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# TAMRI: A Tool for Supporting Task Distribution in Global Software Development Projects

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## Outline

- Motivation
- Model Overview
- Application Scenarios
- The TAMRI Tool
- Summary and Outlook

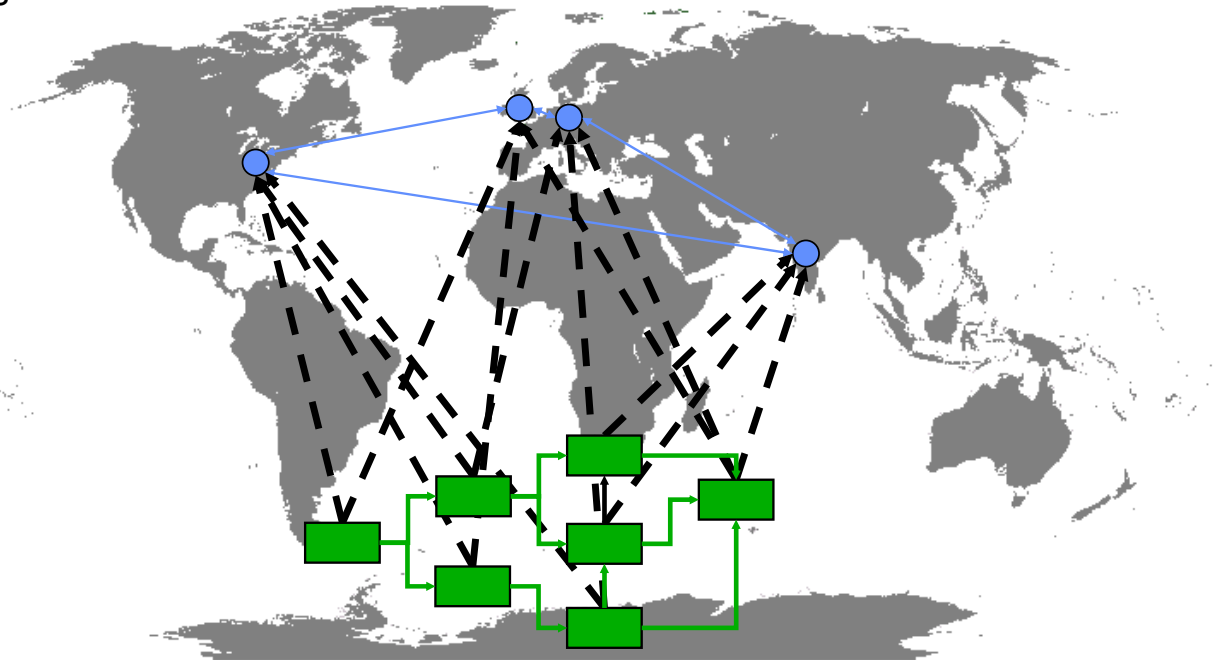
## Motivation: Task Allocation

Software development processes have to be allocated to distributed sites

$n$  tasks to  $m$  sites  $\rightarrow$  up to  $m^n$  different assignments theoretically possible

Task allocation has to consider abilities at sites and communication overhead

In practice: often task allocation by cost and availability only  
 $\rightarrow$  High development risks



## Challenges of Task Allocation Decisions

### Multiple goals

Cost reduction (assign to low-cost sites), development time (reduce communication overhead), development quality (assign to experts), closeness to markets...

### Multiple influences

E.g., expertise at sites, proximity to customer, time zone difference, cultural distance, communication need...

### Organization-specific contexts

Different weight on goals, other influencing factors, differences in importance of influences...

### Uncertainty

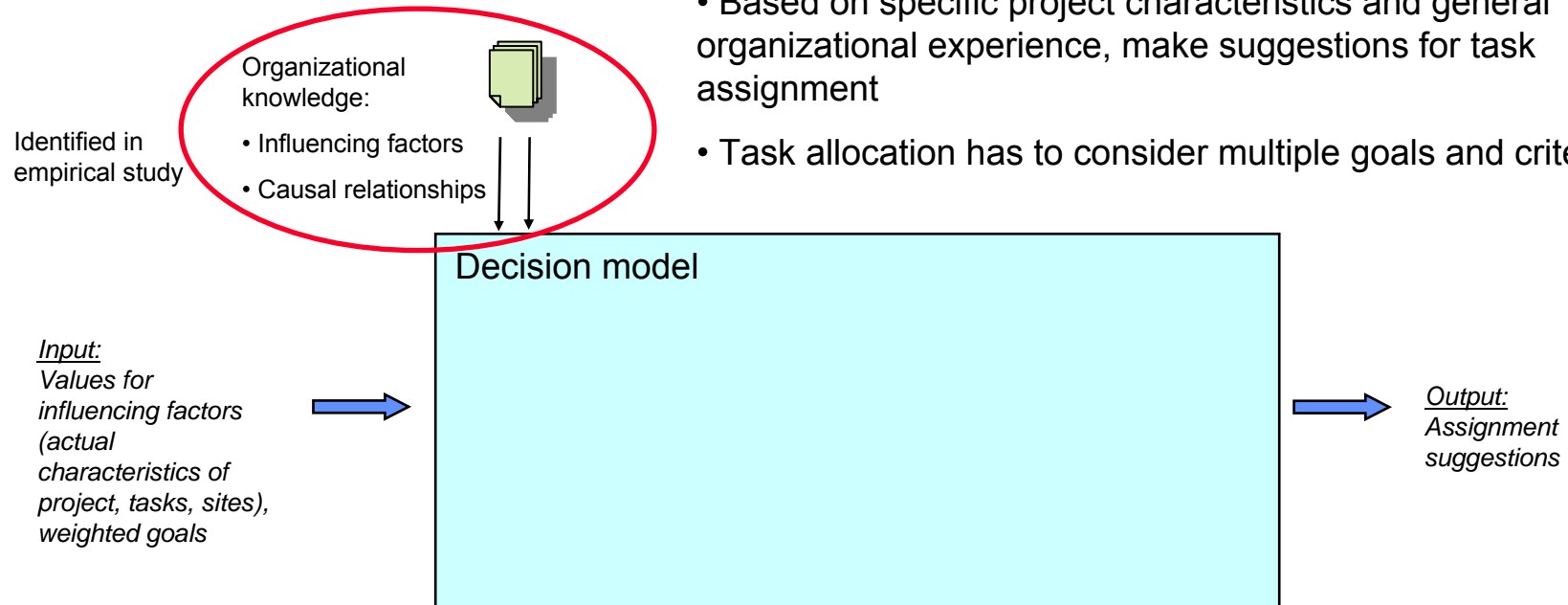
Not all characteristics of remote sites are known; uncertainty in predicting human behavior

Not handled by existing planning approaches  
→ Research goal: Build decision support model addressing these challenges

## TAMRI Overview

Goal: Task allocation based on multiple criteria

- Based on specific project characteristics and general organizational experience, make suggestions for task assignment
- Task allocation has to consider multiple goals and criteria



## Empirical Study: Influencing Factors

### Study goal

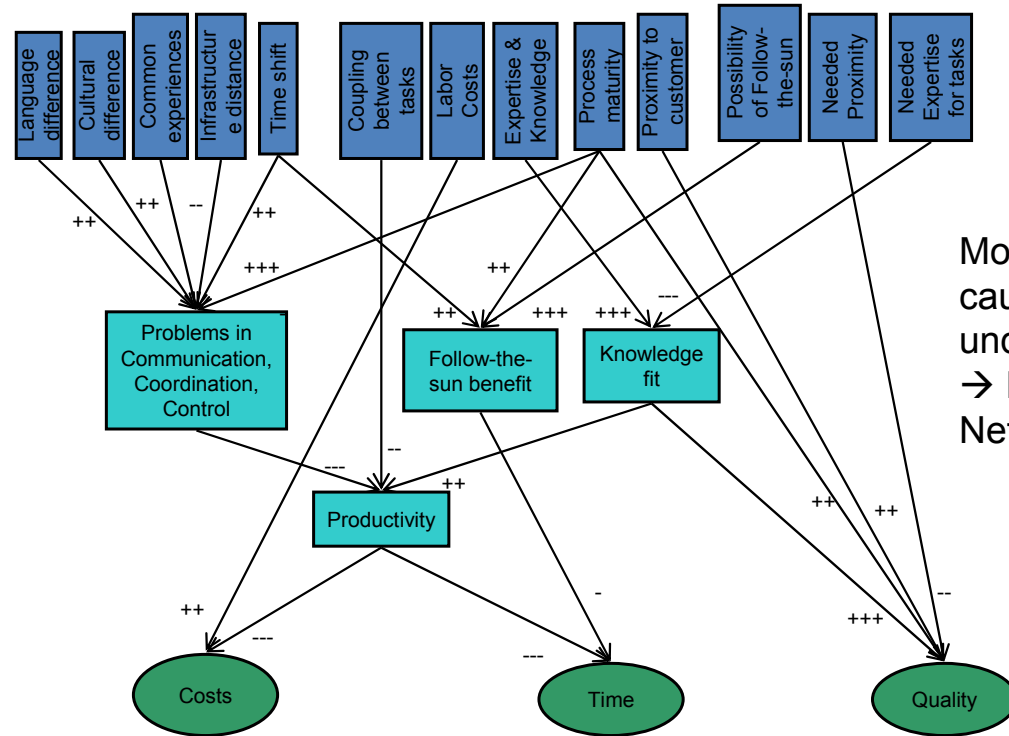
Which factors influence project goals in GSD?

### Study design

Literature study and interviews with 10 practitioners

### Result: Model for evaluating assignment

Influences of task assignment on goals



Model describes causal relations under uncertainty → Bayesian Networks

## Modeling Impact with Bayesian Networks

Bayesian Networks are used for modeling causal relationships under uncertainty

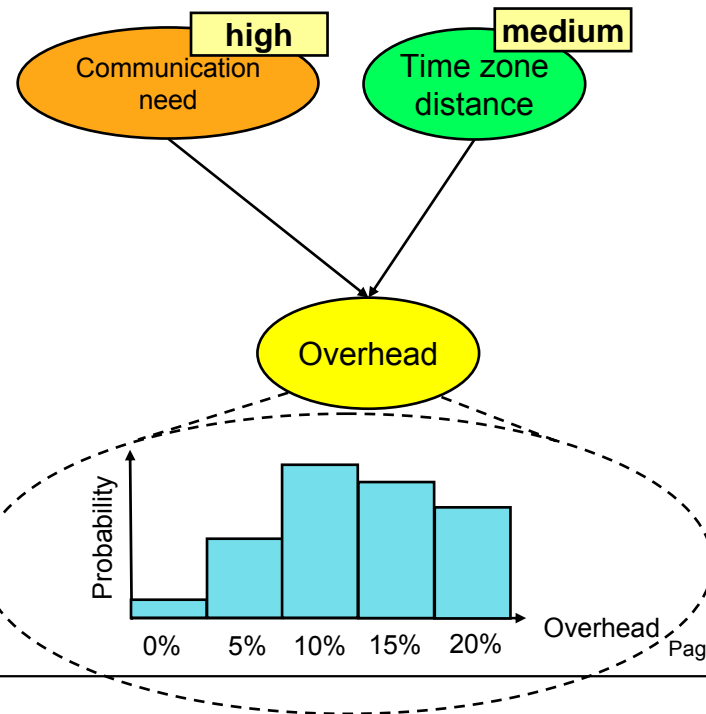
Values for each causal relationship are determined by probabilistic tables

		Communication need														
		Low					Medium					High				
Time zone distance	OH	0%	5%	10%	15%	20%	0%	5%	10%	15%	20%	0%	5%	10%	15%	20%
	Low	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
	Med	...	...	...	...	...	...	...	...	...	...	2%	8%	35%	30%	25%
	High	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...

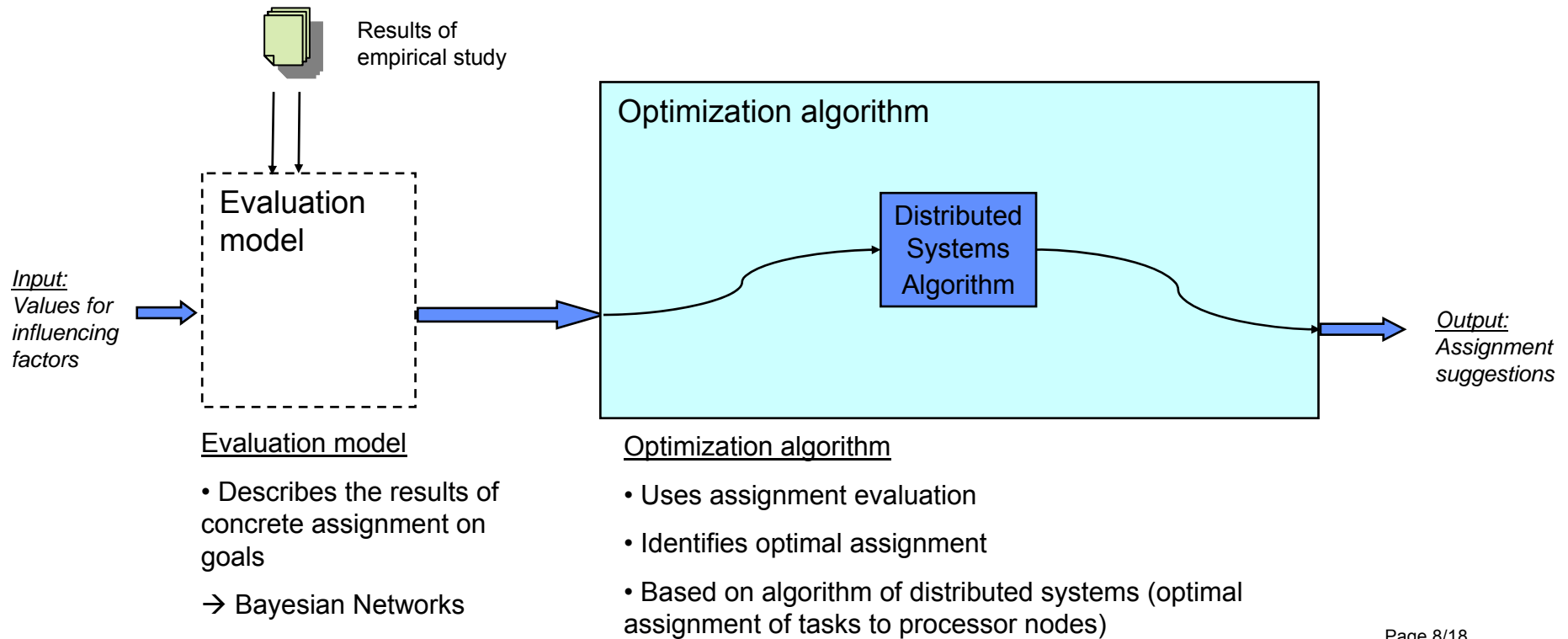
TAMRI: Table values were determined through

- study results
- own estimations
- and mathematical functions

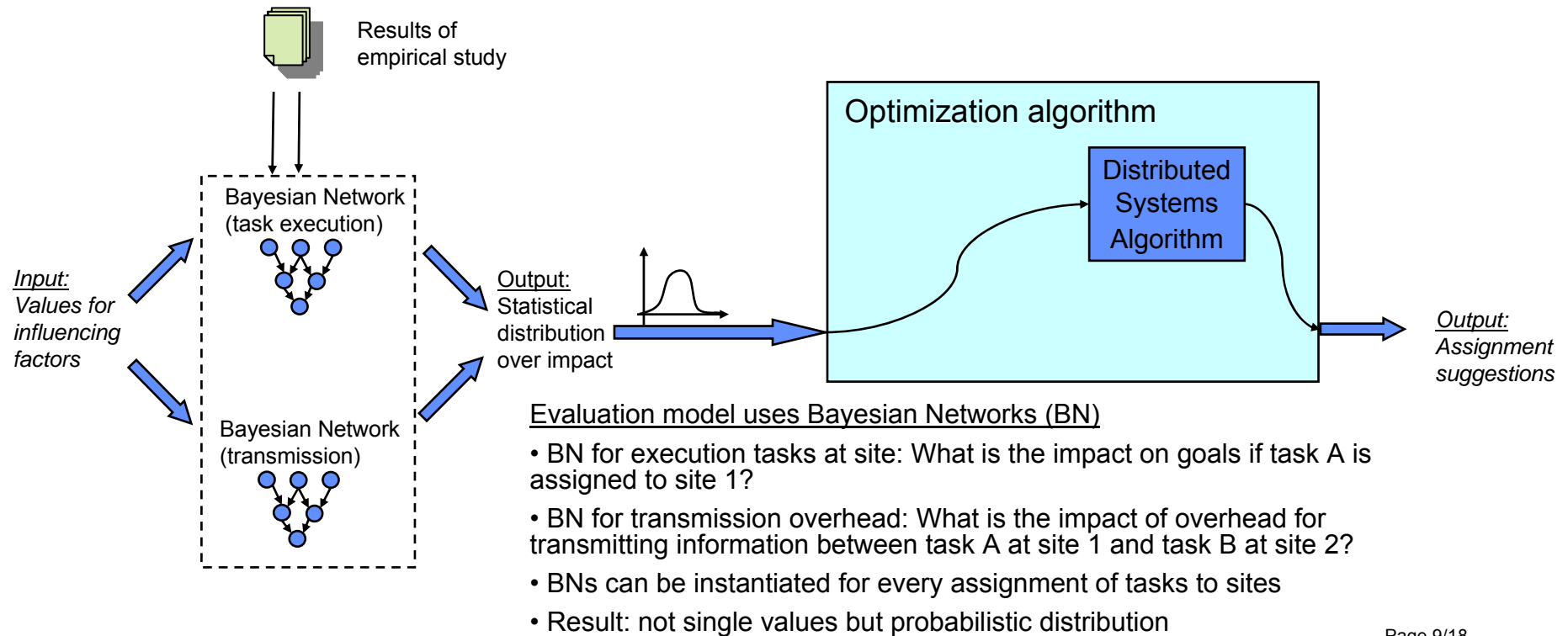
Example:



## TAMRI Overview



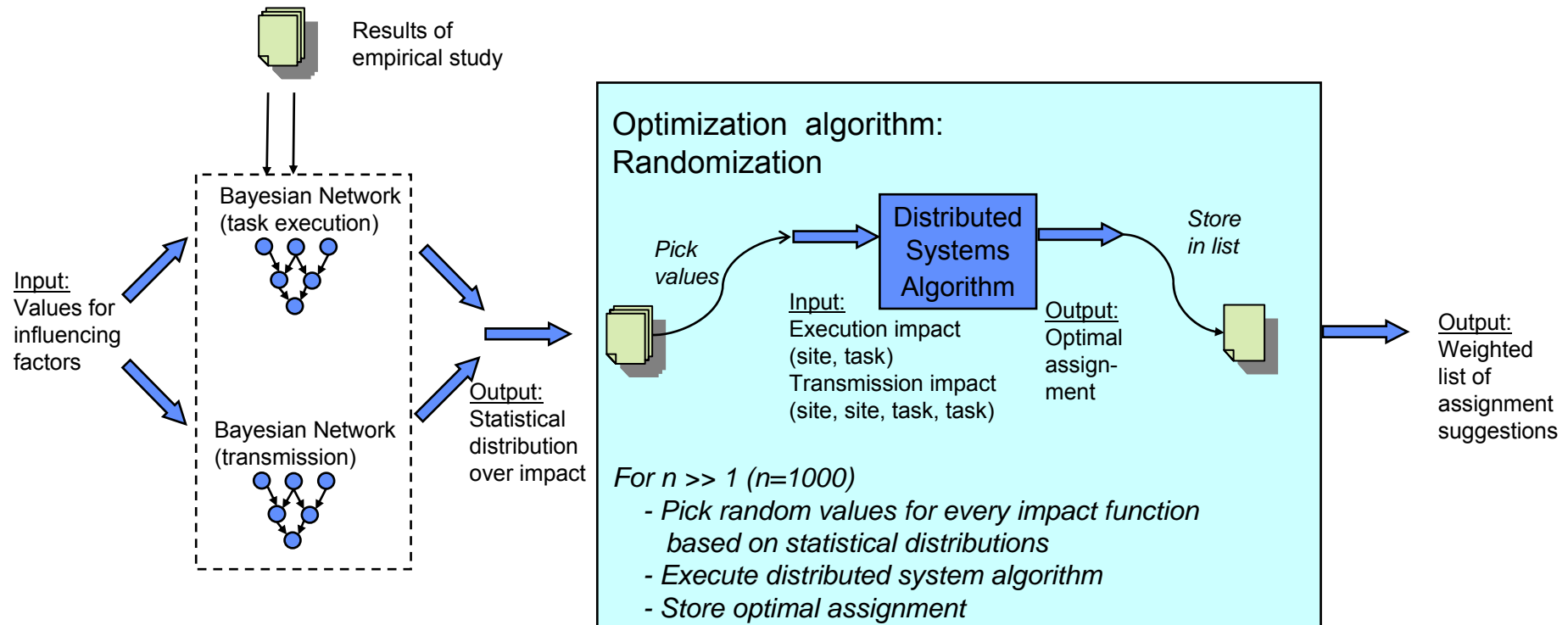
## TAMRI Overview



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# TAMRI: Tool for Supporting Task Distribution

## TAMRI Overview

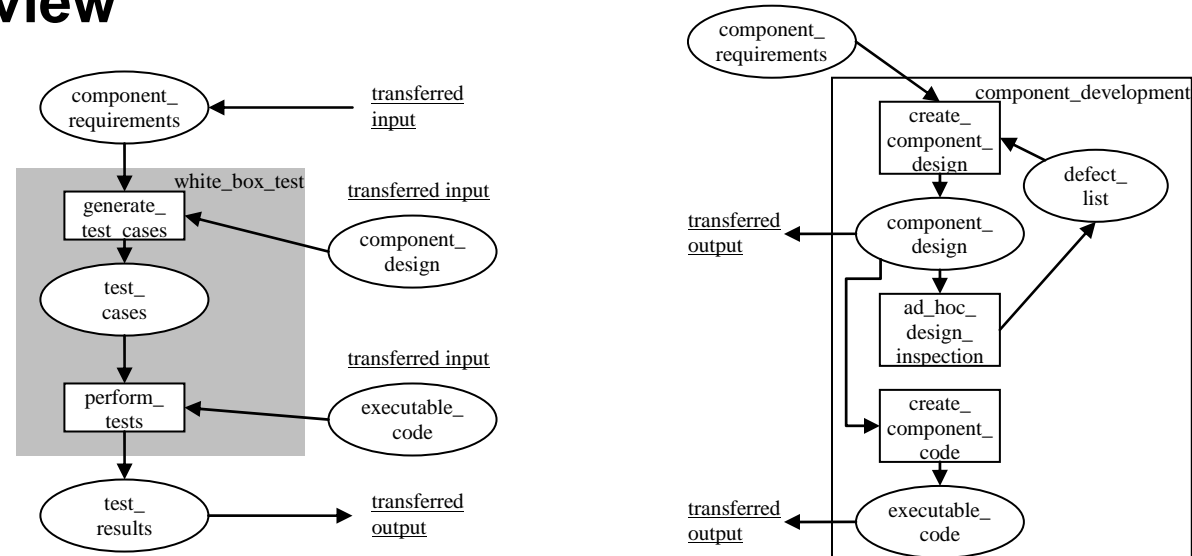


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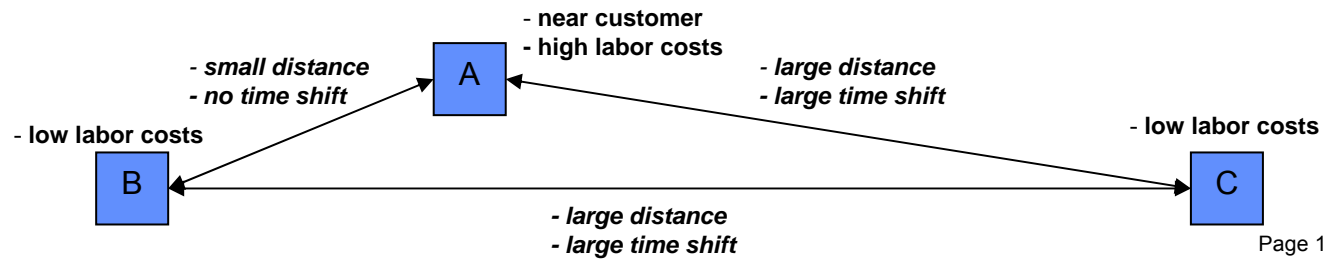
# TAMRI: Tool for Supporting Task Distribution

## Scenario Overview

Tasks:



Sites:

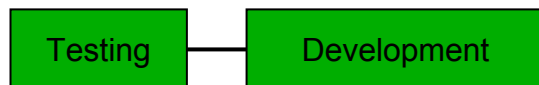


## Task Allocation Scenario (1)

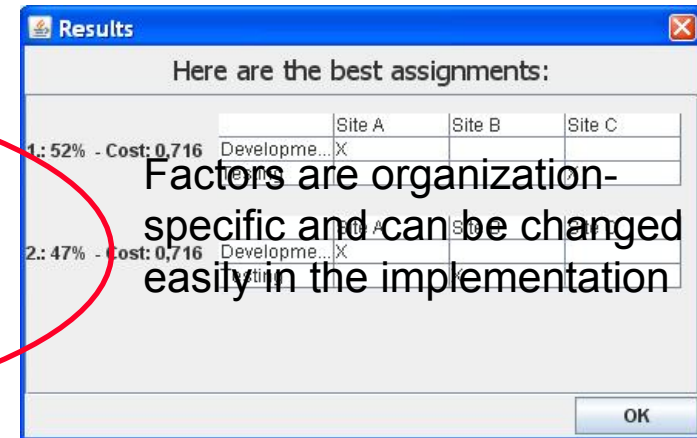
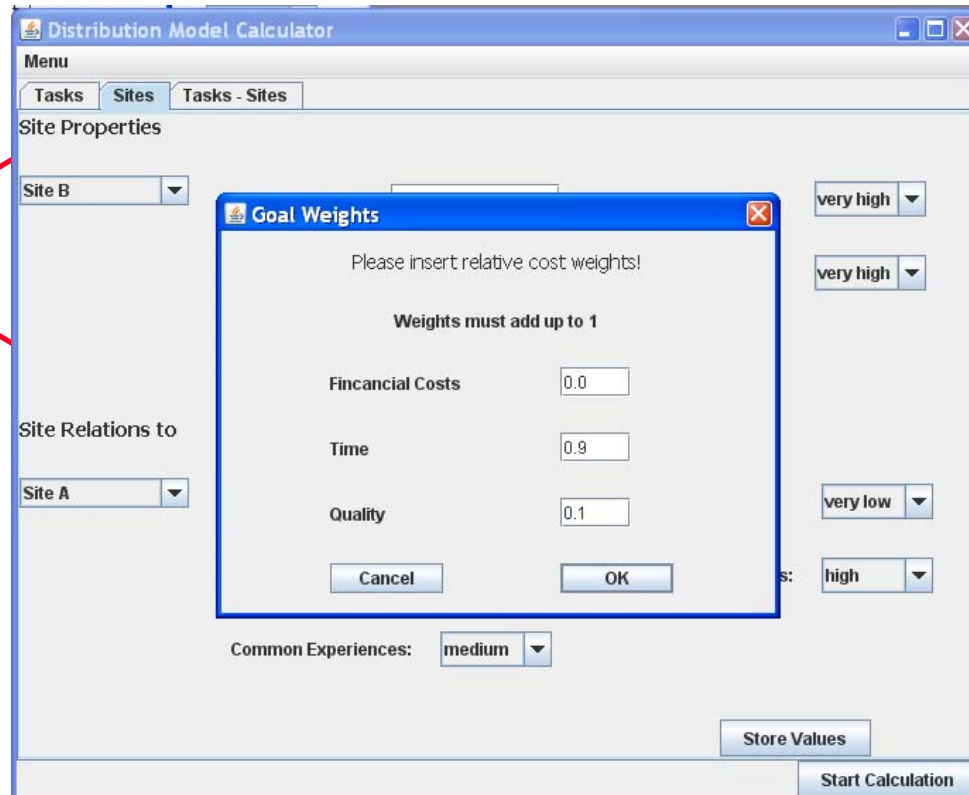
### Scenario 1

#### Component development & testing

- Development is done at A, testing needs to be assigned to B or C
- Follow-the-sun possible between A and C
- Higher familiarity at B
- Cost rate no criterion



# Tool Implementation: Scenario 1



Factors are organization-specific and can be changed easily in the implementation

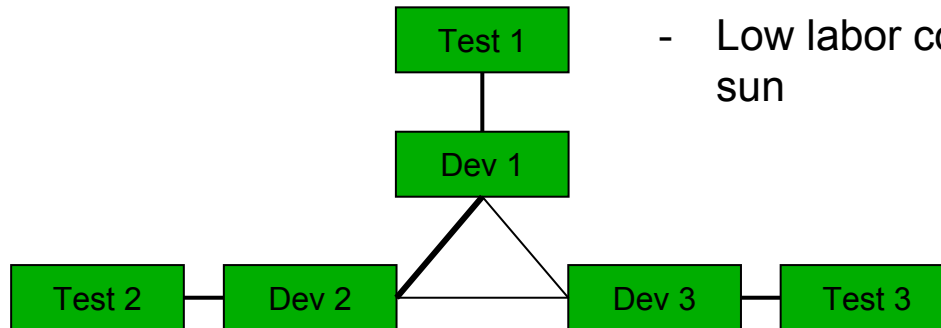
Assigning sites of high priority to sites of high priority is slightly prioritized

## Task Allocation Scenario (2)

### Scenario 2

Development and testing of 3 components

- All tasks can be assigned freely
- Different coupling between components (1↔2: high, 1↔3, 2↔3: low)
- Expertise for development at A, testing at B
- Low labor costs at C, possibility of follow-the-sun



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## Results Scenario 2

Results

Here are the best assignments:

	Site A	Site B	Site C
1.: 16% - Cost: 1,464			
Dev Comp 1	X		
Dev Comp 2	X		
Dev Comp 3	X		
Test Comp 1		X	
Test Comp 2		X	
Test Comp 3		X	

	Site A	Site B	Site C
2.: 6% - Cost: 1,477			
Dev Comp 1	X		
Dev Comp 2	X		
Dev Comp 3	X		
Test Comp 1		X	
Test Comp 2			X
Test Comp 3		X	

	Site A	Site B	Site C
3.: 5% - Cost: 1,467			
Dev Comp 1	X		
Dev Comp 2	X		
Dev Comp 3	X		
Test Comp 1			X
Test Comp 2		X	
Test Comp 3		X	

OK

Priority: quality and cost

Due to complexity, significance in results not so high (best assignment only optimal in 16% of runs)

However, general suggestions can be derived from result list

- Development should be done at A
- It is generally better to do testing at B than at C
- But single testing tasks could also be done at C

## Summary: Characteristics of TAMRI Model

<b>Multiple goals</b>	Different goals can be weighted and aggregated into one impact function
<b>Multiple influences</b>	Large number of different influencing factors can be specified in Bayesian Networks
<b>Organization-specific context</b>	Bayesian Network concept allows for easily exchanging networks without having to change underlying algorithms; Bayesian Networks can be adapted to organization-specific goals, influencing factors, weights
<b>Uncertainty</b>	Bayesian Networks can describe causal relationships under uncertainty; results can be produced without having to specify all input parameters; model output reflects uncertainty by providing multiple suggestions

## Future Research

### **Adaptation of model to specific contexts**

Bayesian Networks are based on empirical study with input from various types of GSD

- Model needs to be adapted to specific environments / organization

### **Evaluation**

The model has only been evaluated in hypothetical scenarios

- Future work: evaluation in real-world context
- Will practitioners accept “black-box” model?

### **Eliciting organizational knowledge**

Underlying assumption: knowledge about organization is very detailed (e.g., cultural differences between sites can be classified)

- Methods for eliciting knowledge have to be found

### **Process for decision support**

The decision model has to be integrated into an organizational task allocation process

- Includes roles, responsibilities, sub-processes for eliciting knowledge, determining influencing factors...

# TAMRI: Tool for Supporting Task Distribution

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Thank you for your attention!

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