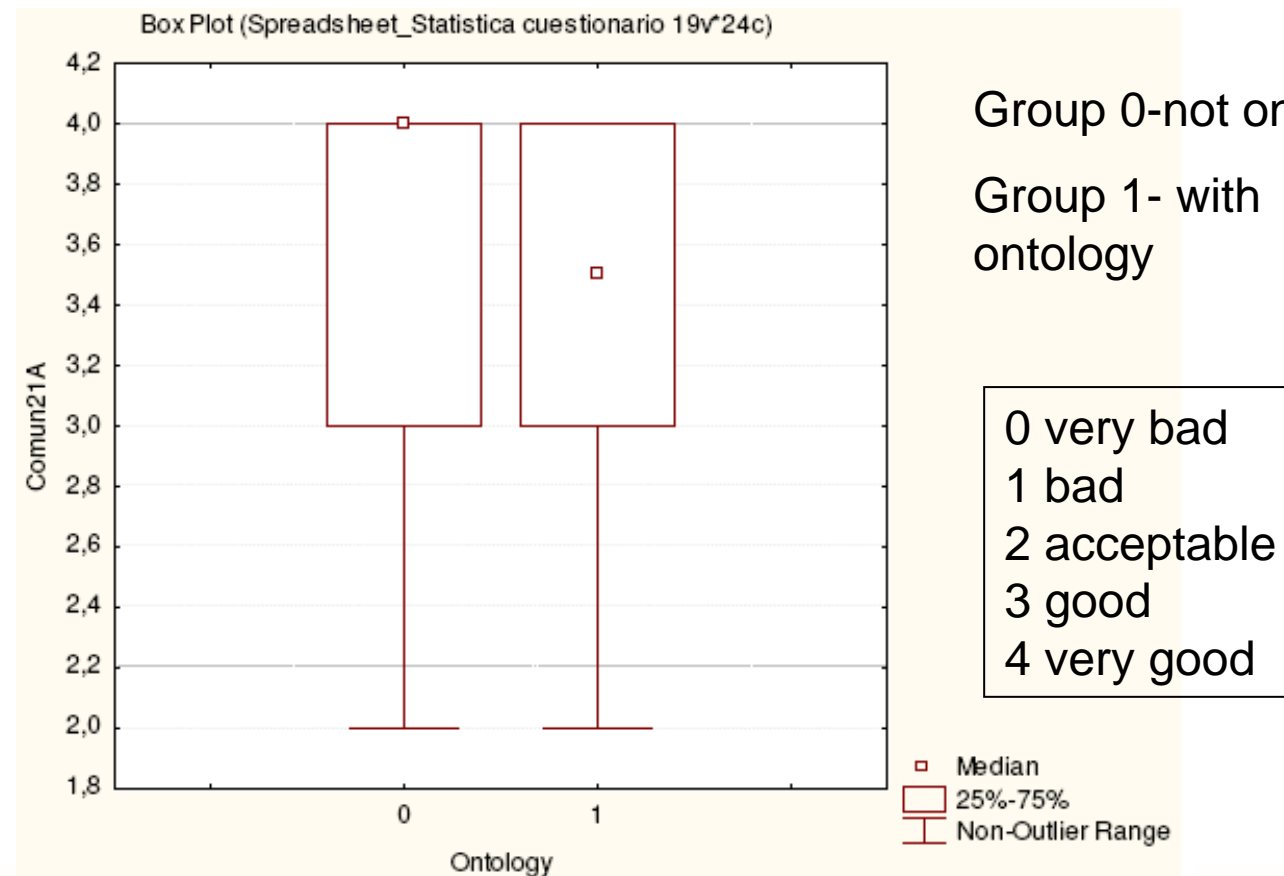
Empirical Validation





Empirical Validation

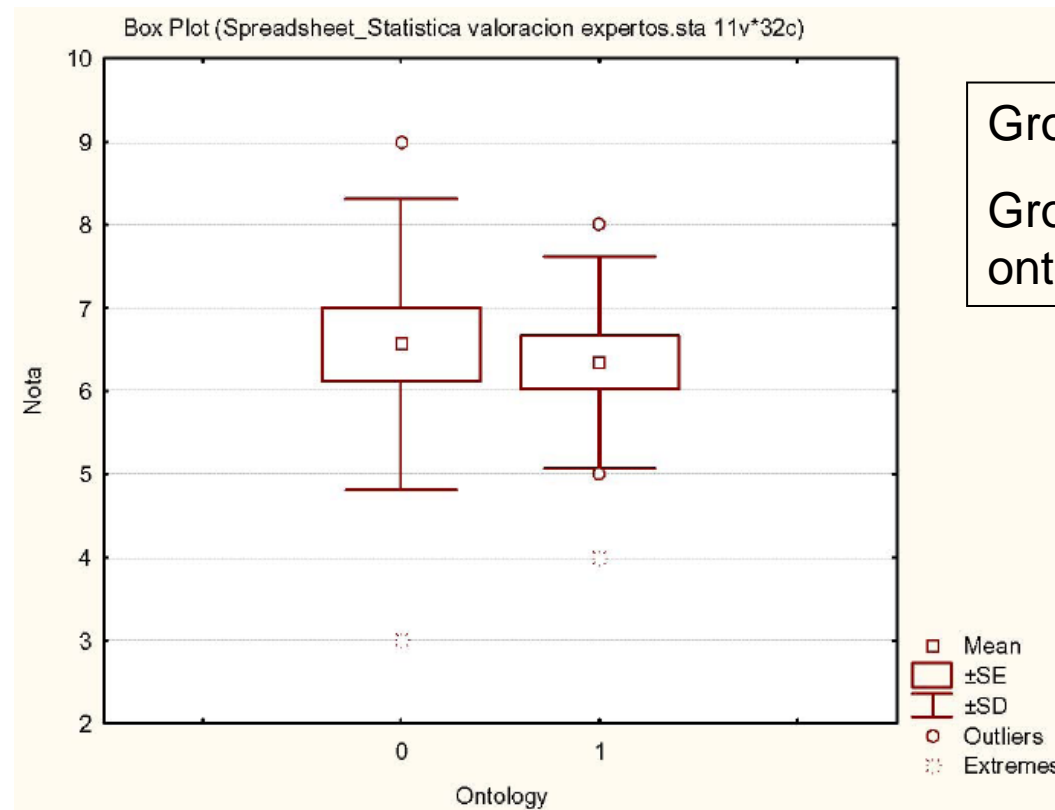
- *“How good do you think the quality of communication in your team was?”*





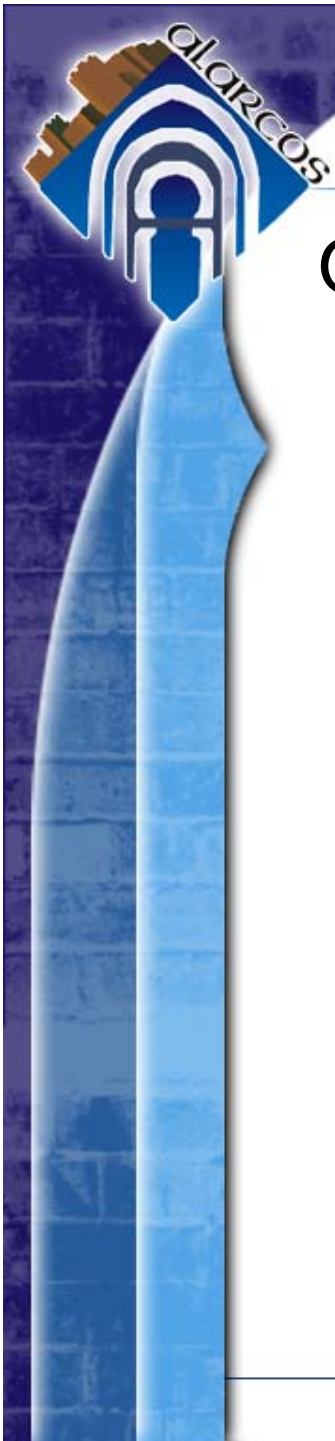
Empirical Validation

- *Quality of the **software requirements specification** from the point of view of external reviewers*



Group 0-not ontology

Group 1- with ontology



Conclusion of the Validation

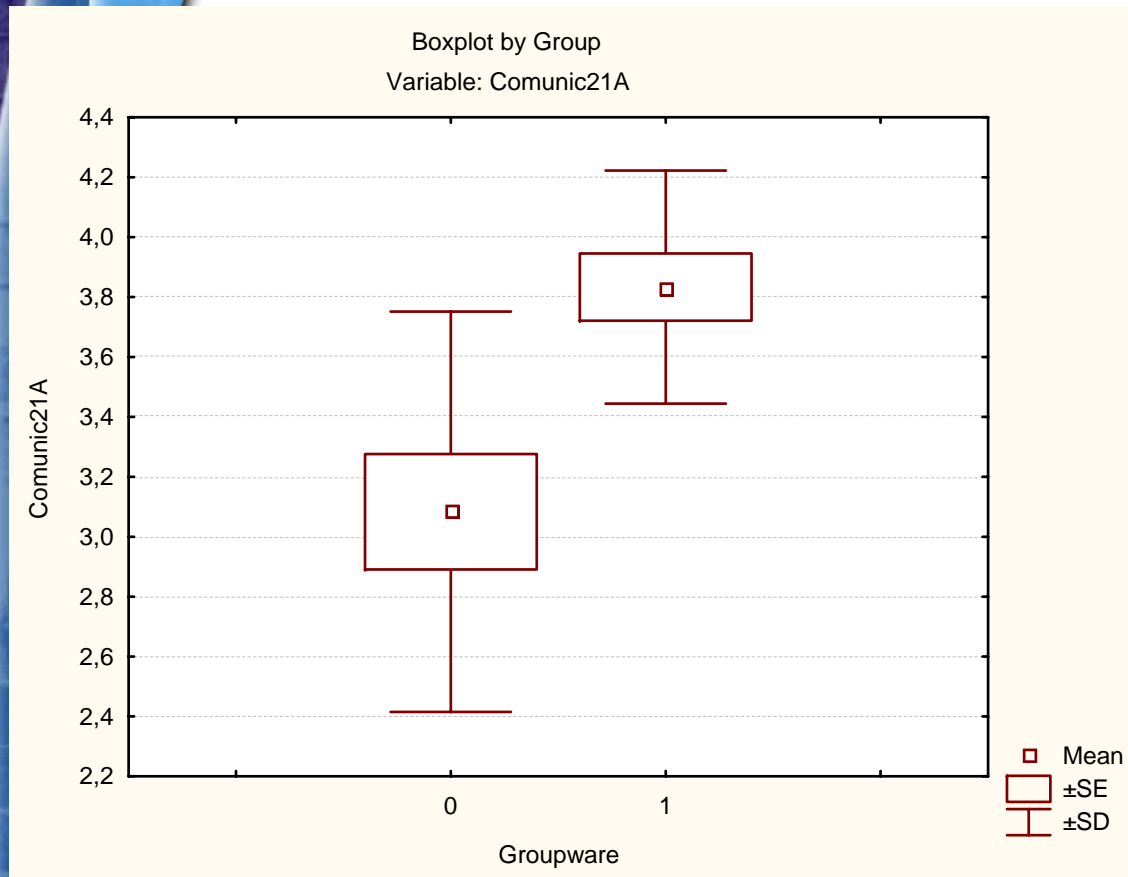
Ontologies used as a communication facilitator during a global requirement elicitation process

- Most people considered the ontology to be useful and very useful (especially analysts)
- However, with regard stakeholders' satisfaction and productivity the results did not coincide with our expectations
- The language difference between the stakeholder are not very great



$H_{0,2}$: Stkh' satisfaction about communication (Gw₊, Gw₋)

- $H_{0,2}$: Using groupware tools according to the cognitive profile of stakeholders does not affect stakeholders' satisfaction with communication during the requirements elicitation process.
- $H_{1,2} = \neg H_{0,2}$



	comun21A
Mann-Whitney U	28,000
Wilcoxon W	106,000
Z	-2,860
Asymp. Sig. (2 tailed)	,004
Exact Sig. [2*(1-tailed Sig.)]	,010(a)

a Not corrected for ties.

b Grouping variable: groupware

We reject the null hypothesis $H_{0,2}$ (99%)



- Global software development is affected by many factors which complicate communication
- We propose a framework which focuses on predicting problems and proposing strategies to avoid those problems
- We are currently evaluating the different strategies



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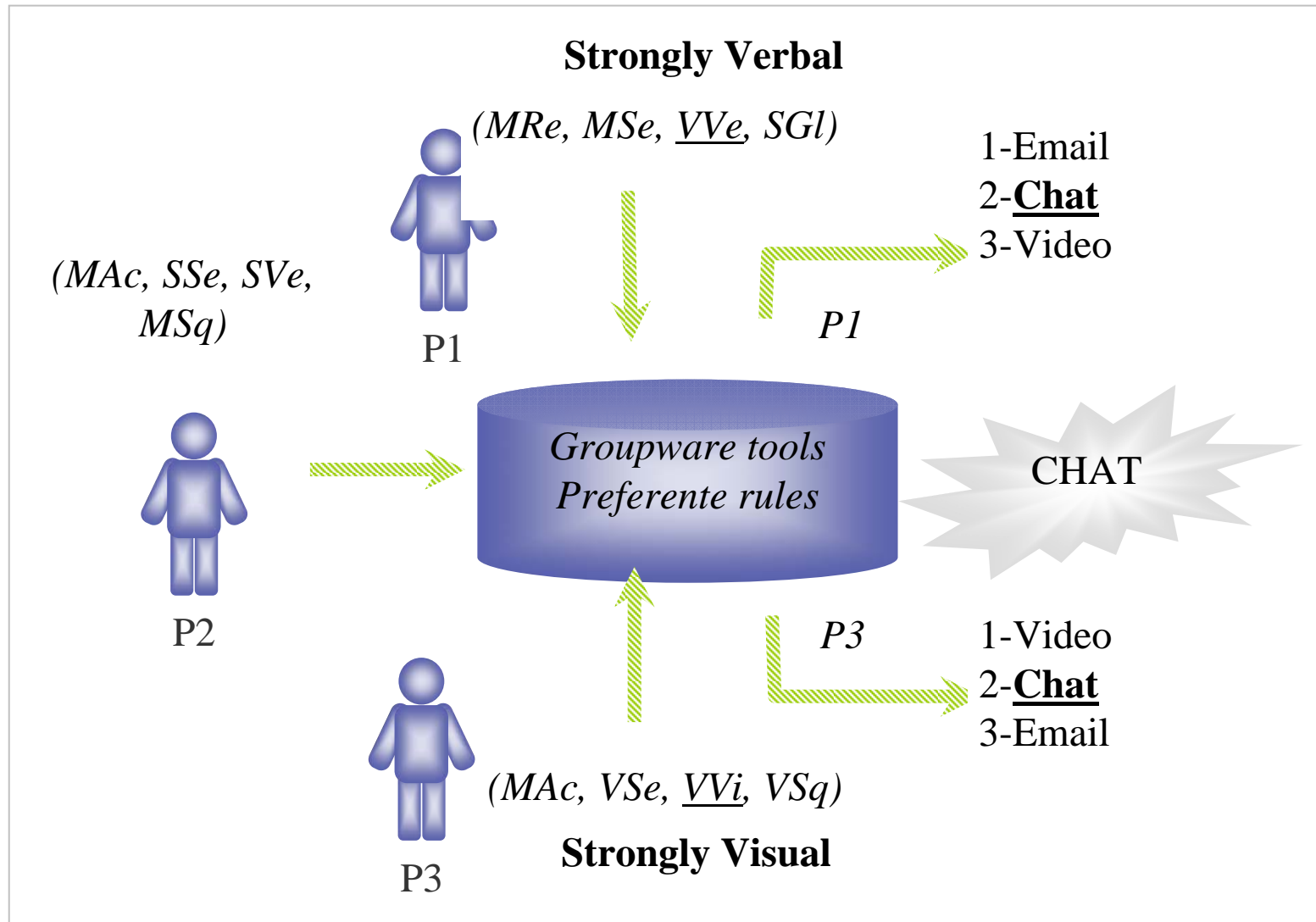


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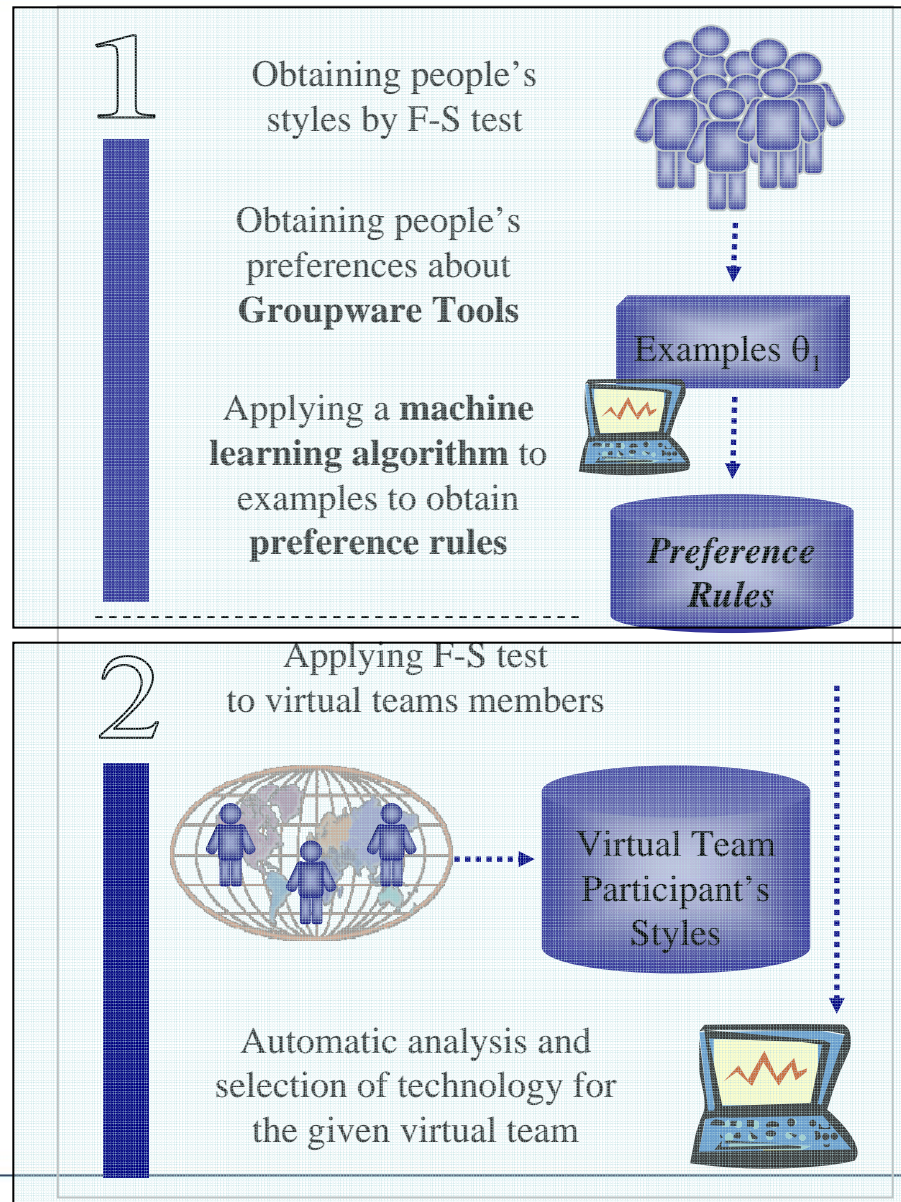


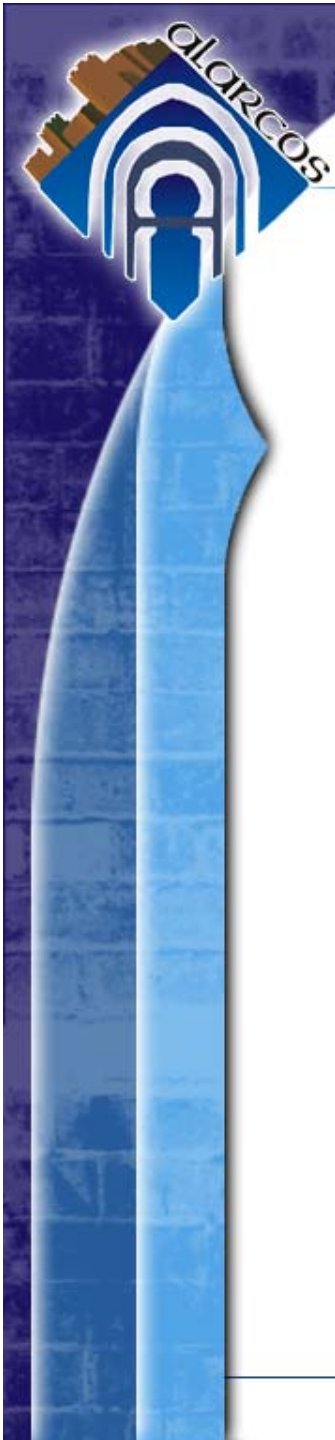
Phase 2: Problem Detection and Solution





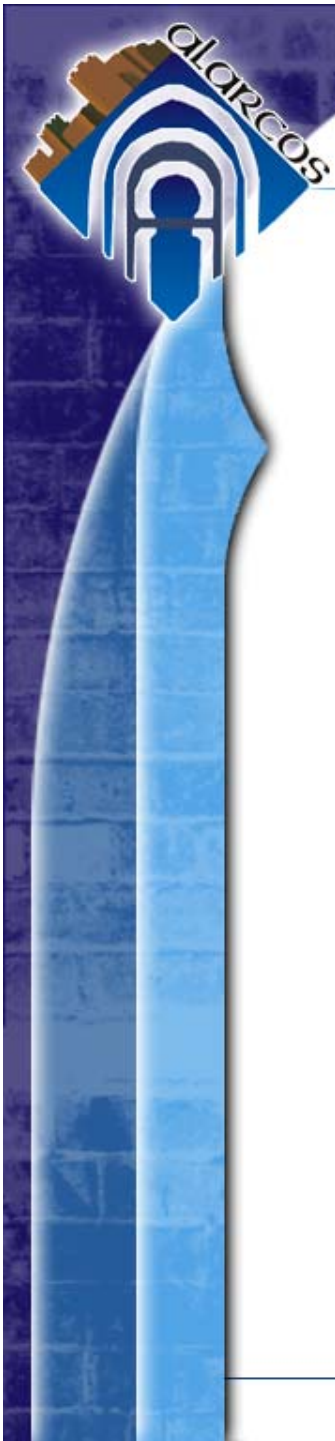
A Groupware tools Selection methodology





(A) Training to minimize cultural differences

- Cultural differences cannot be avoided
 - but stakeholders can learn about the differences of the other culture.
- Being trained about cultural diversity is crucial
 - To be aware of normal behaviour in other cultures
 - To be conscious of our own behaviour (what can be offensive or misunderstood)
- Strategy: Virtual mentoring (simulation)
 - virtual actors become an interesting way for motivating stakeholders in foreign language training and cultural familiarization (Sims, 2007)

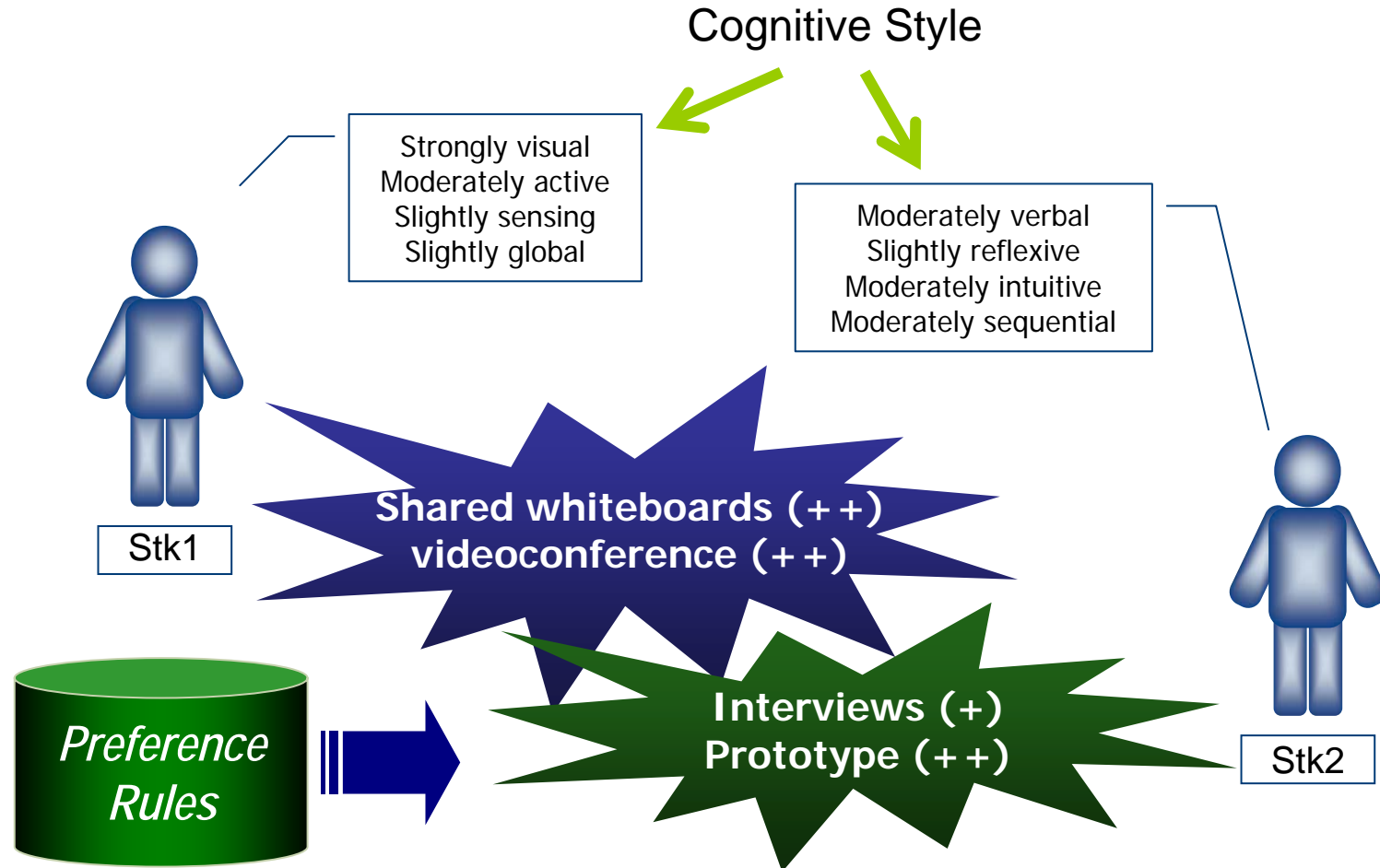


(C) Technology Selection

- **Variety of technology**
 - **Groupware Tools**
 - e-mail, chat, instant messaging, videoconference, audio conference, shared whiteboards, ...
 - **Requirements Elicitation Techniques**
 - Interviews, software prototypes, use cases and scenarios, observation, ...
- **Selection based on stakeholders' cognitive characteristics**
 - Machine learning algorithms applied on preference examples, using F-S Learning Style Model



Technology Selection





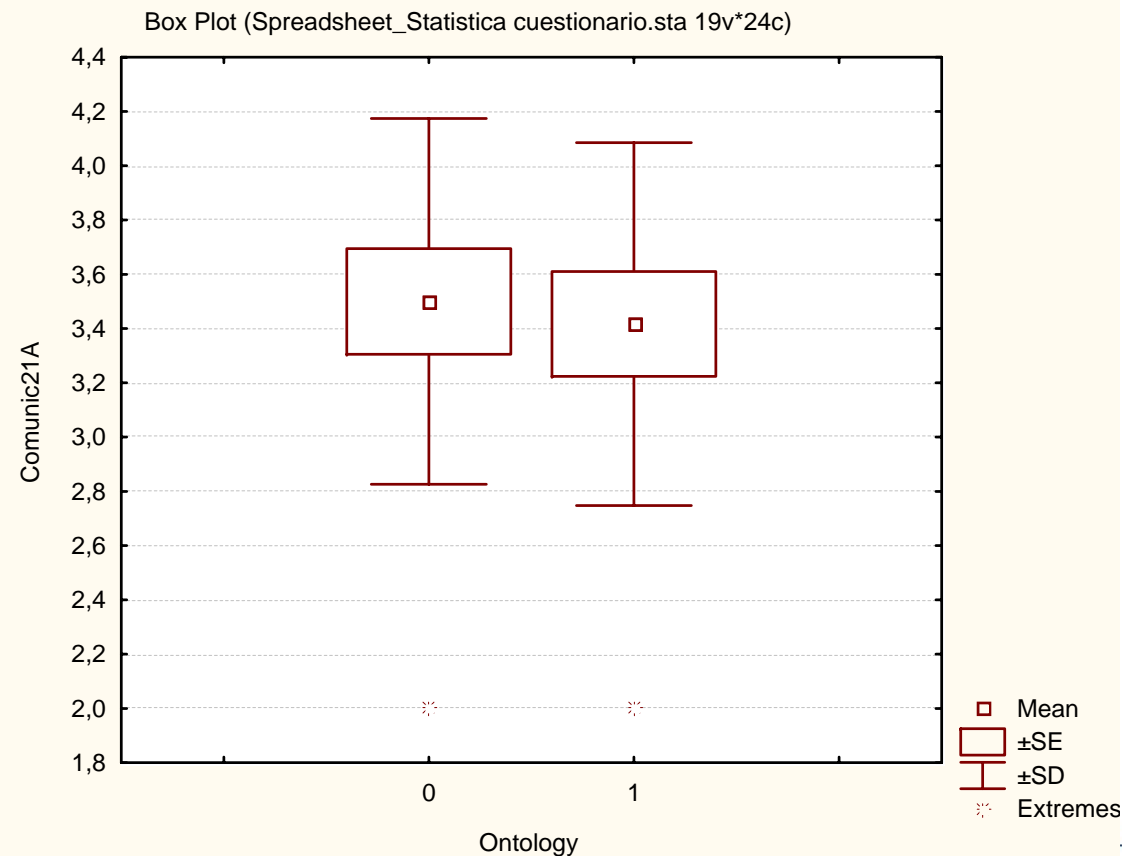
Empirical Validation

- Independent Variables
 - Ontology (Yes/No)
 - Groupware (Most suitable/Less suitable)
- Fixed Variables
 - Cultural difference (low)
 - Language difference (low-intermediate)
 - Time separation (4 hours = intermediate)
 - Type 2 Groups (strong preferences without conflict)
- Dependent Variables
 - Stakeholders' satisfaction with communication during the process
 - Stakeholders' satisfaction with the product (SRS)
 - Software Requirements Specification (SRS) quality



$H_{0,1}$: Stkh' satisfaction with communication (O_+ , O_-)

- $H_{0,1}$: Using a domain ontology does not affect stakeholders' satisfaction with communication during the requirements elicitation process.
- $H_{1,1} = \neg H_{0,1}$



	comun21A
Mann-Whitney U	66.500
Wilcoxon W	144.500
Z	-.357
Asymp. Sig. (2 tailed)	.721
Exact Sig. [2*(1-tailed Sig.)]	.755(a)

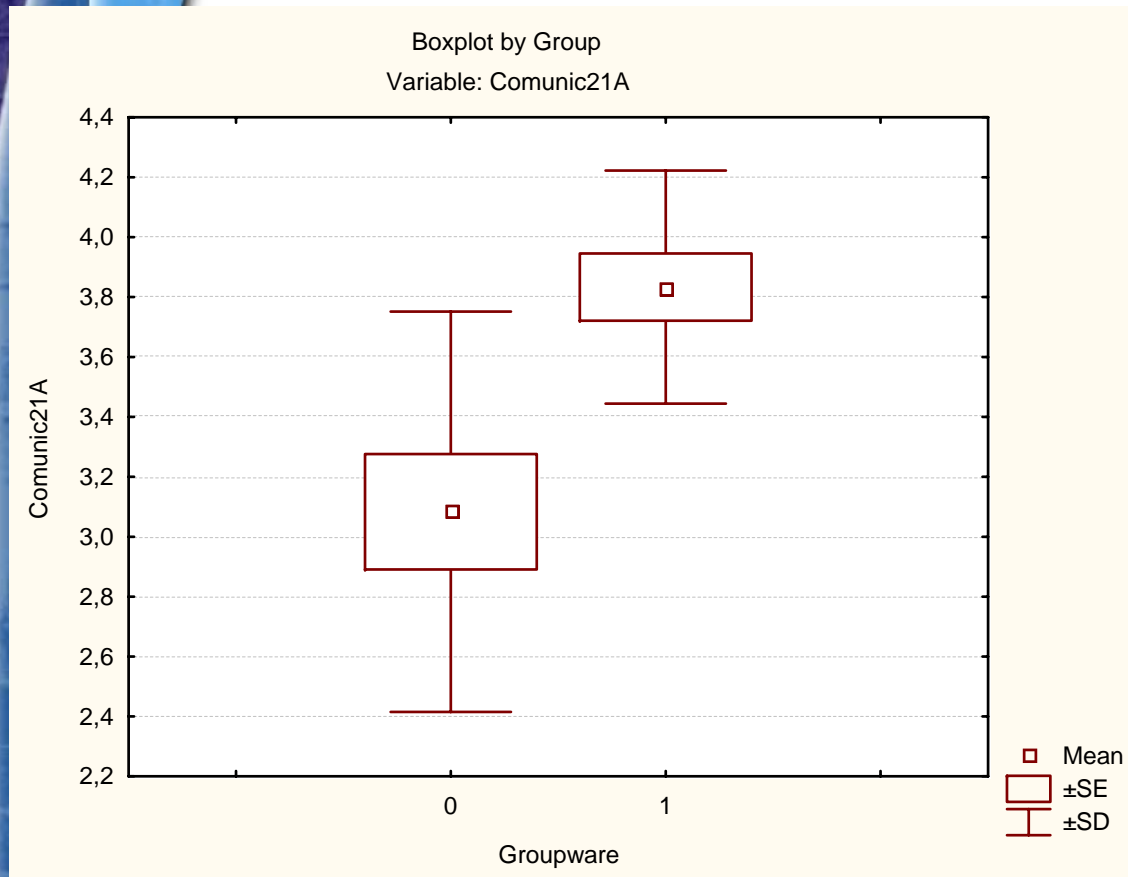
a Not corrected for ties.
b Grouping variable: ontology

We cannot reject the null hypothesis



$H_{0,2}$: Stkh' satisfaction with communication (Gw₊, Gw₋)

- $H_{0,2}$: Using groupware tools according to the cognitive profile of stakeholders does not affect stakeholders' satisfaction with communication during the requirements elicitation process.
- $H_{1,2} = \neg H_{0,2}$



	comun21A
Mann-Whitney U	28,000
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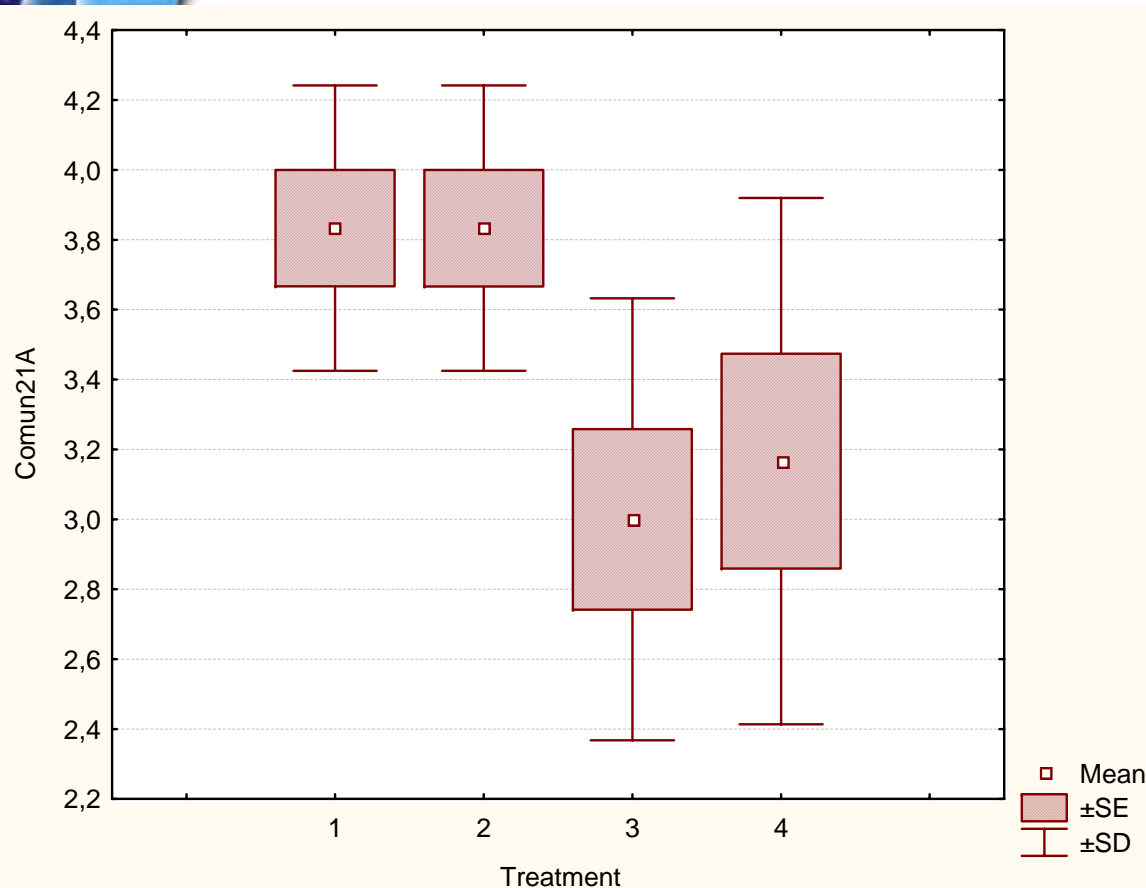
b Grouping variable: groupware

We reject the null hypothesis $H_{0,2}$ (99%)



$H_{0,3}$:Stkh' satisfaction with communication (treatment)

- $H_{0,3}$: *There is no interaction effect between using a domain ontology and groupware tools according to the cognitive profile of stakeholders, concerning stakeholders' satisfaction with communication during the requirements elicitation process.*
- $H_{1,3} = \neg H_{0,3}$



	comun21A
Chi-cuadrado	8,433
gl	3
Sig. asintót.	,038

a Kruskal-Wallis Test

b Variable de agrupación: treatment

We reject the null hypothesis $H_{0,3}$ (95%)