



The Role of Distances in Requirements Communication

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Abstract

In our research, we have explored the concept of distance as a factor that influences requirements communication and ultimately the effort required to successfully complete software engineering projects. Physical distances, as well as, organisational, cognitive and psychological distances between customers, business roles and software engineers can cause communication gaps, and lead to misunderstood or uncommunicated requirements. This in turn may result in producing software that does not meet the customers' requirements, and subsequent low number of sales or additional cost required to redo the implementation.

We have defined a theory of distances for software engineering based on empirical data, and operationalised this theory through case studies of ongoing software development projects. In these case studies, we have measured distances and identified how these affect the requirements communication within the studied cases. We have found that the concept of distance in general, and the use of distance measurements can enable constructive group reflection on communication gaps and improvements to development practices. An increased awareness of distances and their impact can support practitioners in identifying and addressing communication issues.

In this talk, I will present the theory of distances, different types of distances and how they affect requirements communication.



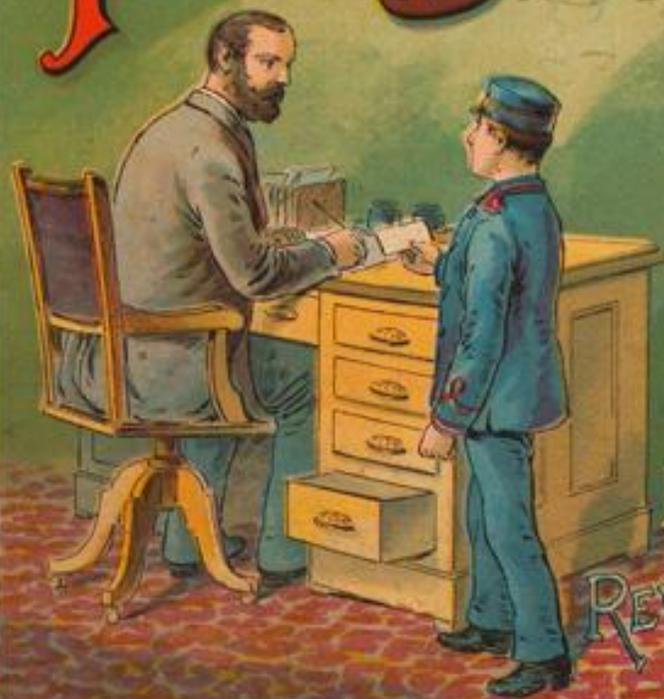
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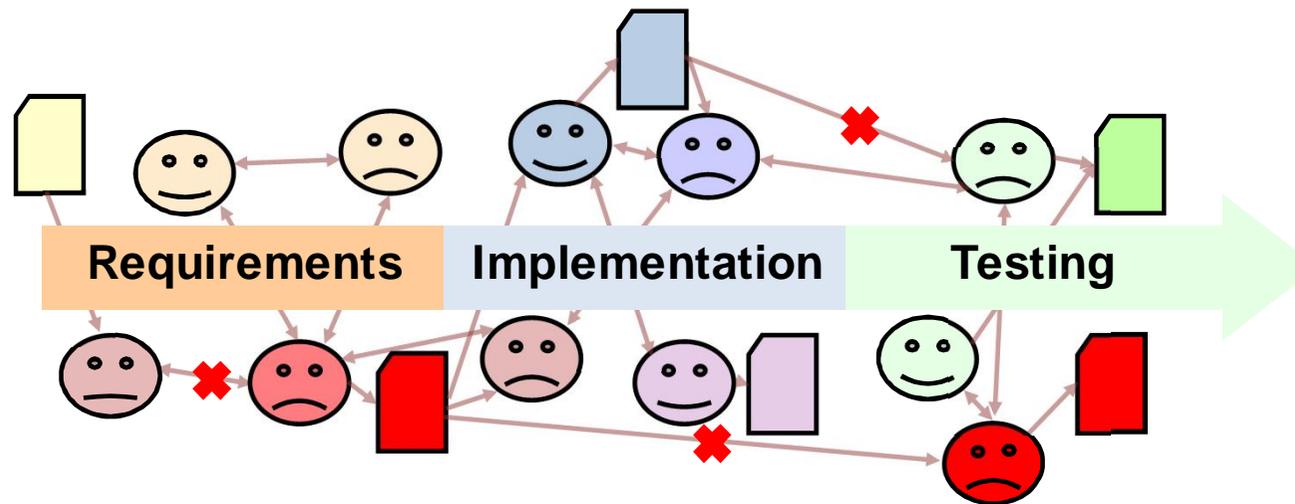
Requirements Communication

Needs &
Expectations



Users &
Customers

Product

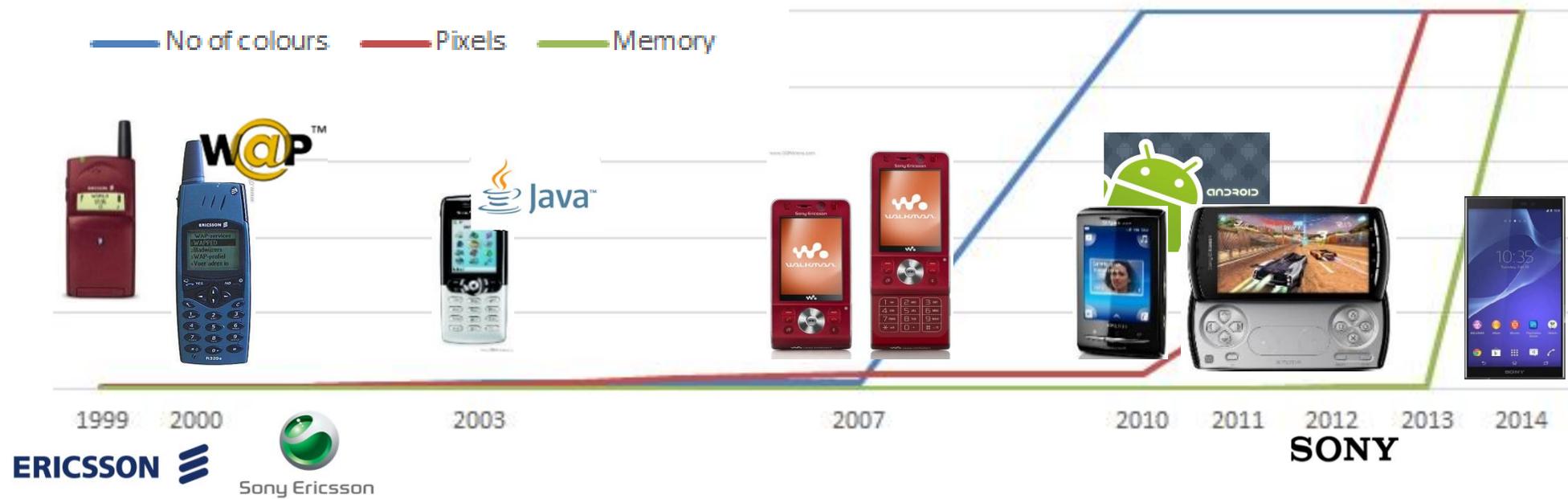


Bjarnason, E, K Wnuk, and B Regnell. "Requirements are slipping through the gaps—A case study on causes & effects of communication gaps in large-scale software development." *Requirements Engineering Conference (RE), 2011 19th IEEE International*. IEEE, 2011.

Distances in Software Engineering



Bjarnason, E. "Distances between requirements engineering and later software development activities: a systematic map." *International Working Conference on Requirements Engineering: Foundation for Software Quality*. Springer, Berlin, Heidelberg, 2013.



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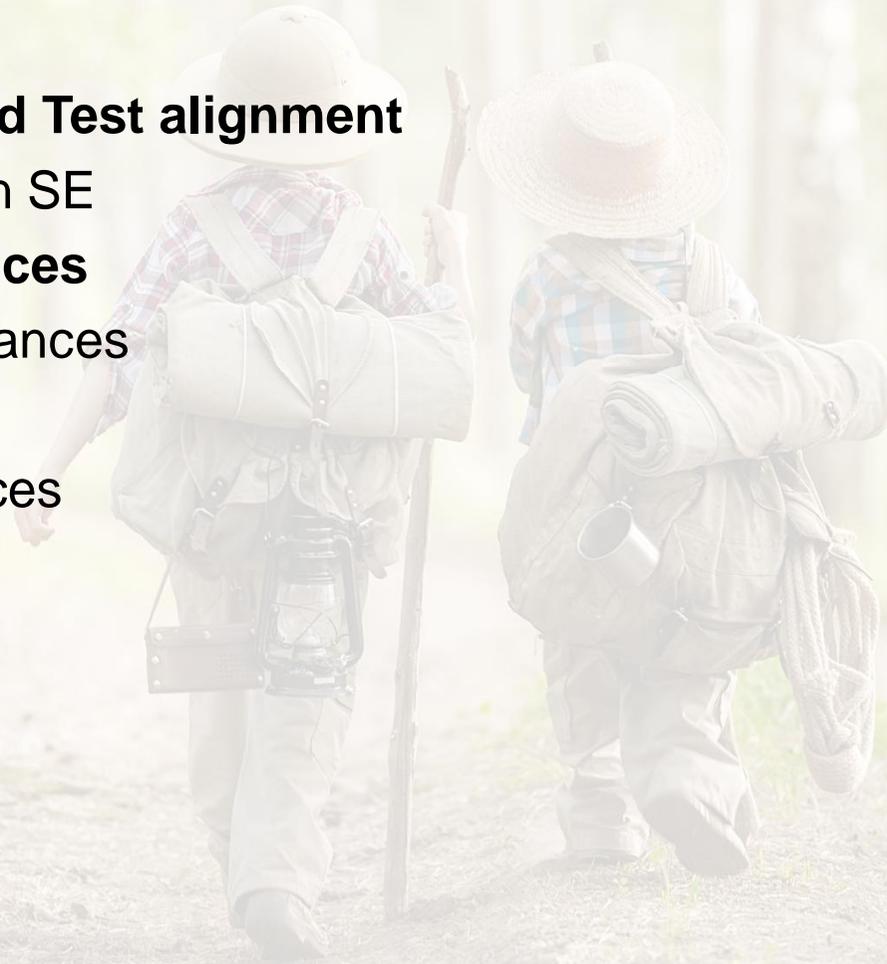


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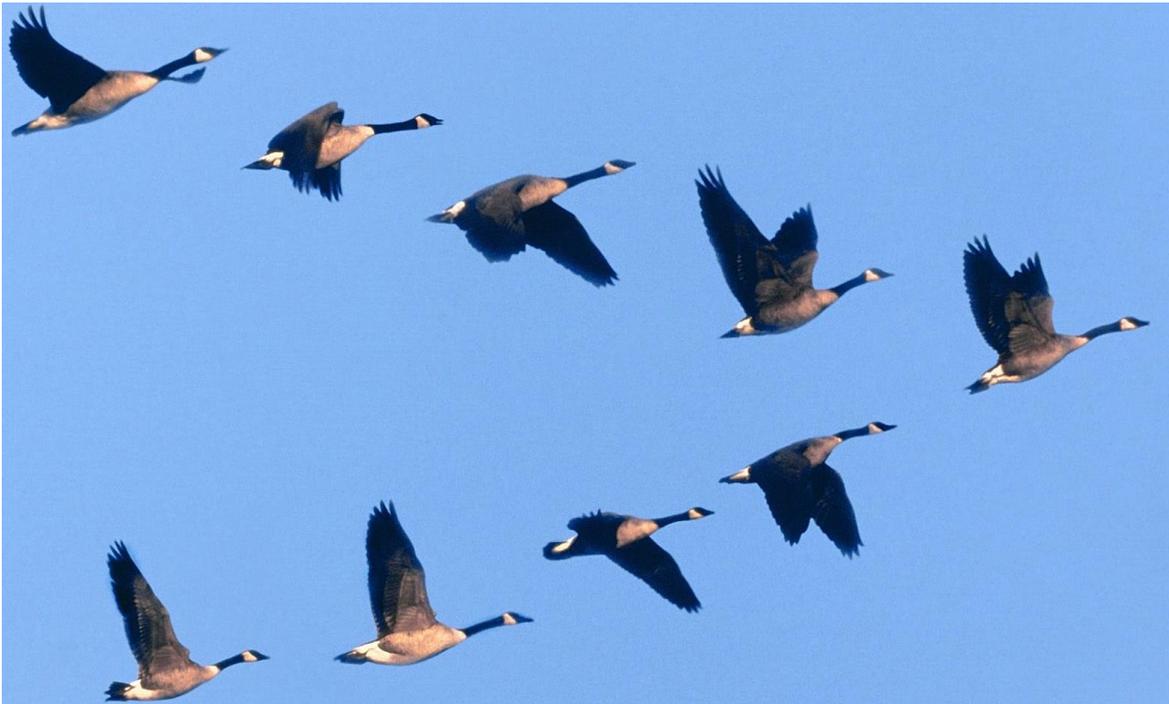
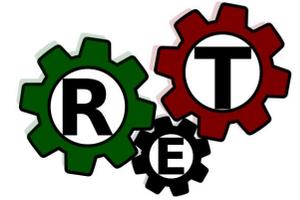


Research Journey

1. **Exploration of RE and Test alignment**
2. **Theory** of Distances in SE
3. **Exploration of distances**
4. **Operationalising** distances
 - Measuring
 - Prescribing practices
5. **Next steps**



Requirements and Test Alignment



Scope

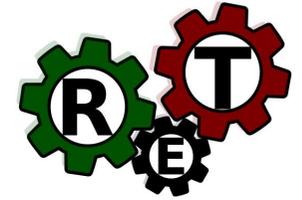
- Challenges & practices
- Processes, artefacts & tools
- Functional vs Quality requirements

Multi-case study

- 10 researchers
- 6 companies
- 30 interviews



Bjarnason, E., Runeson, P., Borg, M., Unterkalmsteiner, M., Engström, E., Regnell, B., ... & Feldt, R. (2014). Challenges and practices in aligning requirements with verification and validation: a case study of six companies. *Empirical Software Engineering*, 19(6), 1809-1855.



Requirements and Test Alignment

Challenges

Common goals & perspectives

Close cooperation

Requirements definition

Test coverage

Requirements volatility

Traceability

Time & resource availability

Managing document space

Outsourcing

Practices

Customer – Dev communication

Job rotation

Non-RE roles involved in requirements definition

Metrics

Policy & process for handling change

Traceability

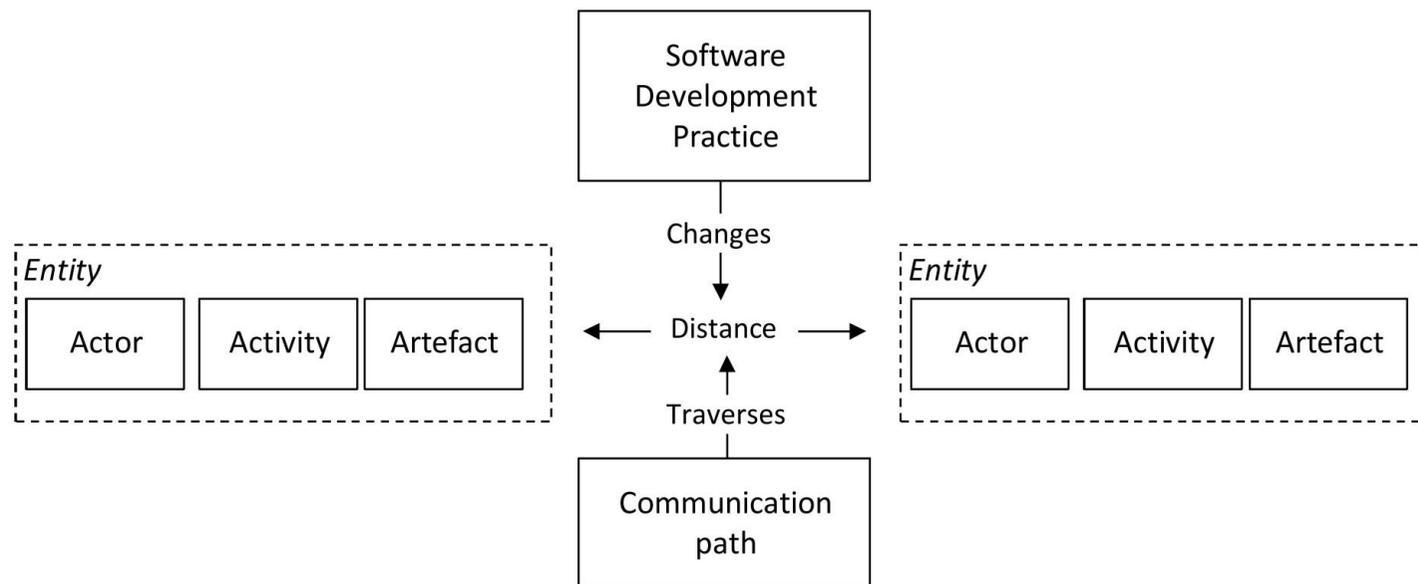
Matching RE & VV techniques (US-ATC, prototype review)

Testing techniques (customer, early, independent)

Safety reqs enforce process adherence

The Theory of Distances in Software Engineering

- Distance: difference in position or level
- Information needs to traverse distance to achieve software development tasks
- Practices decrease problematic distances



Bjarnason, E., Smolander, K., Engström, E., & Runeson, P. (2016). A theory of distances in software engineering. *Information and Software Technology*, 70, 204-219.

Practices affect Distances

	D1 Geographical	D2 Organisational	D3 Psychological	D4 Cognitive	D5 Adherence	D6 Semantic	D7 Navigational	D8 Temporal
AP1 Cross-role collaboration	D	B	D	B; D	D	D		D
AP2 Separate testers		I		B; D	D	B		
AP3 Documentation				B; D	D			
AP4 Aligning documentation structures and tracing		B	D	B; D	D	D	D	
AP5 Cross-artefact reviews		B		B	D	D		
AP6 Incremental software engineering				B; D	D	D		D
AP7 Automated testing					D			D
AP8 Use of alignment metrics				B	D			B

Exploring The Concept of Distances

Case studies

- Open University, IT Department
- Axis Communications, QA Department
- Scania, IT Department

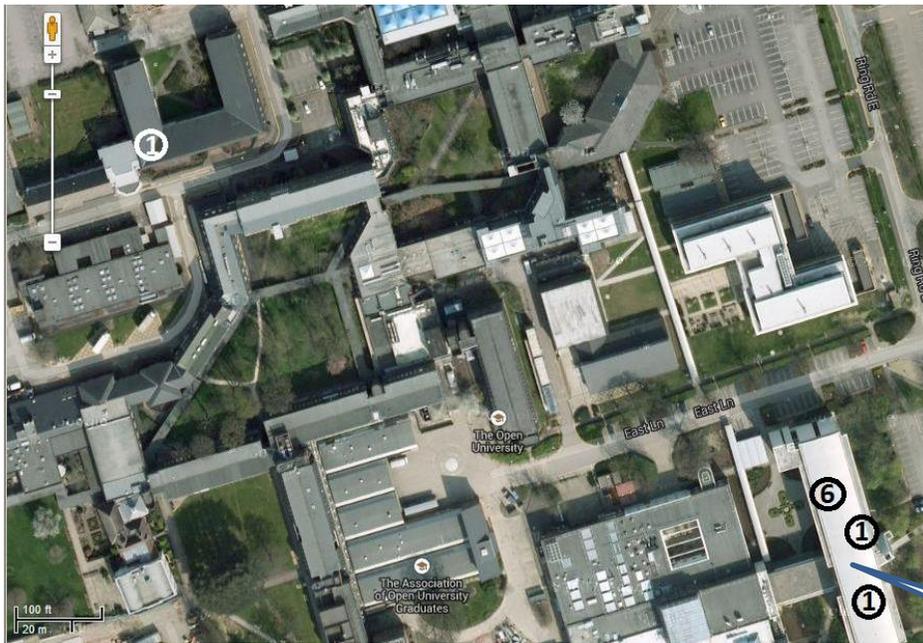


Bjarnason, E, and H Sharp. "The role of distances in requirements communication: a case study." *Requirements Engineering* 22.1 (2017): 1-26.

Mellhorn, M, and E Bjarnason. "Improving Goal Communication with Information Flow Maps and Distances." 2017 IEEE 25th International Requirements Engineering Conference Workshops (REW). IEEE, 2017.

E. Bjarnason, B. Gislason Bern and L. Svedberg. 2018. "A Case Study of Distances in a Large Co-Located Software Development Organisation" In Proceedings of 11th International Workshop on Cooperative and Human Aspects of Software Engineering (CHASE 2018), Gothenburg, Sweden, May 2018, 8 pages.

Example: Geographical distance



Gap: Product owner – core team (Scrum master, devs, tester)

Effect

- Delays in reqts clarification and detailing
- Decreased awareness
- Miscoordination
- Incomplete, incorrect reqts information

Suggested practice: Guest desk for product owner

Average: 77 m
Total within team: 2 760 m

"The conversation slows down."

Example: Organisational distances

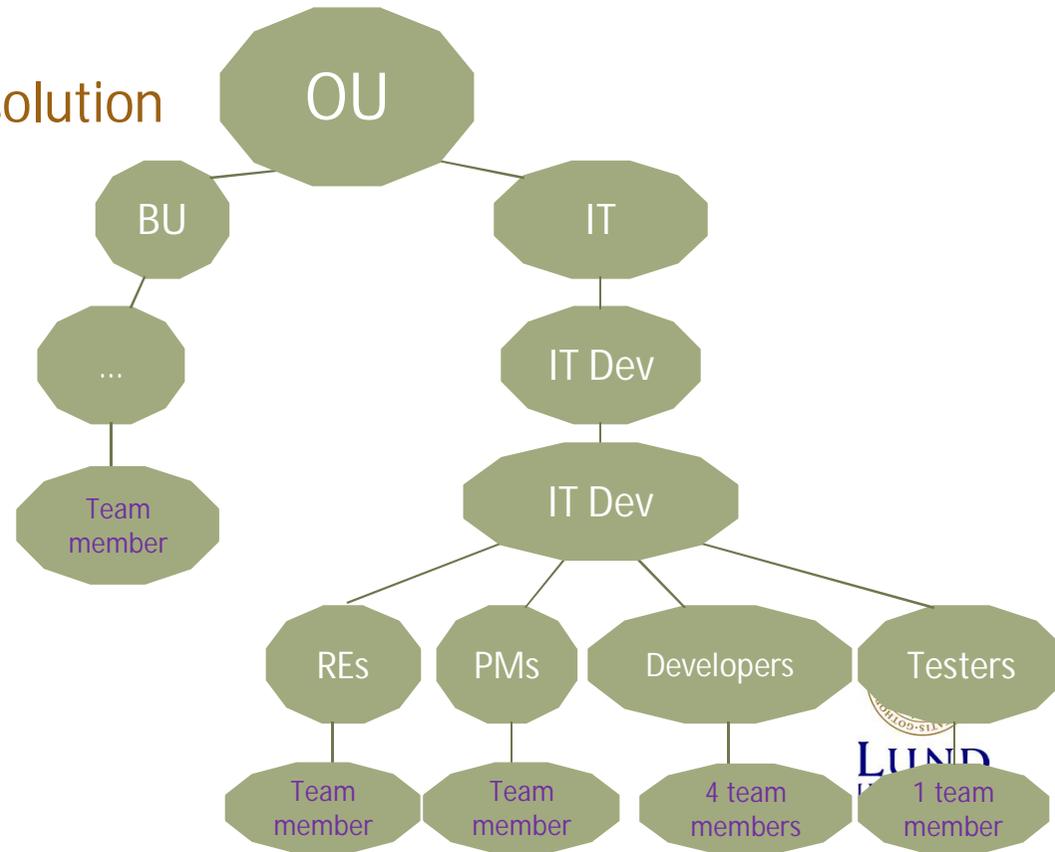
Gap: Product owner – Rest of team, Team – Db admins, Team – other teams

Effect

- Long delays for decision making & conflict resolution
- Miscommunication of information

Suggested practices

- Reqts comm at all levels throughout lifecycle
- New & improved direct comm channels



Example: Cognitive Distance

Gap: Product owner/RE – core team (Scrum Master, devs, tester)

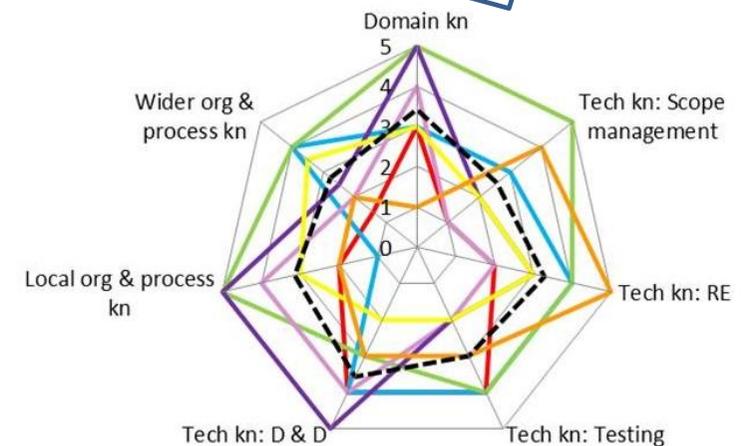
Effect

- Low effectiveness in testing
- Hard to be proactive with low knowledge
- Missed communication of tacit reqts => issues in acceptance testing

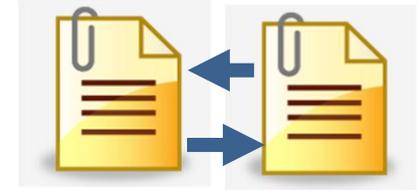
Suggested practices

- Product owner testing
- RE reviewing test cases against reqts spec

"A good mix of people who have been here a long time and new people"



Example: Semantic Distance



- Difference in meaning between related artefacts

Distance indicates

- Un-updated requirements artefacts after change
- Misinterpreted requirements

Example of practices

- Review test cases against requirements
- Tracing requirements – test cases

Example: Psychological Distance

Def: Communicate and reach understanding with someone



Findings

- Not bi-directional
- Objective measurements useful for discussing differences

Example of practices

- Let people have a say in team seating
- Team-building activities
- Consider personalities when combining teams

Measuring Distances with Self-assessment Surveys

- 1b. How familiar are you with **the system** under development, e.g. its users, usage and functionality?
 Not at all Novice Advanced beginner Competent Proficient Expert
- 2a. How would you rate your knowledge and experience of **scope management**?
 For example, having a product vision, assessing business value, prioritisation, communication and negotiation of scope.
 Not at all Novice Advanced beginner Competent Proficient Expert
- 2b. How would you rate your knowledge and experience of **requirements engineering**?
 For example, stakeholder analysis, reqs elicitation, specification and validation, techniques and methods for these etc.
 Not at all Novice Advanced beginner Competent Proficient Expert
- 2c. How would you rate your knowledge and experience of **testing**?
 For example, plan, design & execution of tests, test methods for black box and white box testing etc.
 Not at all Novice Advanced beginner Competent Proficient Expert

2. For each person in the table (except yourself!), please answer the following:

Name	How long have you worked together?	On a scale 1-5, how hard is it for you to communicate and reach understanding with this person? 1 = Not hard, 2 = Some effort required, 3 = Medium effort, 4 = Much effort, 5 = Extremely hard
Denise	___ years ___ months	
Mike	___ years ___ months	
Darren	___ years ___ months	
Laura	___ years ___ months	

Requirement Survey

User story: _____

1. For the *documented requirements and connected test scripts* for this story:

- a) The test scripts express ... **meaning** as the documented requirements.
 Exactly the same Almost the same Roughly the same Somewhat similar Very different Can't say
- b) The test scripts contain ... **level of detail** than the documented requirements.
 Much more Somewhat more The same Somewhat less Much less Can't say
- c) The test scripts cover ... **content** than the documented requirements
 Much more Somewhat more The same Somewhat less Much less Can't say

2. For the *documented requirements relative the agreed requirements* for this story:

- a) The documented requirements express ... **meaning** as the agreed requirements.
 Exactly the same Almost the same Roughly the same Somewhat similar Very different Can't say
- b) The documented requirements specify ... **level of detail** than the agreed requirements.
 Much more Somewhat more The same Somewhat less Much less Can't say
- c) The documented requirements cover ... **content** than the agreed requirements.
 Much more Somewhat more The same Somewhat less Much less Can't say

3. For the *implemented behaviour relative the agreed requirements* for this story:

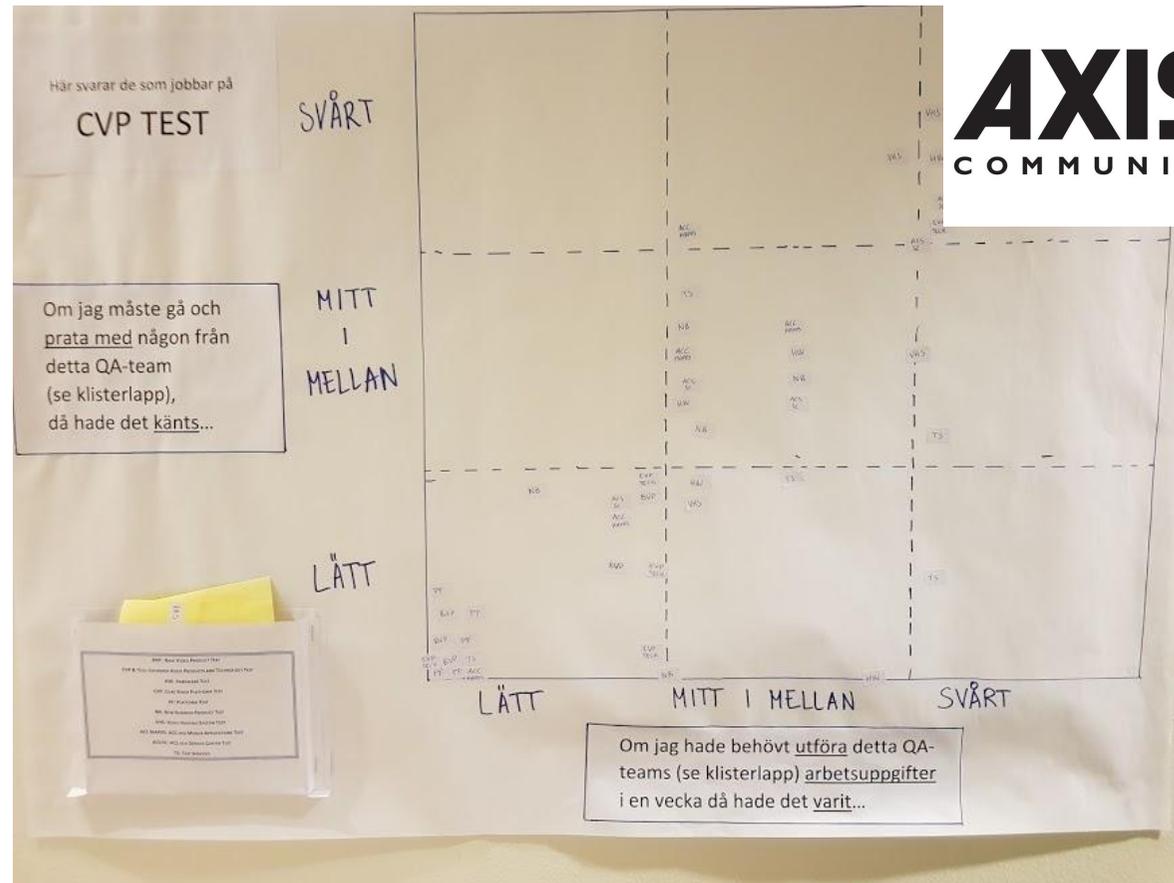
- a) The implemented behaviour is ... **meaning** as the agreed requirements.
 Exactly the same Almost the same Roughly the same Somewhat similar Very different Can't say
- b) The implemented behaviour covers ... **content** than the agreed requirements
 Much more Somewhat more The same Somewhat less Much less Can't say

Name: _____

Measuring Distances with Interactive Posters

Cognitive distance:
“Perform this team’s work”

Psychological distance:
“Talk to this team”



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Measuring Distances

Accuracy

- Actual vs Perceived, e.g. knowledge, competence (Self-rating)
- Question understanding, e.g. how answer when I don't know

Correlations between distances, e.g. cognitive and psychological, geographical and psychological

Cost of measuring



Factors Affecting Distances

- Competence / Education
- Similarity of product / technical layer
- Office location
- Time with company / seniority
- Company culture
- Frequency of interaction
- Personality
- ...



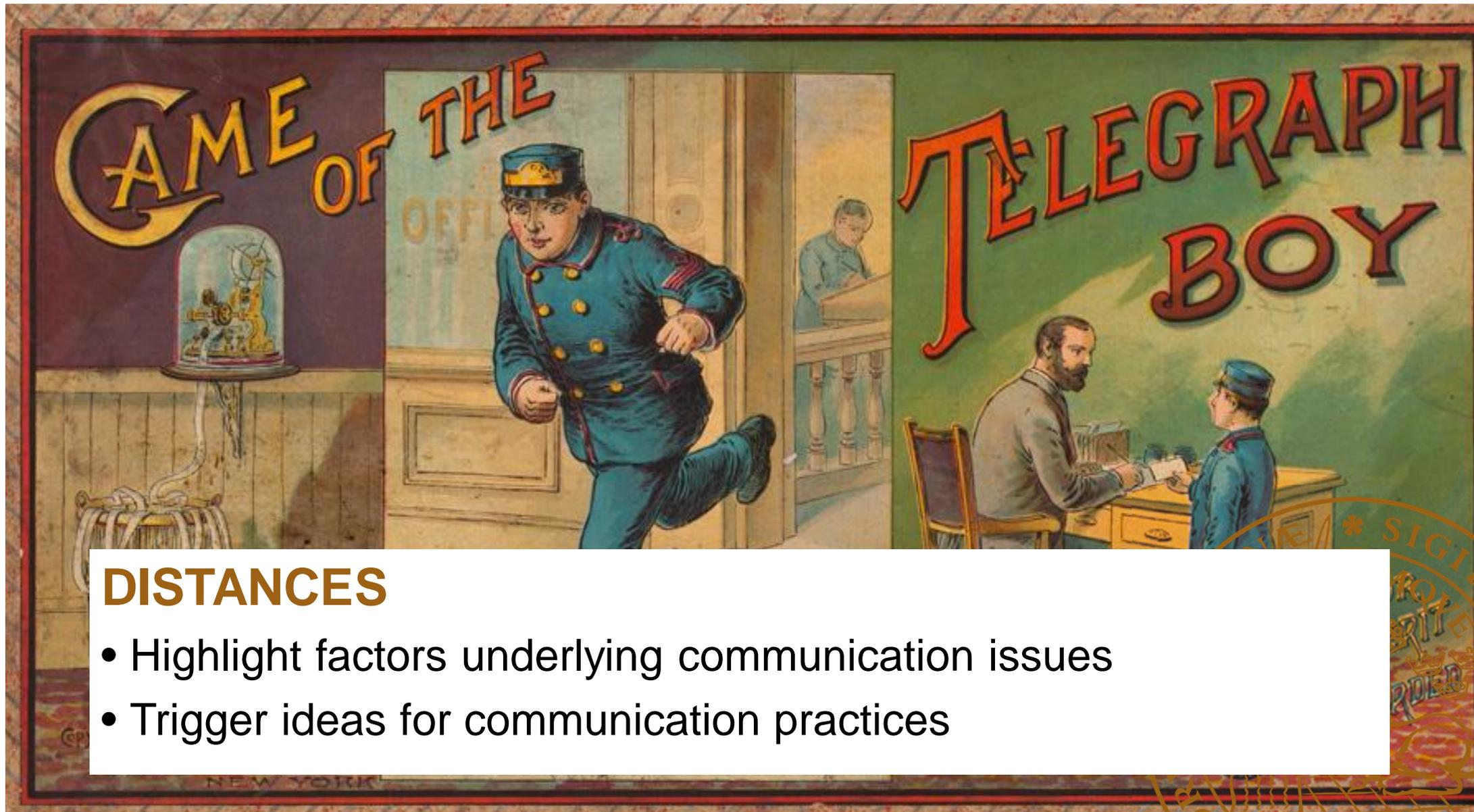
For project with good / bad communication:
 To which degree does factor influence distance & collaboration?

Affect on COGNITIVE distance or <i>ability to perform person's job</i>		Factor	Affect on PSYCHOLOGICAL distance or <i>ability to talk to person</i>	
Low	High		Low	High
		Competence / Education		
		Similarity of work product / technical layer		
		Office location		
		Time in organisation / seniority		
		Organisational culture		
		Frequency of interaction		
		Personality		

Ongoing and Next Steps

- Support management at Axis to take action: organisation, location in new building
- Operationalising the concept
 - Good-enough measurements
 - Connect with information flows
- Theory building: factors, correlations btw distance types
- Relevance of distances in SE – User communication





DISTANCES

- Highlight factors underlying communication issues
- Trigger ideas for communication practices