Model-based Task Allocation in Distributed Software Development

SEAFOOD 2010

June 18, 2010

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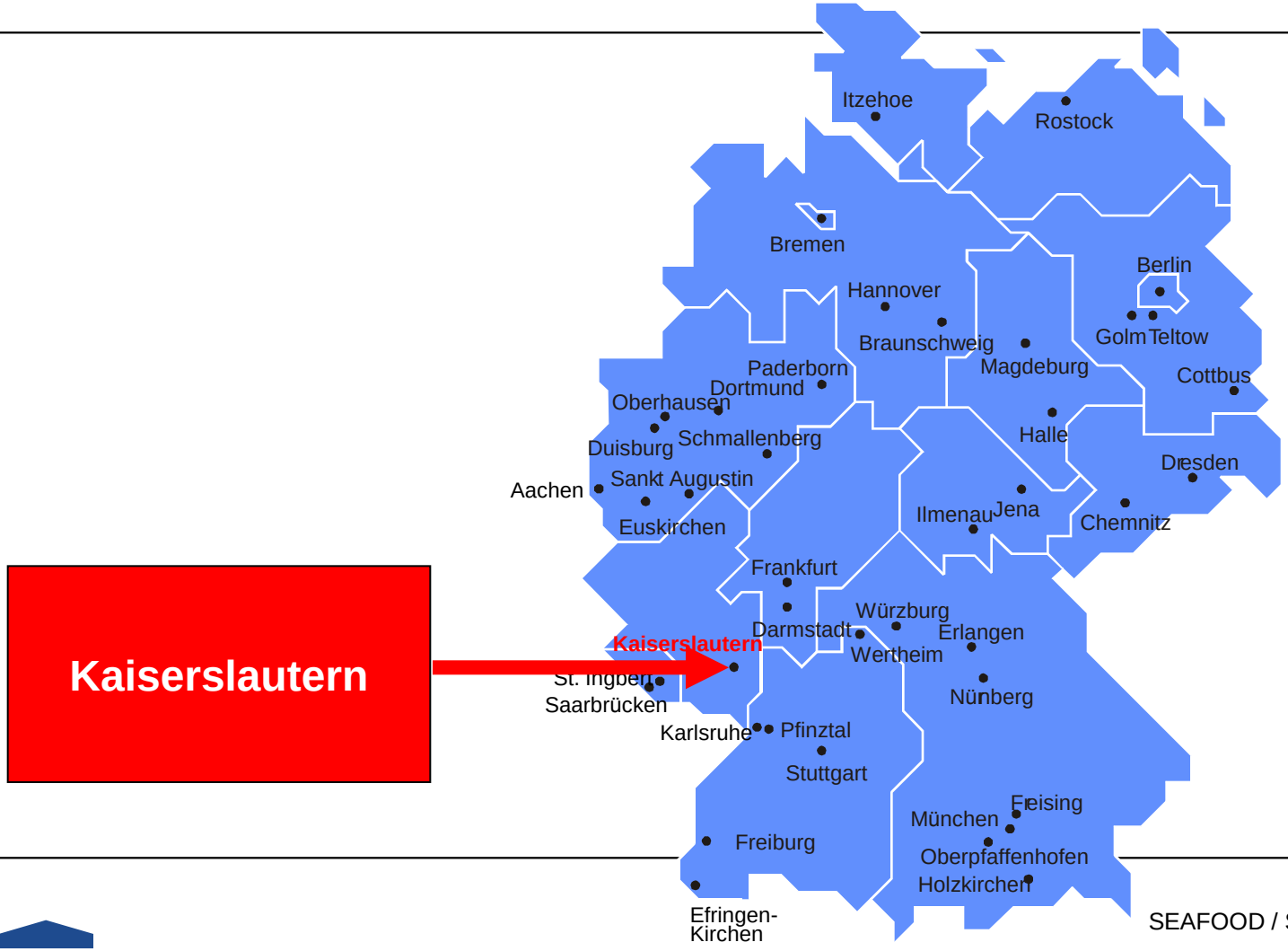
Model-based Task Allocation in DSD



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Outline

- Motivation
- Approach Overview
- Application Example
- Conclusion & Future Work

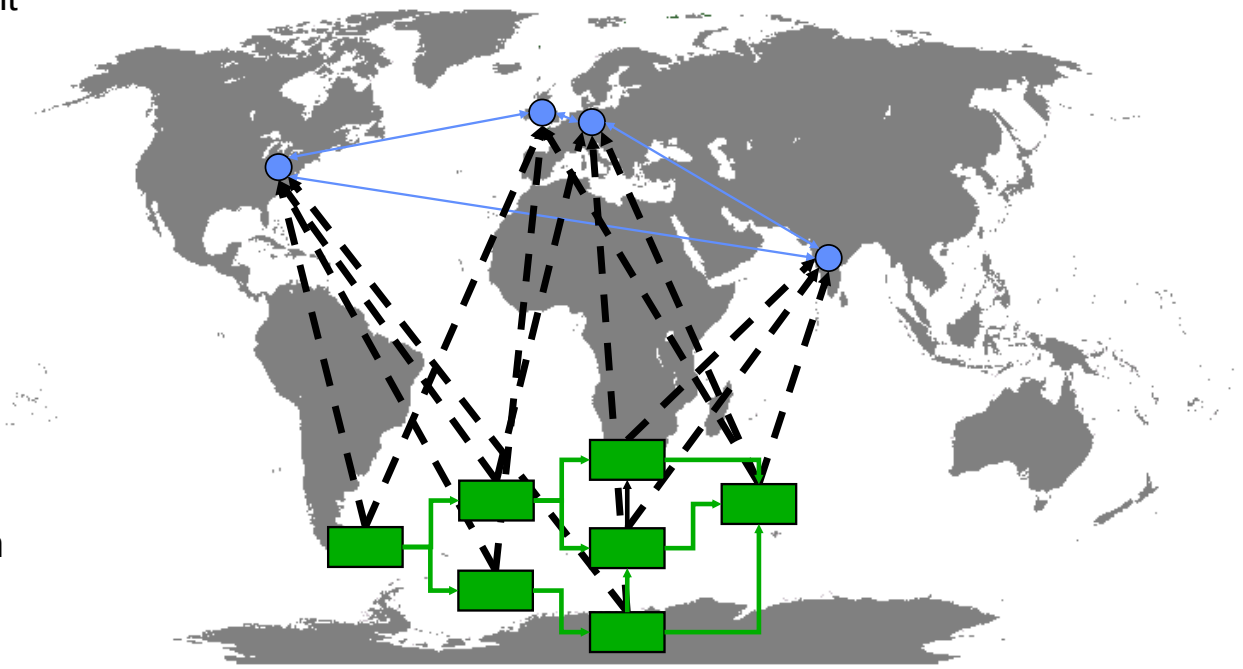
Motivation: Task Allocation in GSD

In Global Software Development (GSD), processes have to be assigned to distributed sites

Task allocation has to consider abilities at sites and communication overhead

Impact of task allocation on various project gals and risks

In practice: often task allocation by cost per head per hour and availability only
→ High failure rate



Problems in Task Allocation

Multiple influences

- If work is assigned to inexperienced sites → productivity and quality may suffer
- If closely coupled work is assigned to distant sites, communication problems occur → productivity suffers, quality may suffer, motivation decreases…
- If work is assigned to low-cost sites → costs may decrease

→ Influences are interdependent, must all be regarded simultaneously

Multiple viewpoints necessary for decision

- Risk Management perspective must analyze GSD-specific risks
- Multi-criteria decision out of potentially exponentially large space
- Cost perspective:
  - GSD is mainly driven by cost considerations
  - Cost estimation is essential in project planning

Solution: → Support decision makers with models reflecting multiple viewpoints!
→ Integrate models into one coherent approach!

Risk Model

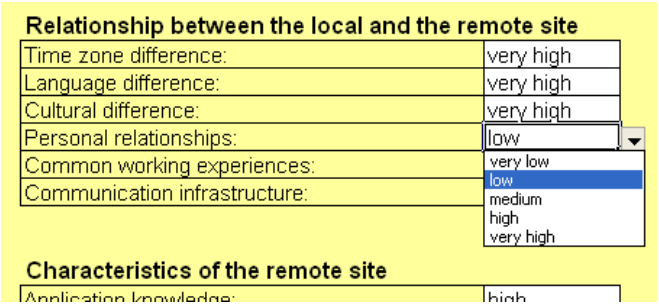
Example

"Cultural differences can lead to lack of trust if teams have not worked together previously"

Influencing factors:
- Cultural differences
- Previous experiences

Problems:
- Lack of trust

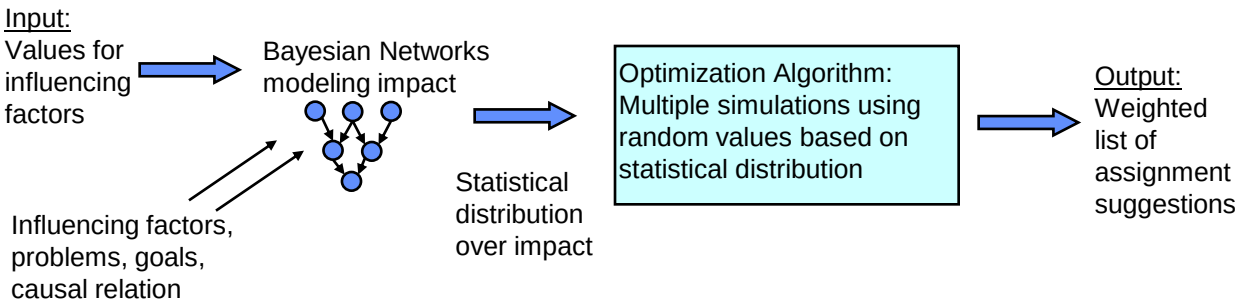
(Cultural Differences) & !(Previous Experiences) →+ Lack of trust

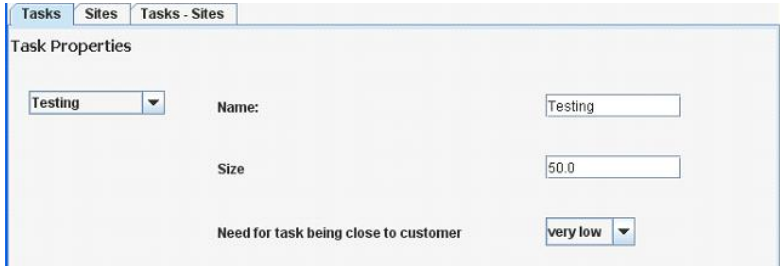


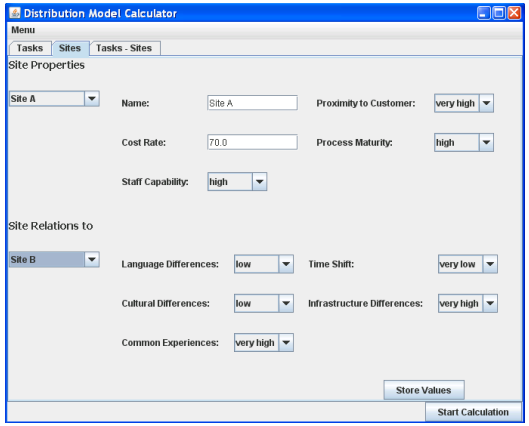
Rules:

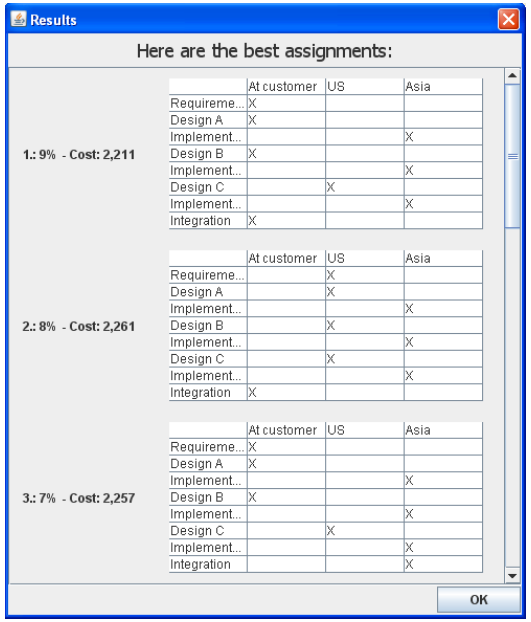
Relevance	Rule
++	*1: Time zone difference -->+ Commnication problems, lack of trust*
+	*2: Process maturity & time zone difference -->- productivity downfall (Follow-the-sun)*
+	*3: Coupling & time zone difference -->+ Communication problems*
++	*4: Time zone difference & (cultural difference | language difference) -->+ Coordination problems*
--	5: Time zone difference & (cultural difference | language difference) & Phase=Requirements -->+ Quality

Assignment Suggestion Model

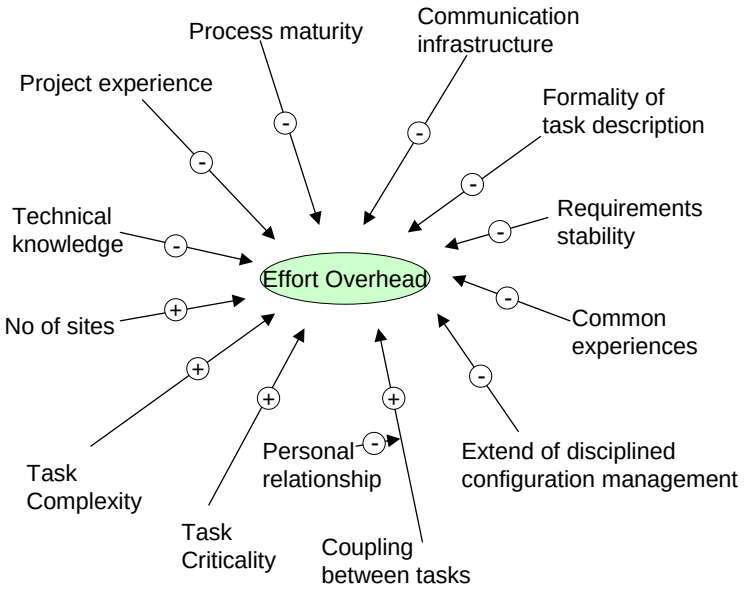








Effort Overhead Model



Task-Site Characteristics

Technical Experience

	Frankfurt	Cologne	London	Bangalore
Comp 1	4	3	1	0
Comp 2	4	3	1	0
Comp 3	1	3	0	4
Comp 4	3	1	0	4
Comp 5	1	3	4	1

Time-zone Diffs

Frankfurt	
Cologne	
London	
Bangalore	

Expert Estimations

	Maximum increase factor (%)
Technical expertise	80
Language diffs	20
Time zone diffs	10

		Maximum increase (%)
Cultural differences	low personal relations	50
	high personal relations	15
Application experience	high task complexity	100
	low task complexity	25
Work coupling	low technical infrastructure	40
	high technical infrastructure	5

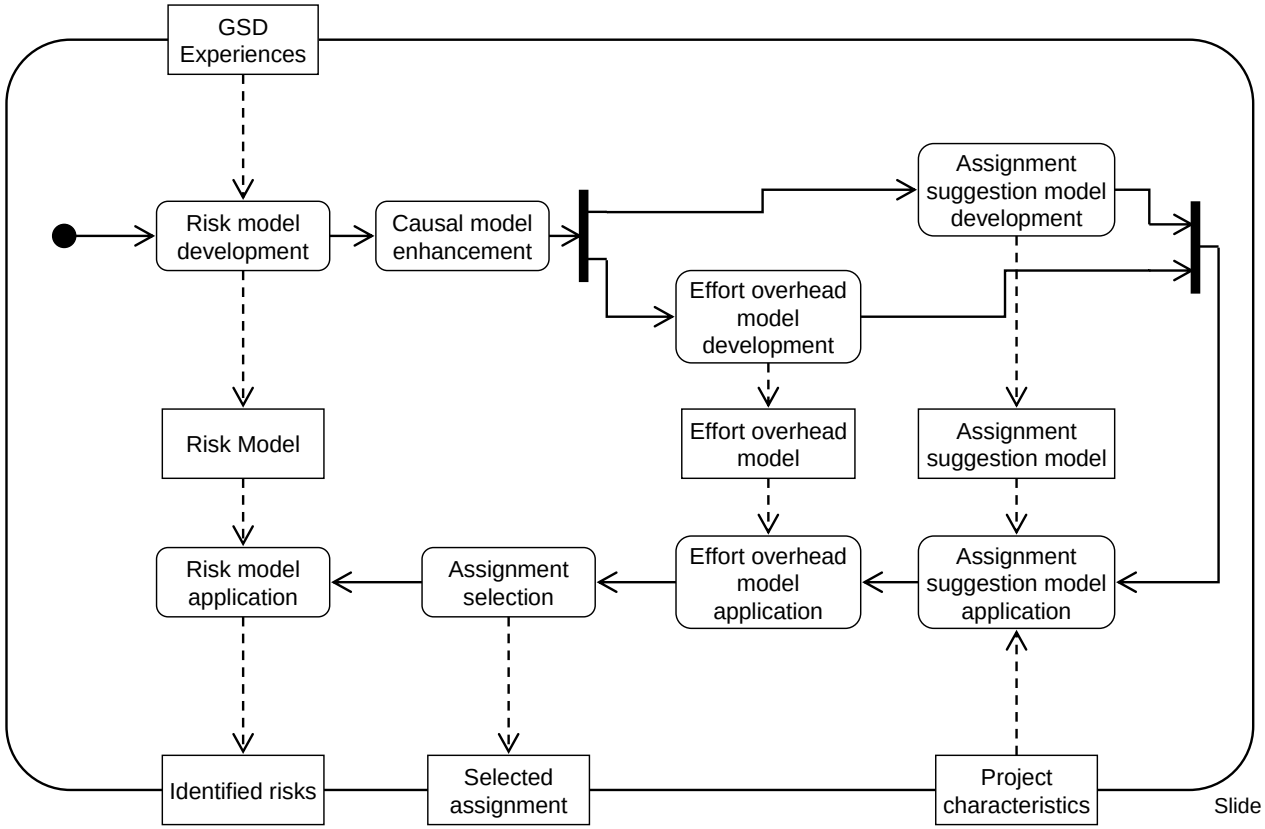
Assignment

		is fix?
Comp 1	Frankfurt	yes
Comp 2	Bangalore	no
Comp 3	Bangalore	no
Comp 4	Bangalore	no
Comp 5	London	yes

Total Effort (PM):	303,51
Total Cost (EUR):	1.542.345

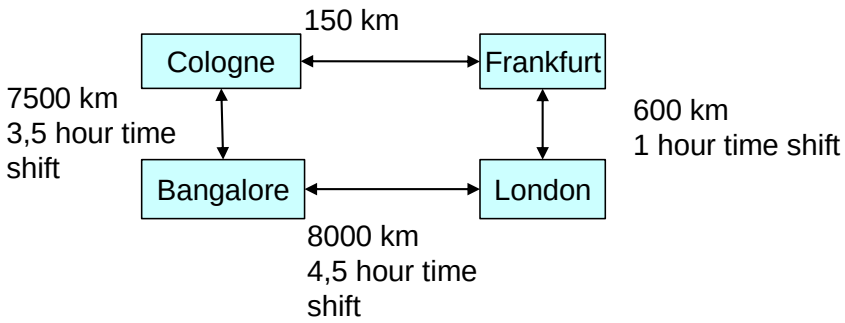
See also CoBRA (hybrid cost estimation and risk assessment approach by Fraunhofer IESE)

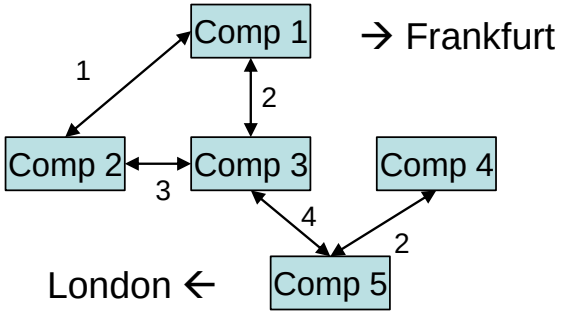
Process overview



Example Application (Lessons learned and new project)

- Cultural differences lead to communication problems if there are no personal relationships
- Technical experience increases productivity
- Language differences lead to communication problems
- Time zone differences decrease motivation
- Time zone differences decrease productivity
- Closely coupled work leads to communication problems if there is no high technical infrastructure between sites
- Complex tasks decrease productivity if they are done at sites with little application experience





1. Risk Model Development

Influencing factors

- Cultural differences
- Personal relationships
- Technical experience
- Language differences
- Time zone differences
- Work coupling
- Task complexity
- Application experience
- Technical infrastructure

Causal factors

- Productivity

Goals

- Motivation

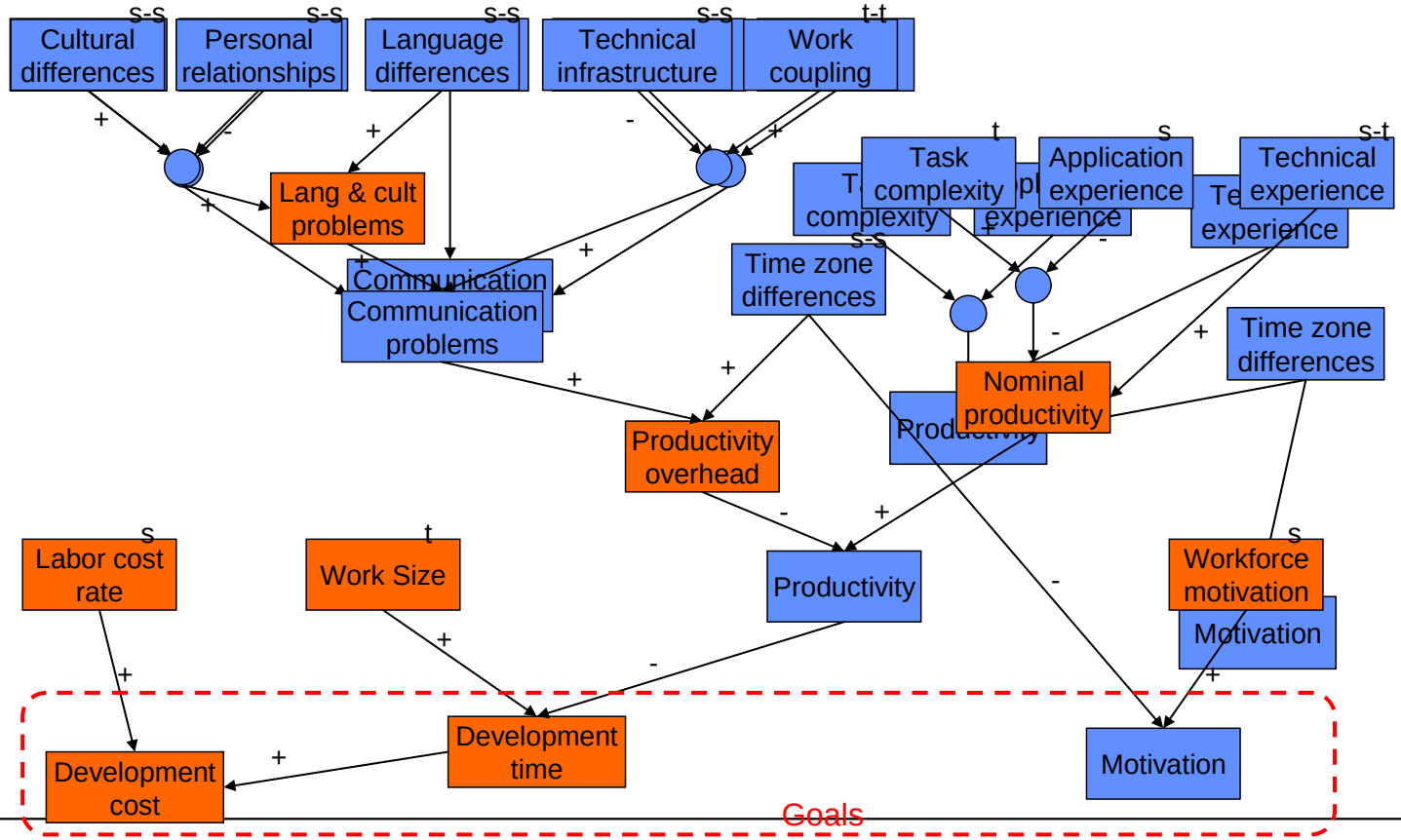
Problems

- Communication problems

Logical rules

- Cultural differences & ! personal relationships → +communication problems
- Technical experience → +productivity
- Language differences → +communication problems
- Time zone differences → -motivation
- Time zone differences → -productivity
- Work coupling & !infrastructure → +communication problems
- Task complexity & ! application experience → -productivity

2. Causal Model Enhancement



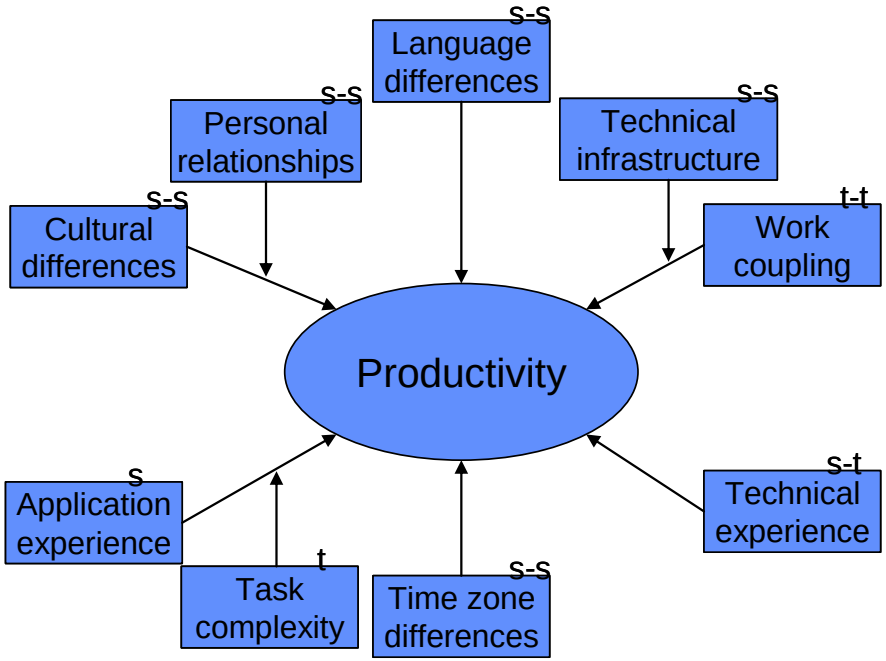
4. Effort Overhead Model Development

Very low technical expertise	80%
Very high language differences	20%
Very high time zone differences	10%

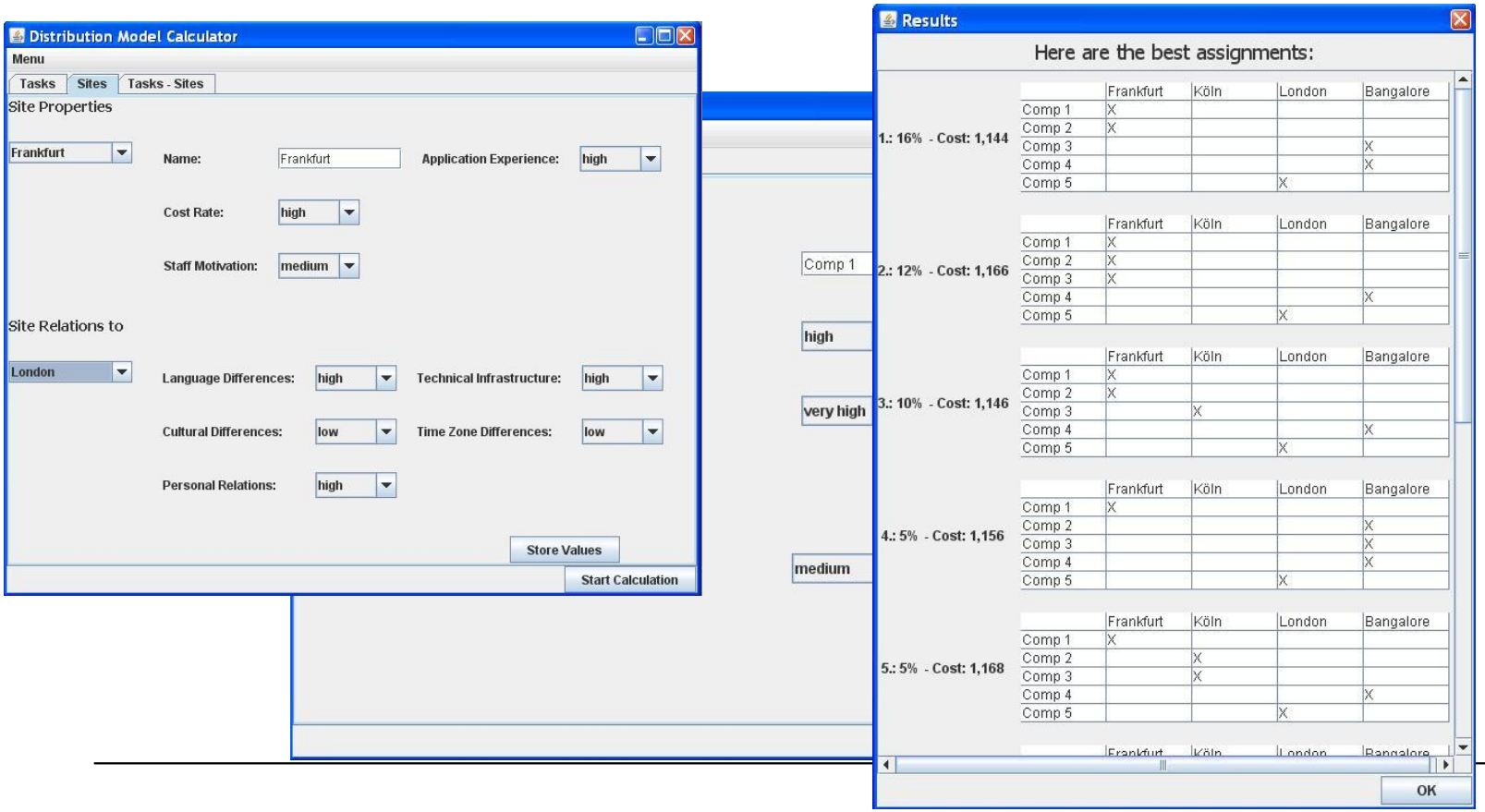
	Very low personal relationships	Very high personal relationships
Very high cultural differences	50%	15%

	Very high task complexity	Very low task complexity
Very low application experience	100%	25%

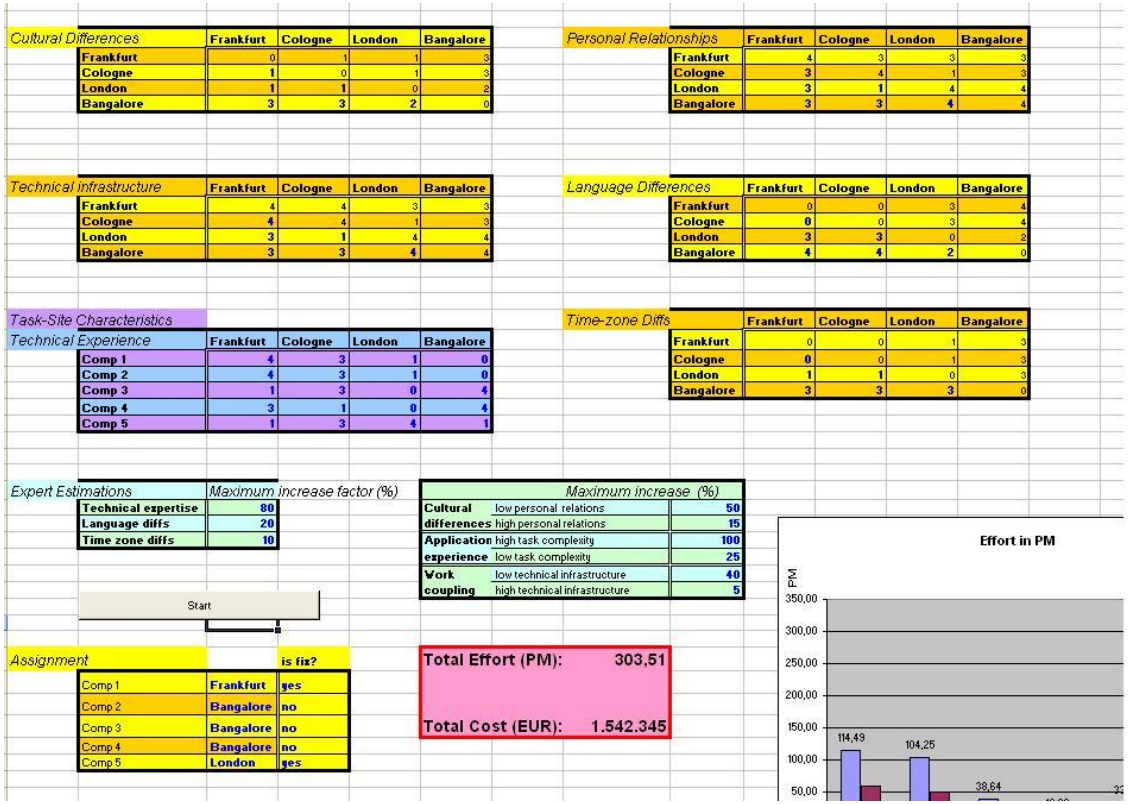
	Very low technical infrastructure	Very high technical infrastructure
Very high work coupling	40%	5%



5. Assignment Suggestion Model Application



6. Effort Overhead Model Application



Cultural Differences

	Frankfurt	Cologne	London	Bangalore
Frankfurt	0	1	1	3
Cologne	1	0	1	3
London	1	1	0	2
Bangalore	3	3	2	0

Personal Relationships

	Frankfurt	Cologne	London	Bangalore
Frankfurt	4	3	3	3
Cologne	3	4	1	3
London	3	1	4	4
Bangalore	3	3	4	4

Technical infrastructure

	Frankfurt	Cologne	London	Bangalore
Frankfurt	4	4	3	3
Cologne	4	4	1	3
London	3	1	4	4
Bangalore	3	3	4	4

Language Differences

	Frankfurt	Cologne	London	Bangalore
Frankfurt	0	0	3	4
Cologne	0	0	3	4
London	3	3	0	2
Bangalore	4	4	2	0

Task-Site Characteristics

Technical Experience

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Comp 3	1	3	0	4
Comp 4	3	1	0	4
Comp 5	1	3	4	1

Time-zone Diffs

	Frankfurt	Cologne	London	Bangalore
Frankfurt	0	0	1	3
Cologne	0	0	1	3
London	1	1	0	3
Bangalore	3	3	3	0

Expert Estimations

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Start

Assignment

		is fix?
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Comp 2	Bangalore	no
Comp 3	Bangalore	no
Comp 4	Bangalore	no
Comp 5	London	yes

Total Effort (PM): 303,51

Total Cost (EUR): 1.542.345

Assignment no.	Predicted Cost (€)
1	1,592,373
2	1,603,164
3	1,591,529
4	1,542,345
5	1,655,992

- Component 1 → Frankfurt
- Component 2 → Frankfurt
- Component 3 → Bangalore
- Component 4 → Bangalore
- Component 5 → London

8. Risk Model Application

Risk Model

Dependencies between sites

Time zone difference:	high
Language difference:	medium
Cultural difference:	medium
Personal relationships:	high
Technical infrastructure:	high

Characteristics of the remote site

Application experience	very low

Dependencies between task and site

Technical experience	very high

Characteristics of the tasks

Complexity:	low

Dependencies bewteen tasks

Work coupling	medium

Rules:

-	Cultural differences & Ipersonal relationships --> + communication problems
++	***Technical experience --> + Productivity***
o	Language difference --> + Coordination problems
+	***Time zone difference --> - Motivation***
+	***Time zone difference --> - Productivity***
-	Work coupling & Infrastructure --> + Communication problems
-	Task Complexity &Iapplication experience --> - productivity

- Example: Analysis of component 4 (assigned to Bangalore) and its coordination with component 5 (assigned to London)
- Result:
  - Biggest risk: Decrease of motivation and productivity due to time zone differences

Conclusions & Future Work

Models have been applied in industrial contexts

- Risk model has been applied at Spanish multinational and was highly accepted by practitioners
- Assignment suggestion model was applied in multiple industrial scenarios and presented in several publications
- Cost overhead model was also applied at Spanish company and is based on an approach successfully applied in multiple case studies

Limitations

- Knowledge on tasks and sites must be available at decision point
- Upfront effort required to develop organization-specific models, further effort for maintenance
- Unclear if all influencing factors can be made explicit and modeled

Future work

- Development of a coherent tool including all models and decision process
- Evaluation of the complete approach within industrial context

Thank you for your attention!

Questions?

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