The potential of socio-technical approaches in dealing with complexity

Preparing production systems for the Internet of Things

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The Internet of Things and Production

Pervasive digitalization

Integrated cyber-physical systems
- Improved capacity utilization
- Improved cost-effectiveness

Foster innovation

Challenges in Industrie 4.0

What will we have to adapt to?

Transition in engineering work

- Self-optimizing, individualized, integrated processes
- Regulatory and monitoring tasks

Challenges in

- Managing knowledge
- Sharing responsibility
- Dealing with **complexity**

Socio-Technical Systems (according to Leavitt 1964)

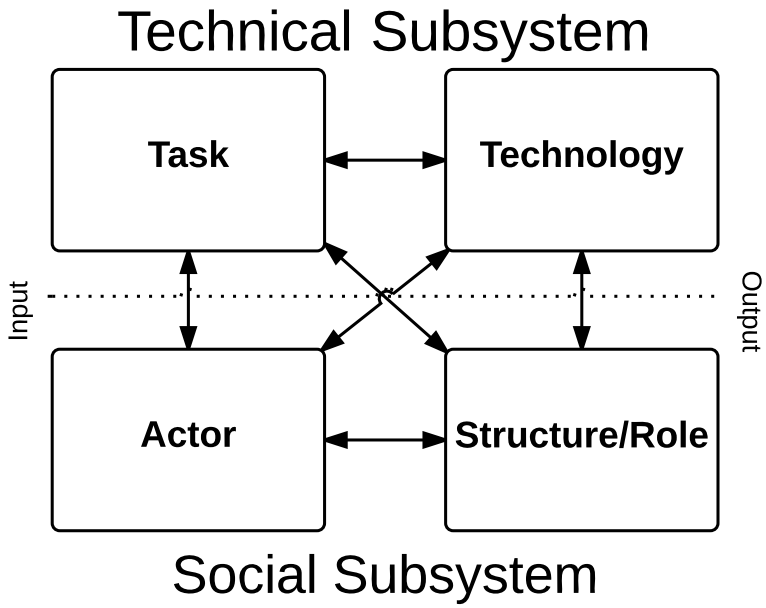
What drives a STS?

Humans and Technology
- Solve a specific task
- Mutual benefits

Quality depends on interactions of subsystems

Designed features with linear cause-effect

Non-designed non-linear emergent features => **Complexity**



Complexity in Human Machine Interaction

Not all complexity is created equal

Perceptual complexity

- Gestalt theory, homogeneity, simplicity, information entropy, form complexity, visual chunking, pop-out, etc.

Task-complexity

- Multi-variate decision making, goal complexity, input complexity, process/training, time, presentation, etc.

Cognitive complexity

- Relational knowledge (t,s,b), planning tasks, categorization, narrativity, uncertainty, risk

Use Cases

When does complexity matter?

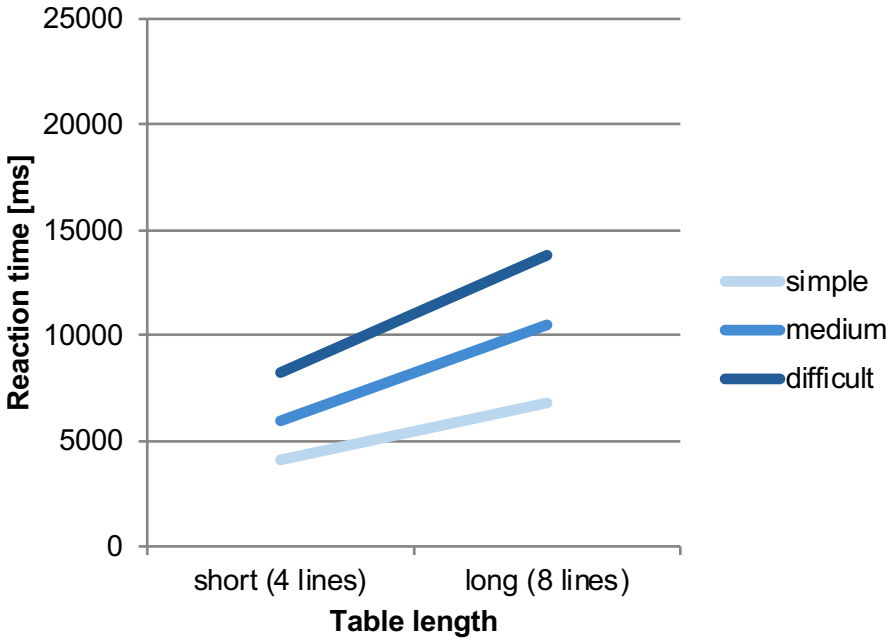
Visualization of complex data (ERP)
- Monitoring tasks, multivariate tasks
- Decision-Support => Consequences

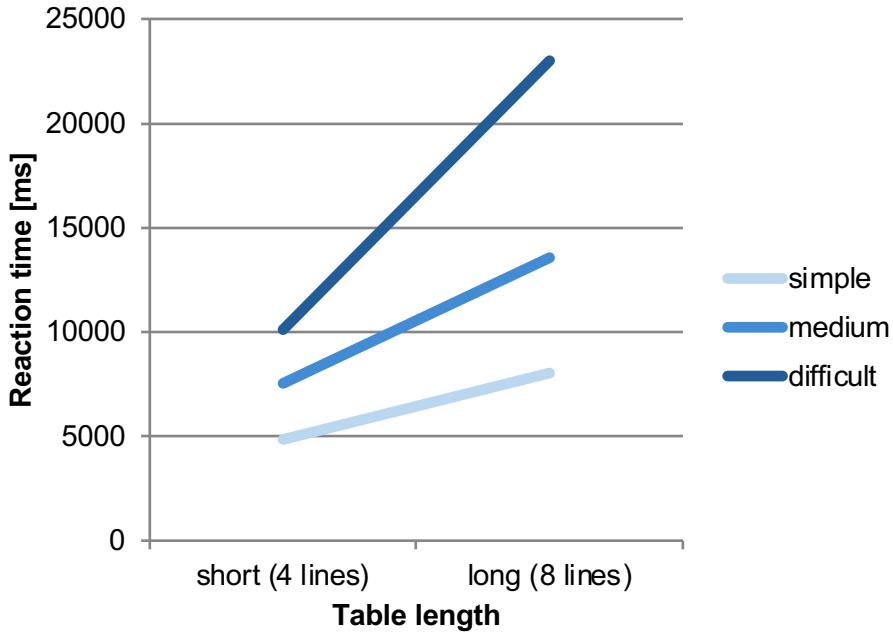
Simulation and scientific visualization
- Burden of knowledge
- High-dimensional data

Implications for UI Design Processes
Associated Costs?

Experimental Example: Reading of numerical data

Poor usability is pricey in scenarios with high complexity





Research Framework for STS

What aspects influence complexity in Industrie 4.0?

Research Framework for STS

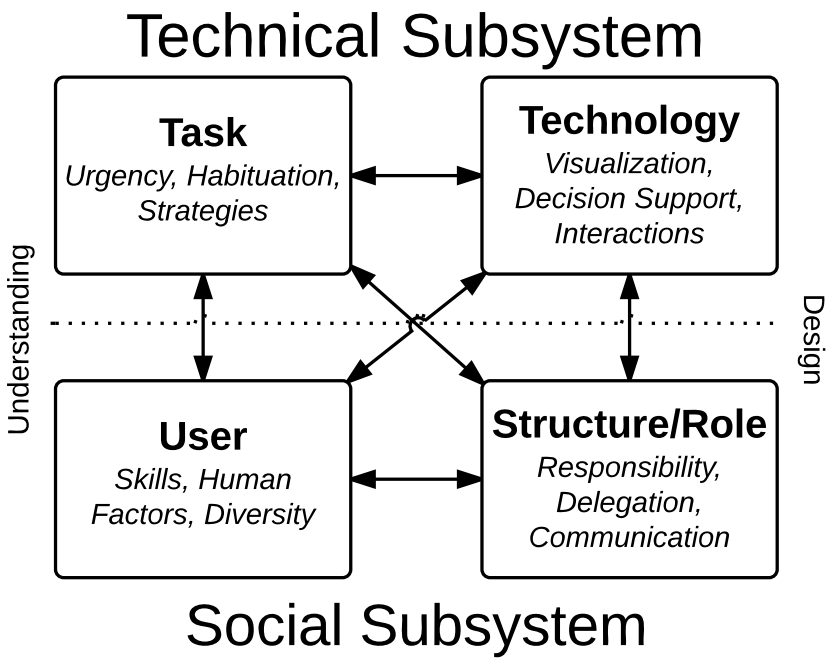
What factors should we focus on?

Task domain

Urgency
- Shorter Time-Frames
- Faster planning

Habituation
- Repetition frees cognitive resources
- Small changes?

Strategies
- Good strategies (best practices)
- Circumvention strategies



Research Framework for STS

What factors should we focus on?

User domain

Skills

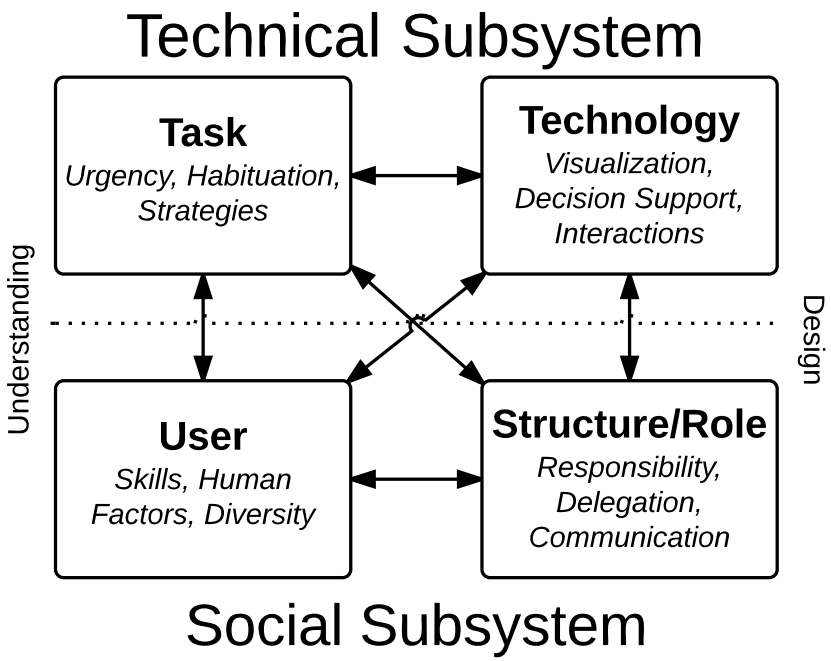
- HR-Management of competencies
- Learning on the job

Human Factors

- Ergonomics
- Task-Fit

Diversity

- Motivation & Values
- Demographic changes



Research Framework for STS

What factors should we focus on?

Technology domain

Visualization

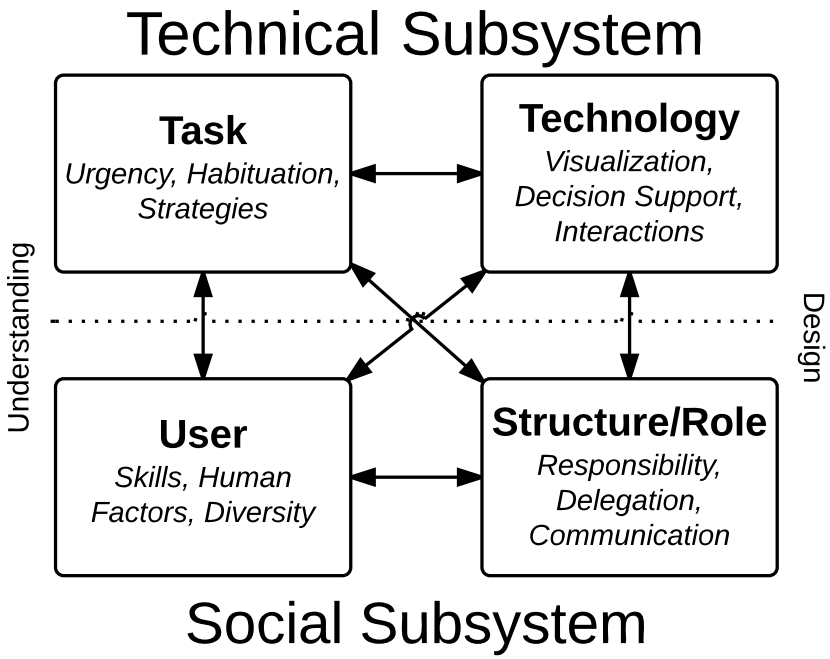
- Perceptual mapping
- Entropy detection & Hypothesis generation

Decision Support

- Transparency & comprehensibility
- Trust

Interactions

- New forms of interaction
- Adaptive Interfaces



Research Framework for STS

What factors should we focus on?

Structure domain

Responsibility

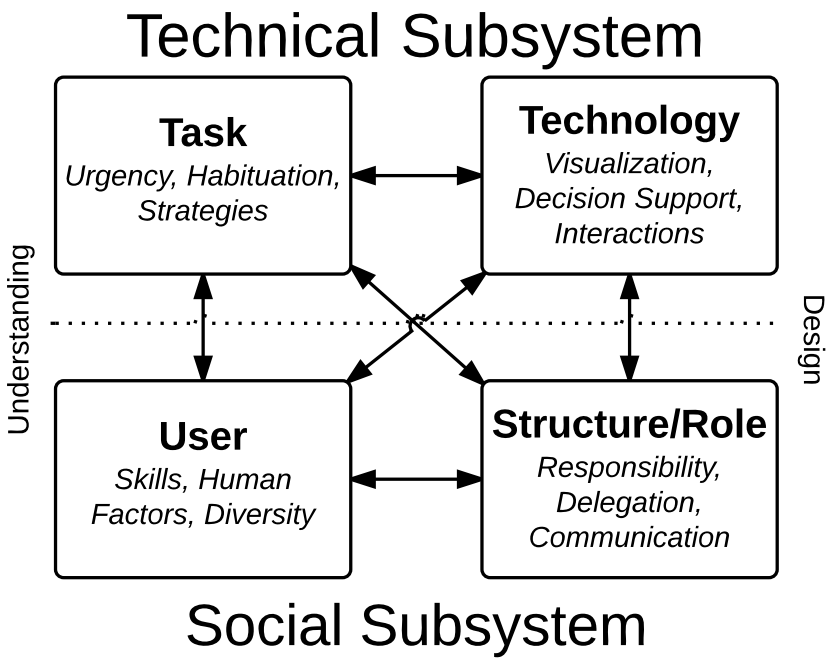
- Shared between algorithm or user
- Influence on Motivation

Delegation

- Benefit trade-offs (performance/learning)
- Adjustable complexity

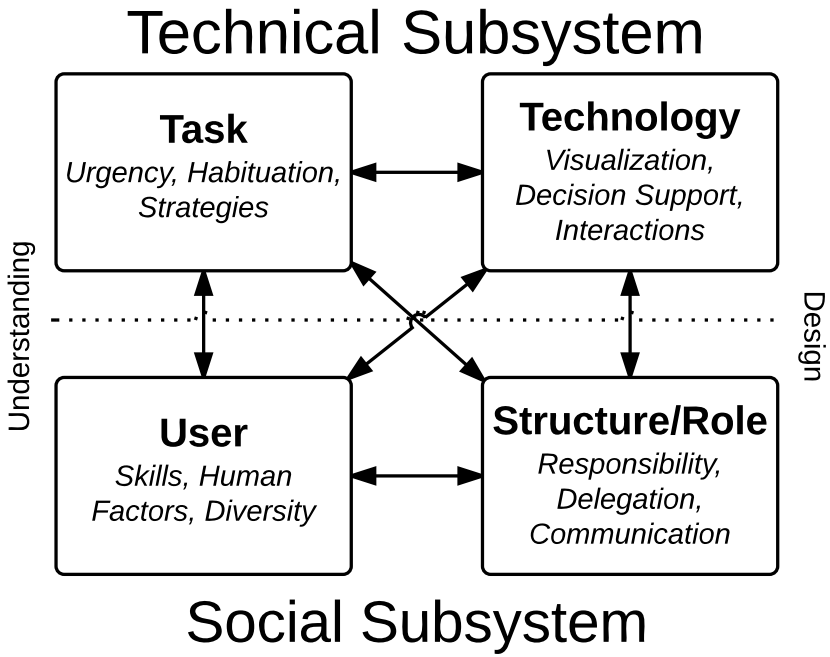
Communication

- Planned, organizational development
- Ad-hoc understanding



Unification of four domains

Understanding Task and User
Designing Technology and Structure



Summary

Thank you very much for your attention!

Socio-technical systems
- Linear and non-linear features

Different forms of complexity
- Visual, Cognitive, Task

Usability is crucial in complex environments

Research framework investigating complexity