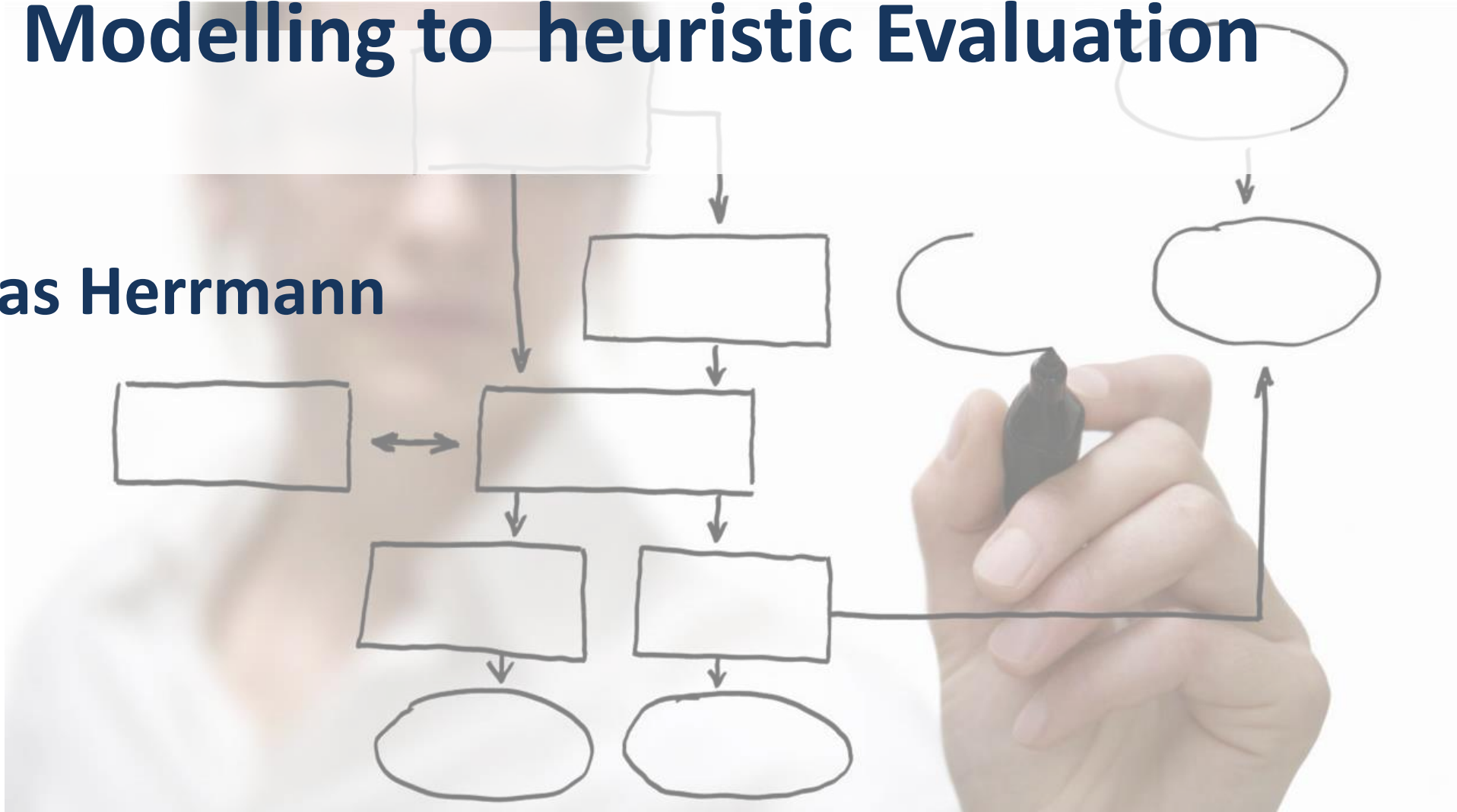


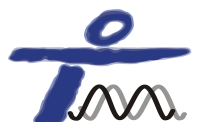
# Methods of socio-technical Design – from Modelling to heuristic Evaluation

Thomas Herrmann



# Outline:

- Defining socio-technical design
- Sociotechnical modelling
- Socio-technical walkthrough and socio-technical evaluation
- Heuristics as an evaluation guidance



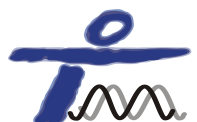
# Agile detection of problems of complex socio-technical concepts

(Industry 4.0, autonomous systems, AI-based task handling)

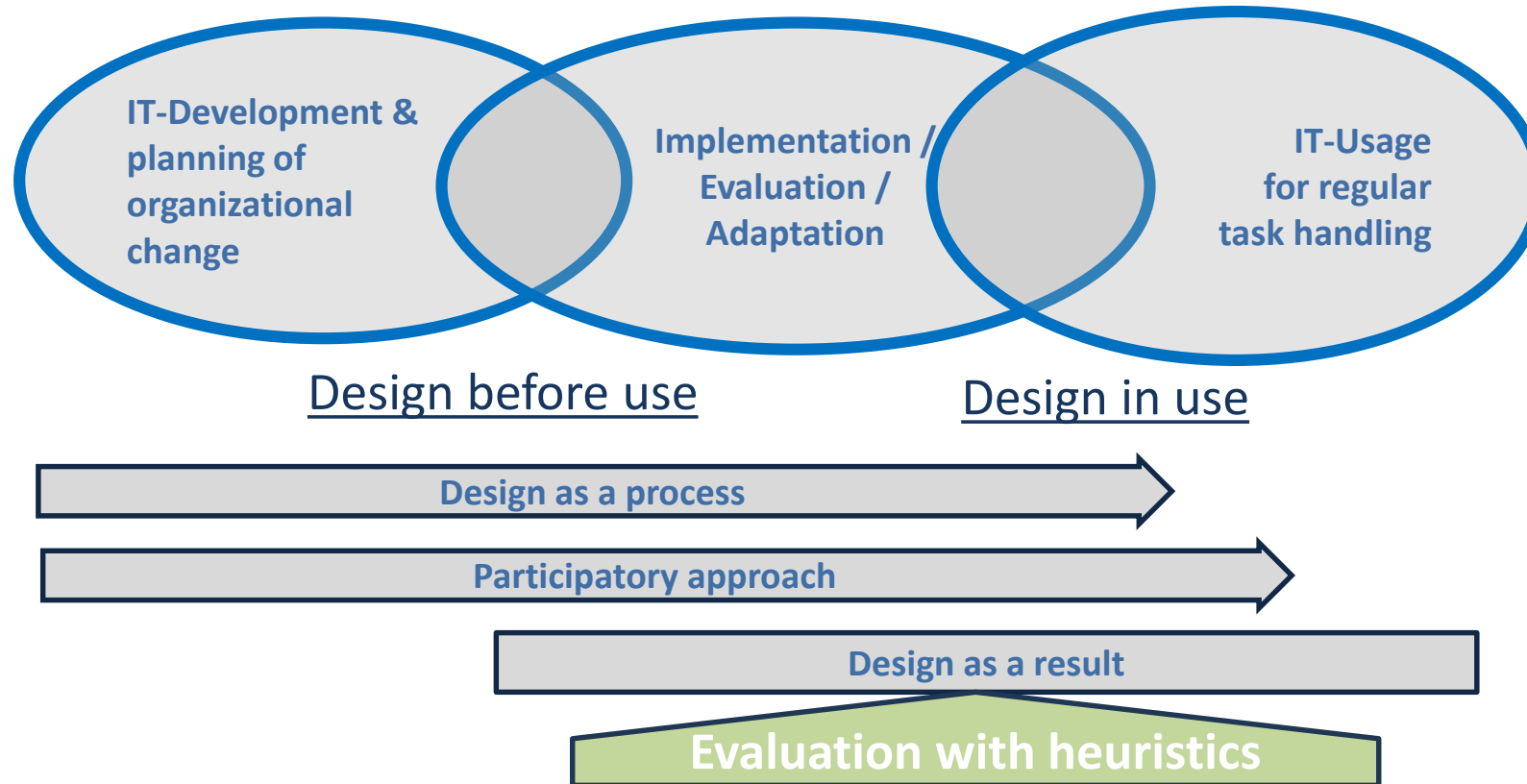
## Goals:

- Human-centered Job-design
- Dealing with complexity by pragmatic evaluation
- Fast evaluation for initiating agile improvement
- Seamless integration of human, technology and organization

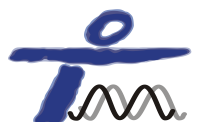
Approach → **Usage of socio-technical heuristics**



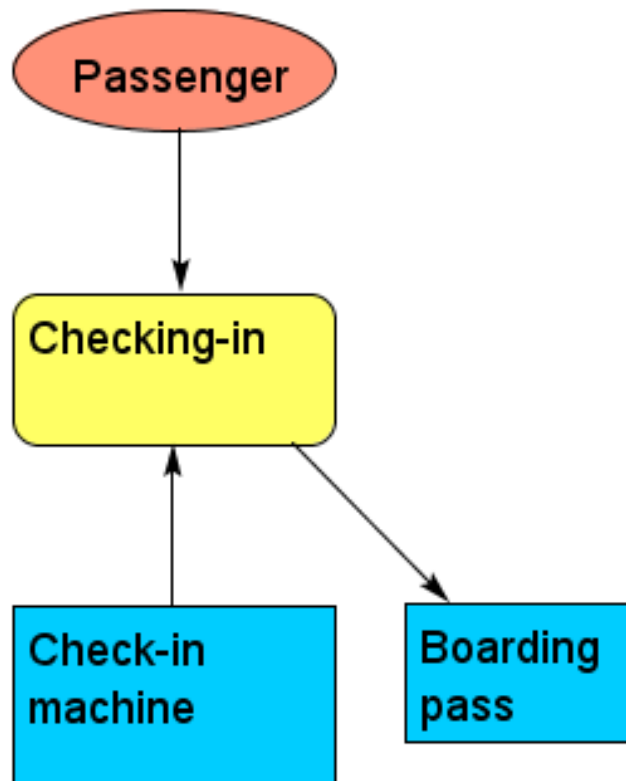
# Design, implementation and usage of socio-technical systems



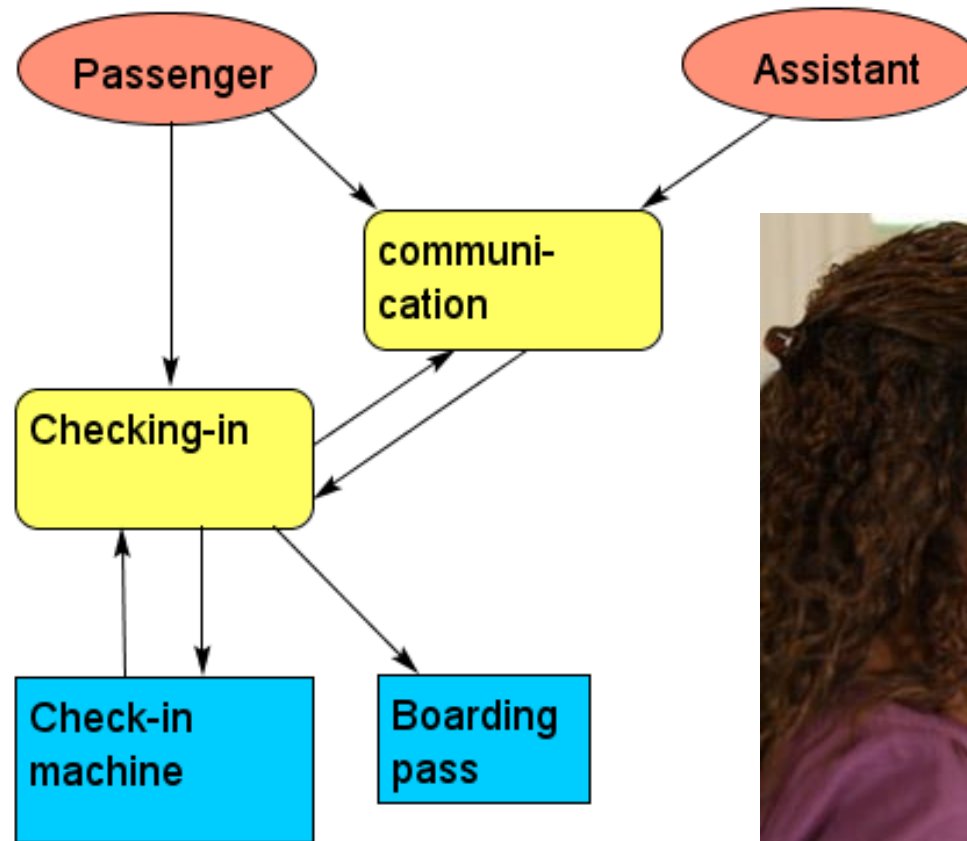
# Defining socio-technical design



# Human-Computer Interaction – a central perspective



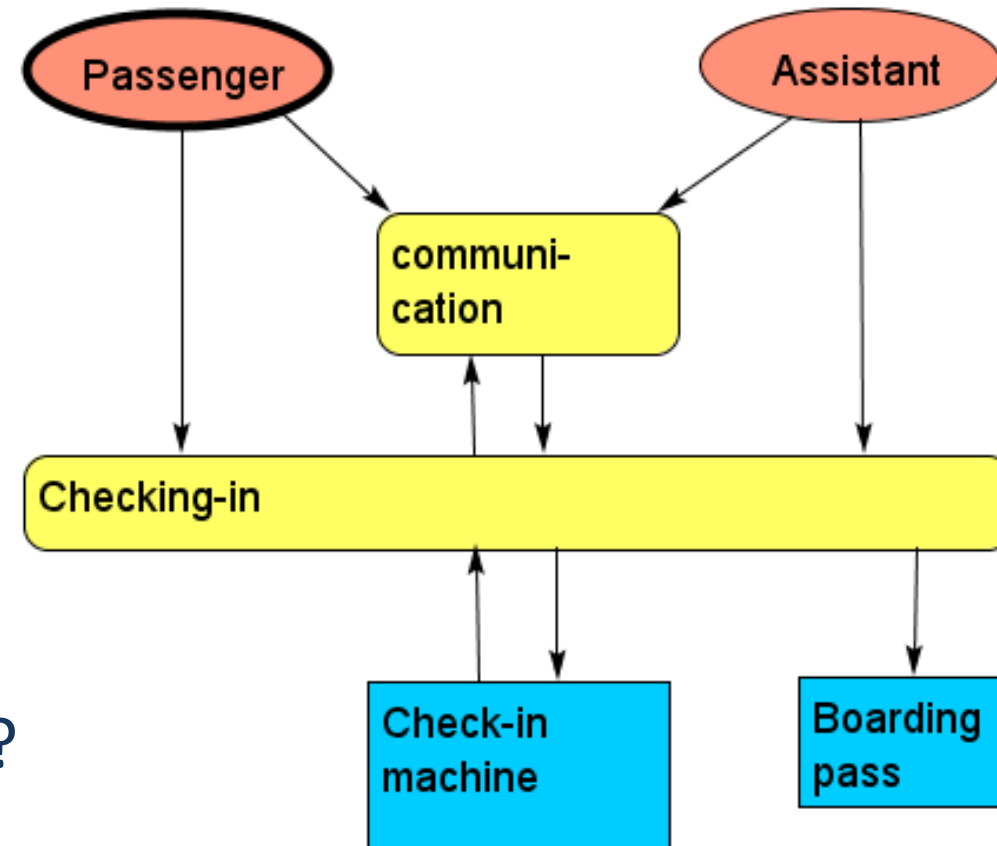
# Human-computer Interaction in context of a socio-technical process



# Variations of the socio-technical process

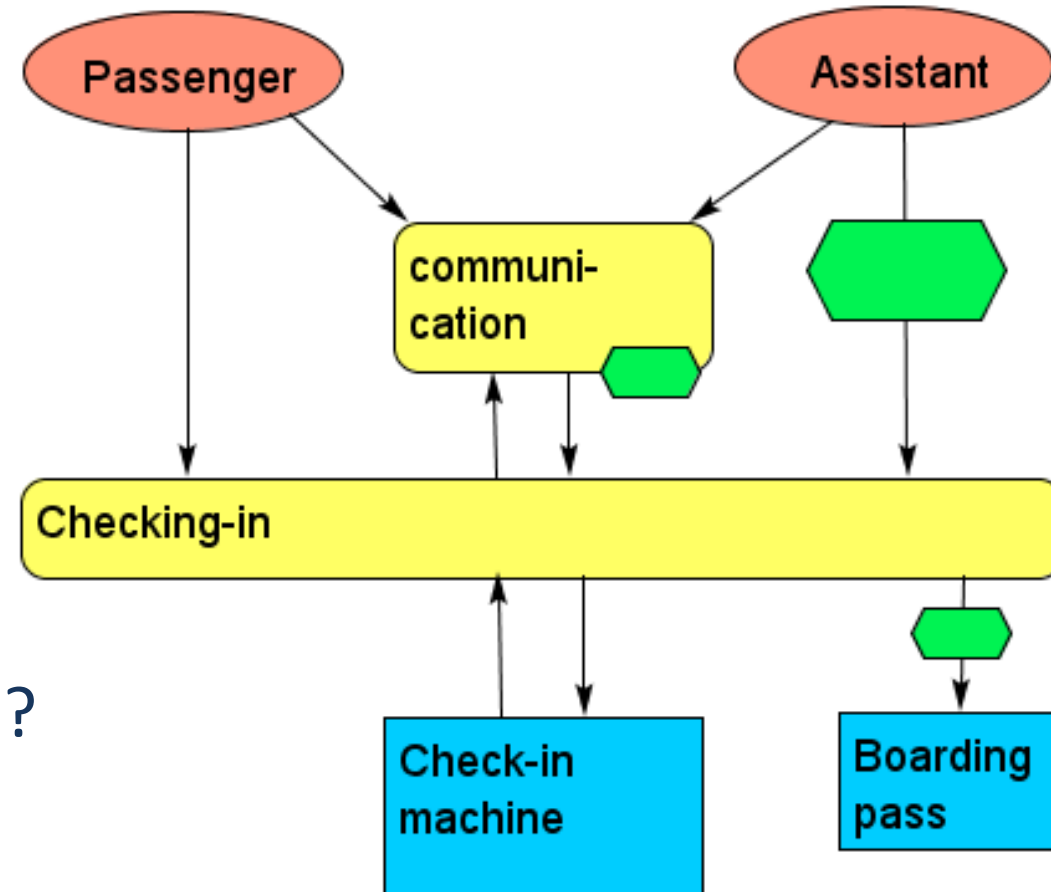


What is the difference here?





# Planning the socio-technical process

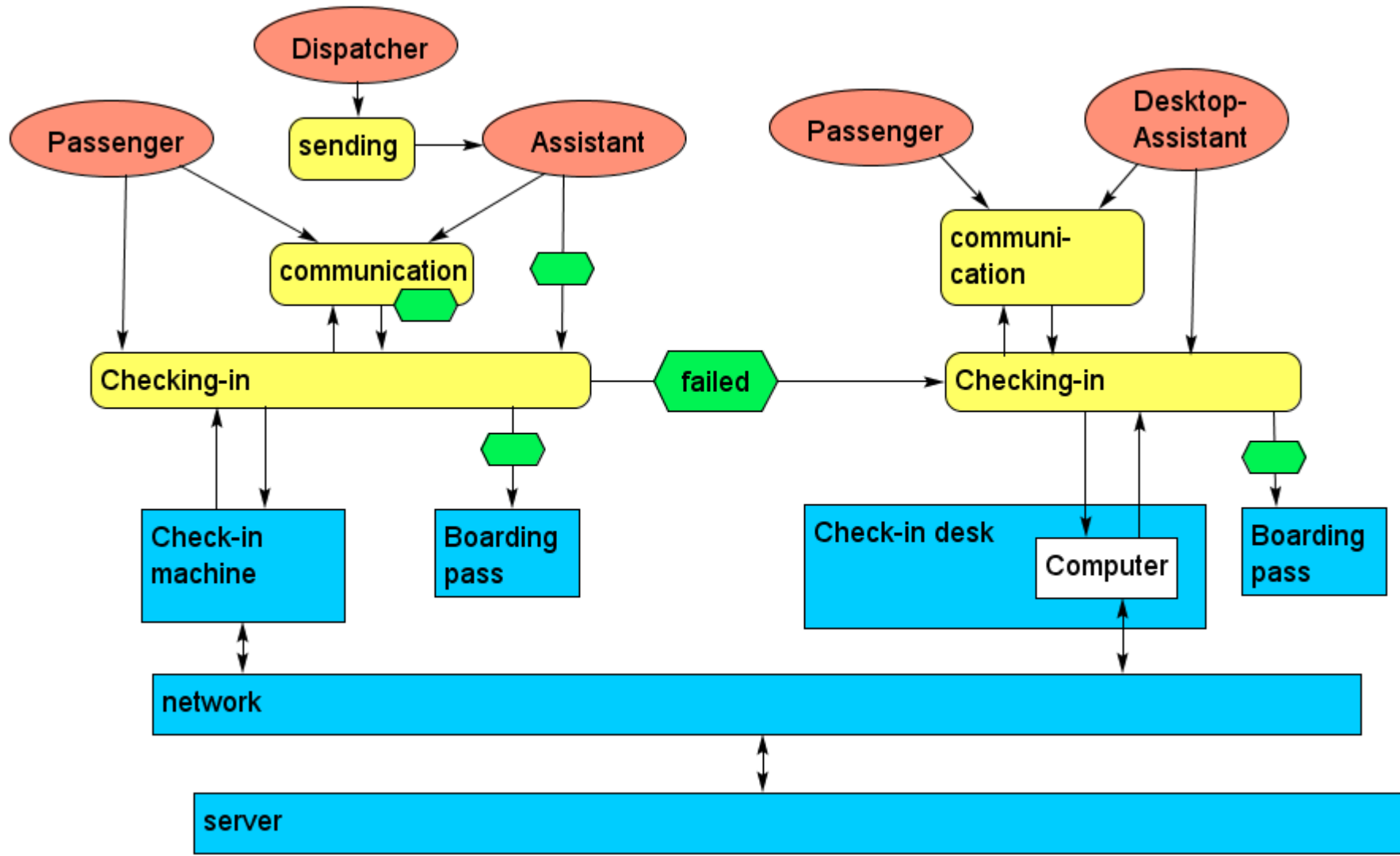


What is the difference here?

When will this happen?

**→ Complete anticipation not possible!**

# The socio-technical process unfolded



# Does this belong to the social side of checking-in?

Don't we know  
each other

Yes - you helped me with this  
machine last week , and again I  
don't understand ...



It depends how the process evolves!

# Does this belong to the social side of checking-in?

Don't we know each other

Yes – I guess we came in on the same plane last week ...



Does accompanying small-talk belong to the process?

# Defining „socio-technical process design“

„socio-technical process design“ –

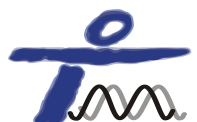
The planned integration of

**a. collaboration and communication  
between humans**

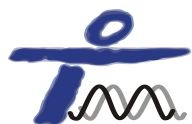
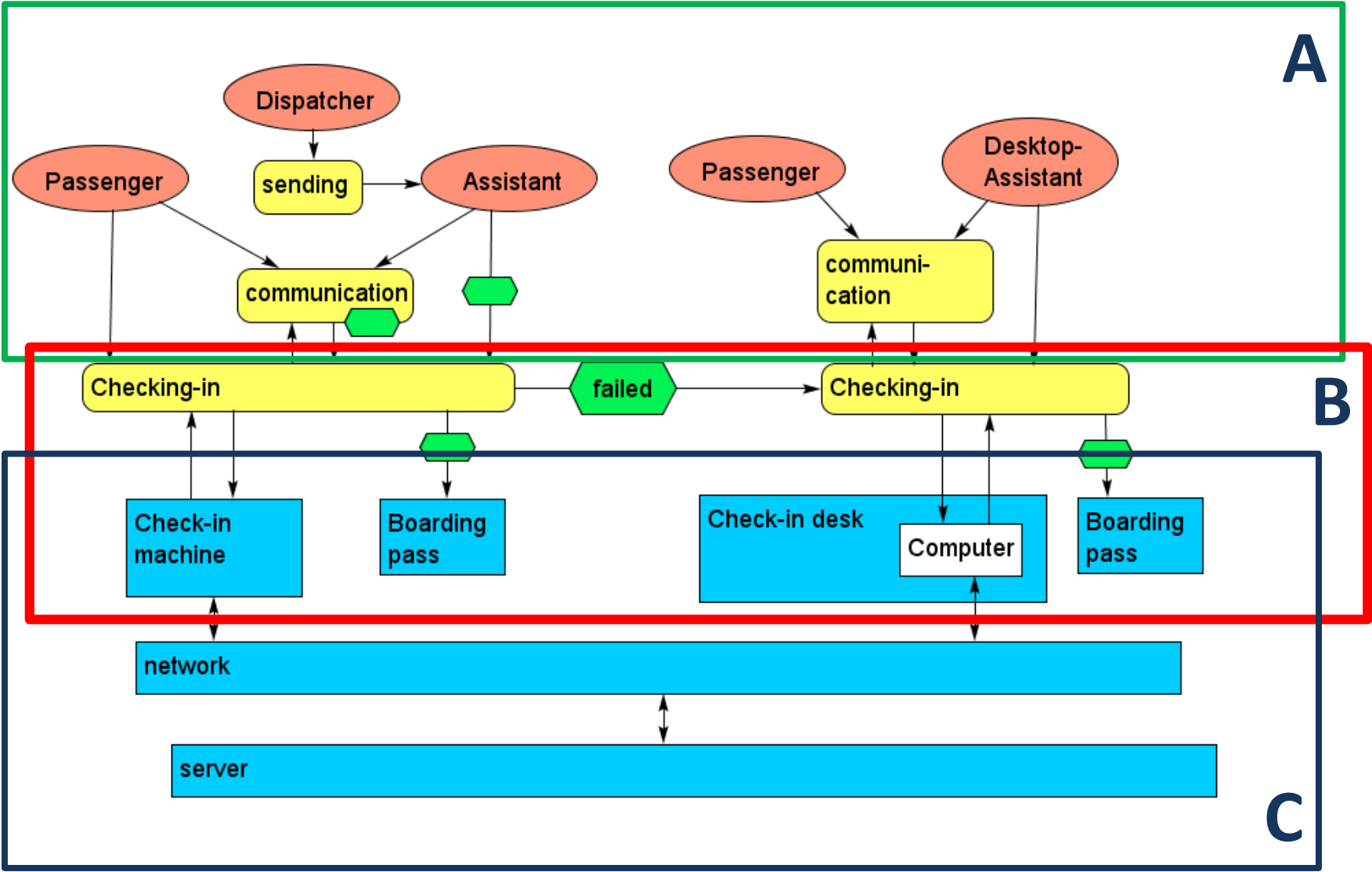
**b. Interaction between humans and  
technical artefacts**

AND

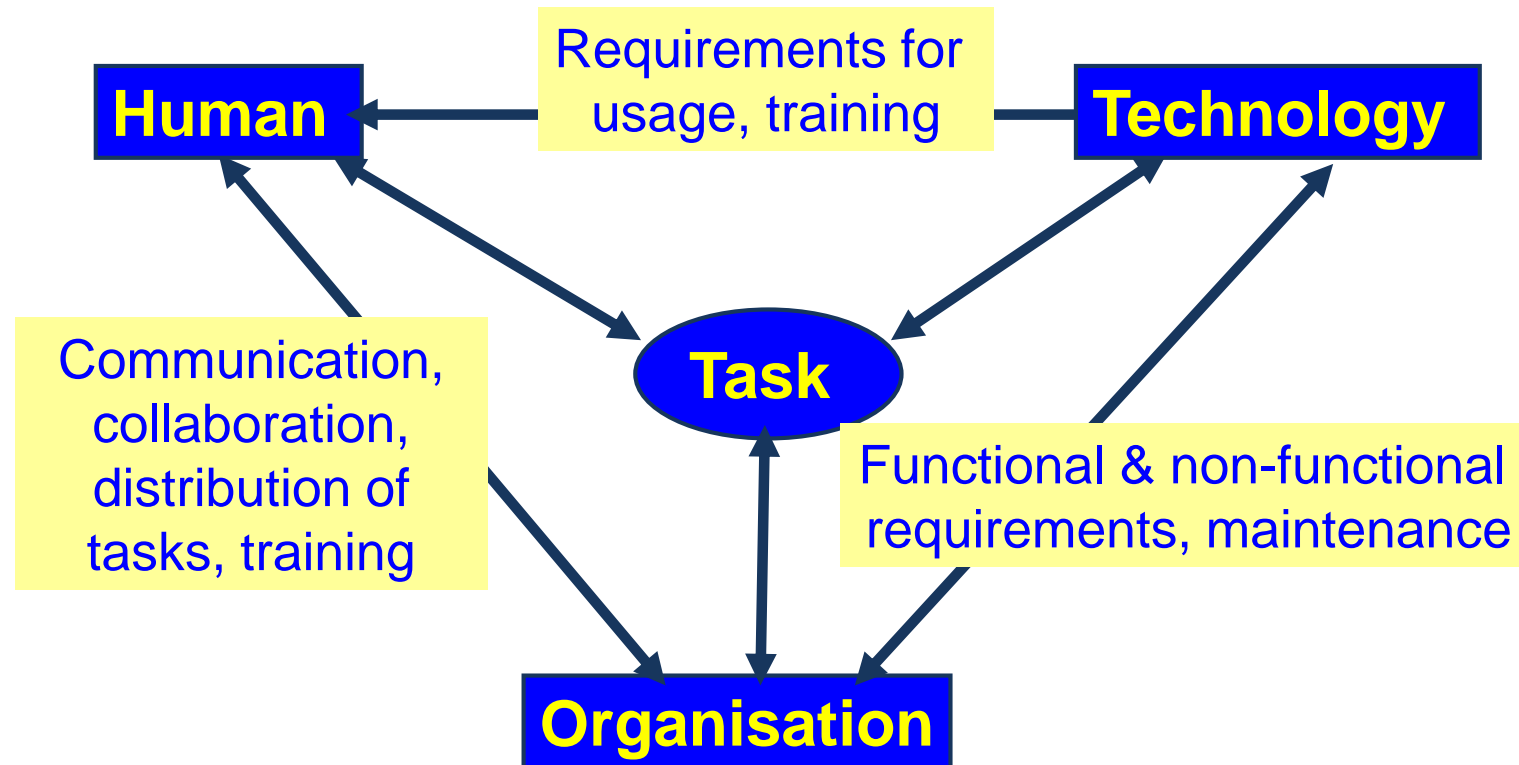
**c. The data exchange between components  
of a technical infrastructure and  
processes.**



# The socio-technical process unfolded



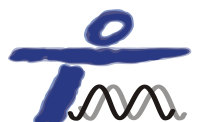
# Interplay between Human, Technology and Organization



**Goal of socio-technical Design: Integration of and calibration between these aspects; pursuing a complementary completion**

# Organizational perspective and processes instead of tandems

- How do technically supported work steps interact in processes?
- How is this interaction negotiated and agreed upon in terms of coordination?
- Which roles emerge in this process of coordination and negotiation?
- How do AI-based components, conventional IT and human work interact?
- How are operational steps linked to planning, reflection, learning and knowledge transfer?





# Relevance of socio-technical thinking

## Ghaffarian (2011): New Stream of socio-technical Approach ...

- Has not become established as a holistic guidance and orientation for the management of organizations.
- Consideration of the social dimension is still relevant for the sustainable success of the introduction of technical solutions with regard to the tasks and concerns of the actors involved.
- “Ensemble View” (Orlikowski & Iacono, 2001): ... web of ... commitments, additional resources such as training, skilled staff, and support services, and the development of organizational arrangements, policies, and incentives to enable the effective management and use of new technologies.

**The socio-technical perspective is not sufficient, but necessary**



# Challenge: Sustainable integration of technical infrastructure and social interaction

Todd Richmond 2017 (Director of Advanced Prototypes; University of Southern California Institute for Creative Technologies):

The challenge is figuring out how to make the technology useful and meaningful to humans, because analog (human) and virtual (digital) don't really mix. That said, oil and vinegar combined (in the right amounts) with agitation to create an emulsion that can result in a tasty salad dressing. And continuing the food metaphor, introducing a binding agent such as egg yolk transforms the separating salad dressing into mayonnaise – which is a stable emulsion.

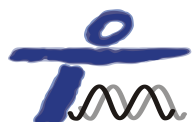
**Approaches to solution:**

**Storytelling (Todd)**

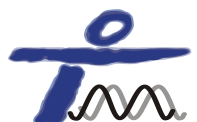
**exemplary process descriptions**

**Self-description,**

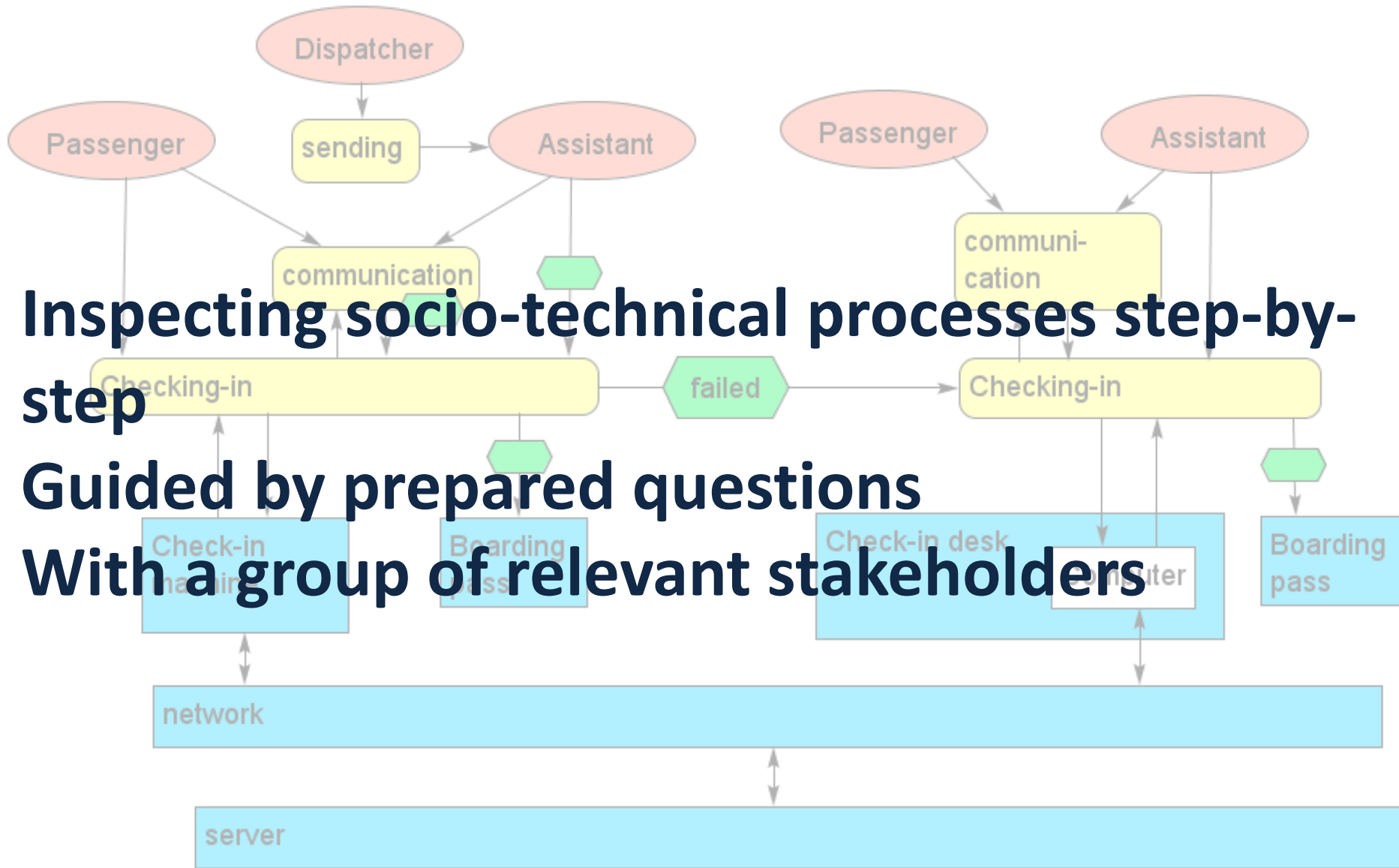
**actors as role models**



# Evaluation of socio-technical processes



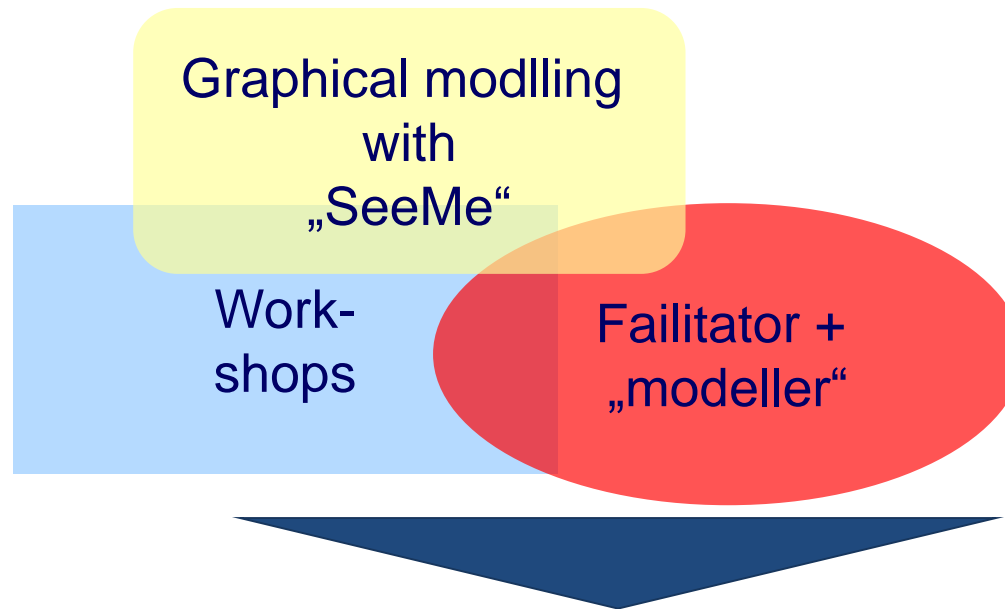
# The socio-technical walkthrough (STWT) organizing the communication between Stakeholders



**Inspecting socio-technical processes step-by-step**  
**Guided by prepared questions**  
**With a group of relevant stakeholders**



# Basic elements of a step-by-step planning of processes



## Socio-Technical Walkthrough (STWT)

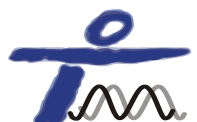
**Role models:** Cognitive Walkthrough for Usability-Engineering

Thomas Herrmann

→ “**Sociotechnical Walkthrough: Designing Technology along Work Processes.**” PDC 2004.

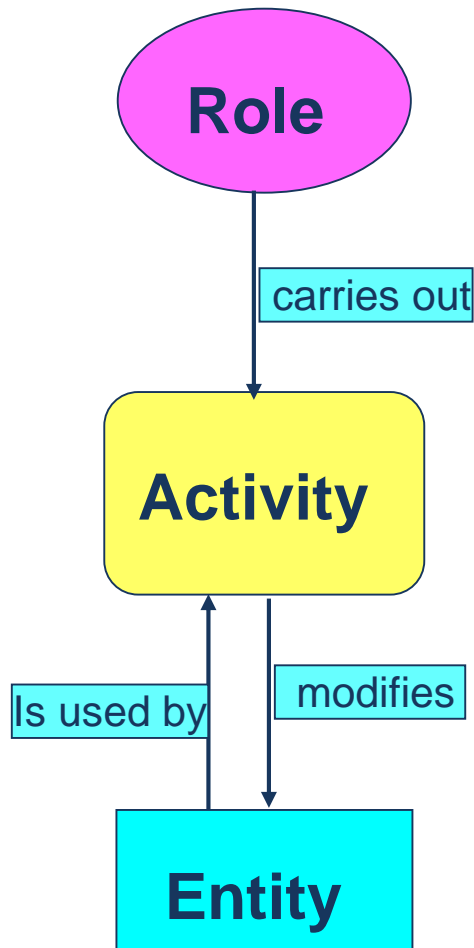
→ Herrmann, T. (2009). **Systems design with the socio-technical walkthrough.** In *Handbook of research on socio-technical design and social networking systems* (pp. 336-351). IGI Global.

Oldenburg, 15.1.2020



# Basic Elements of the Notation

## (SeeMe – semi-structured, socio-technical modelling Method)



Mainly duties and rights of persons, teams, organizations → social aspects

Behaviour which leads to change

Ressources which support activities (technology, ...)

→Herrmann, T., Hoffmann, M., Kunau, G., & Loser, K. U. (2004). A modelling method for the development of groupware applications as socio-technical systems. *Behaviour & Information Technology*, 23(2), 119-135..

Further information: [SeeMe in a Nutshell](#)

Low threshold – high ceiling



# Flexible vs. prescribed sequence

Antrag bearbeiten

Daten auf  
Vollständig-  
keit prüfen

fehlende  
Daten an-  
fordern

Daten  
nach-  
tragen

Berech-  
nung durch-  
führen

Entschei-  
dung vor-  
bereiten

Antrag bearbeiten

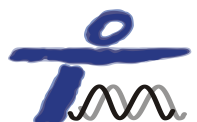
Daten auf  
Vollständig-  
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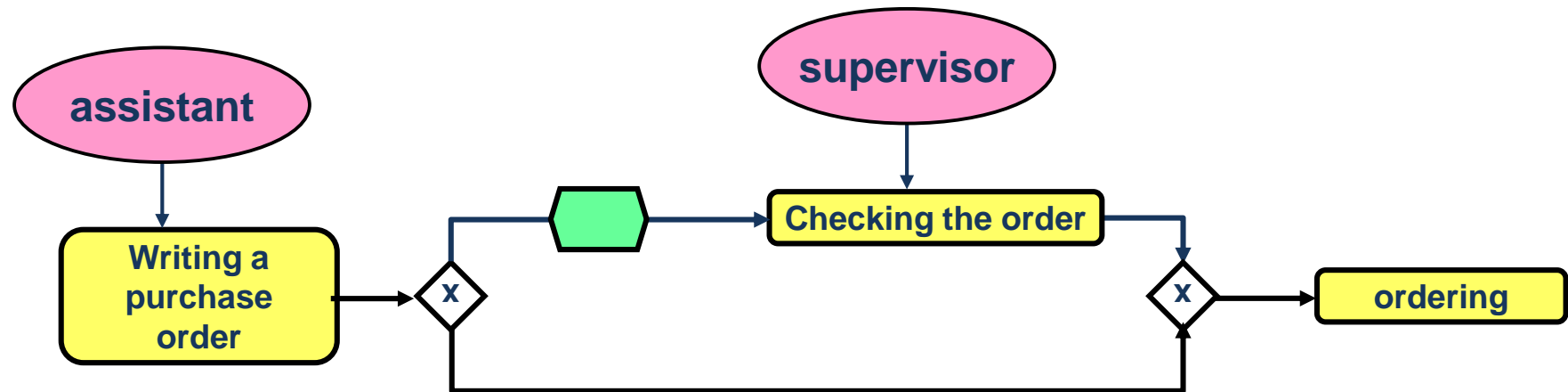
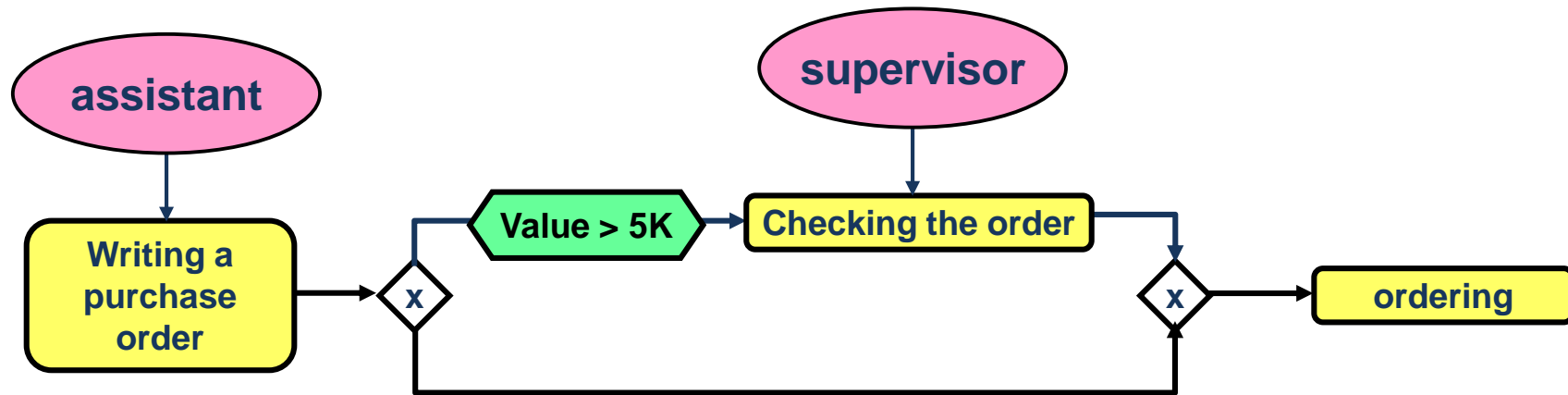
Daten  
nach-  
tragen

Berech-  
nung durch-  
führen

Entschei-  
dung vor-  
bereiten



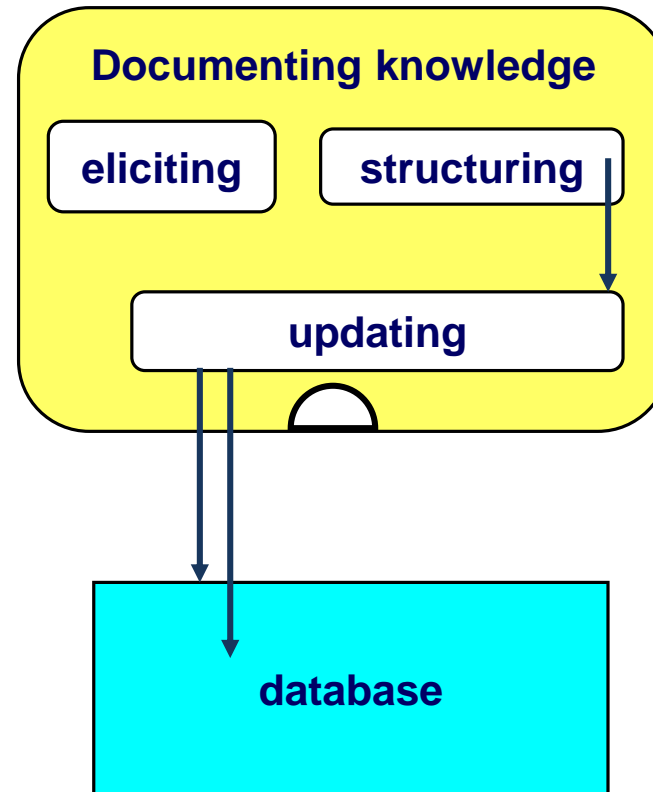
# Freedom of decision





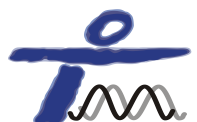
# Specific structures

## Embedding, incompleteness

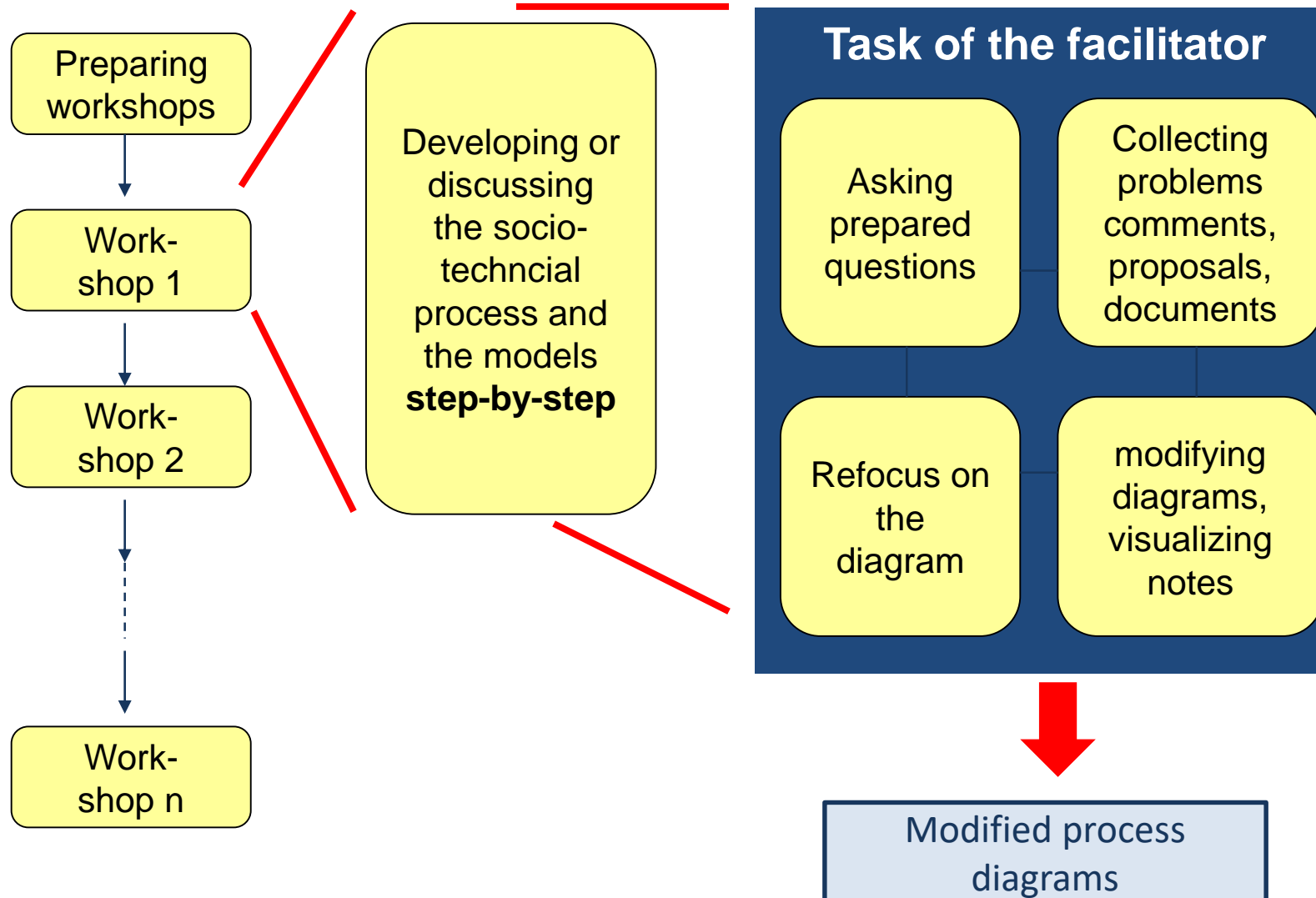


**Indication of incompleteness supports the handling**

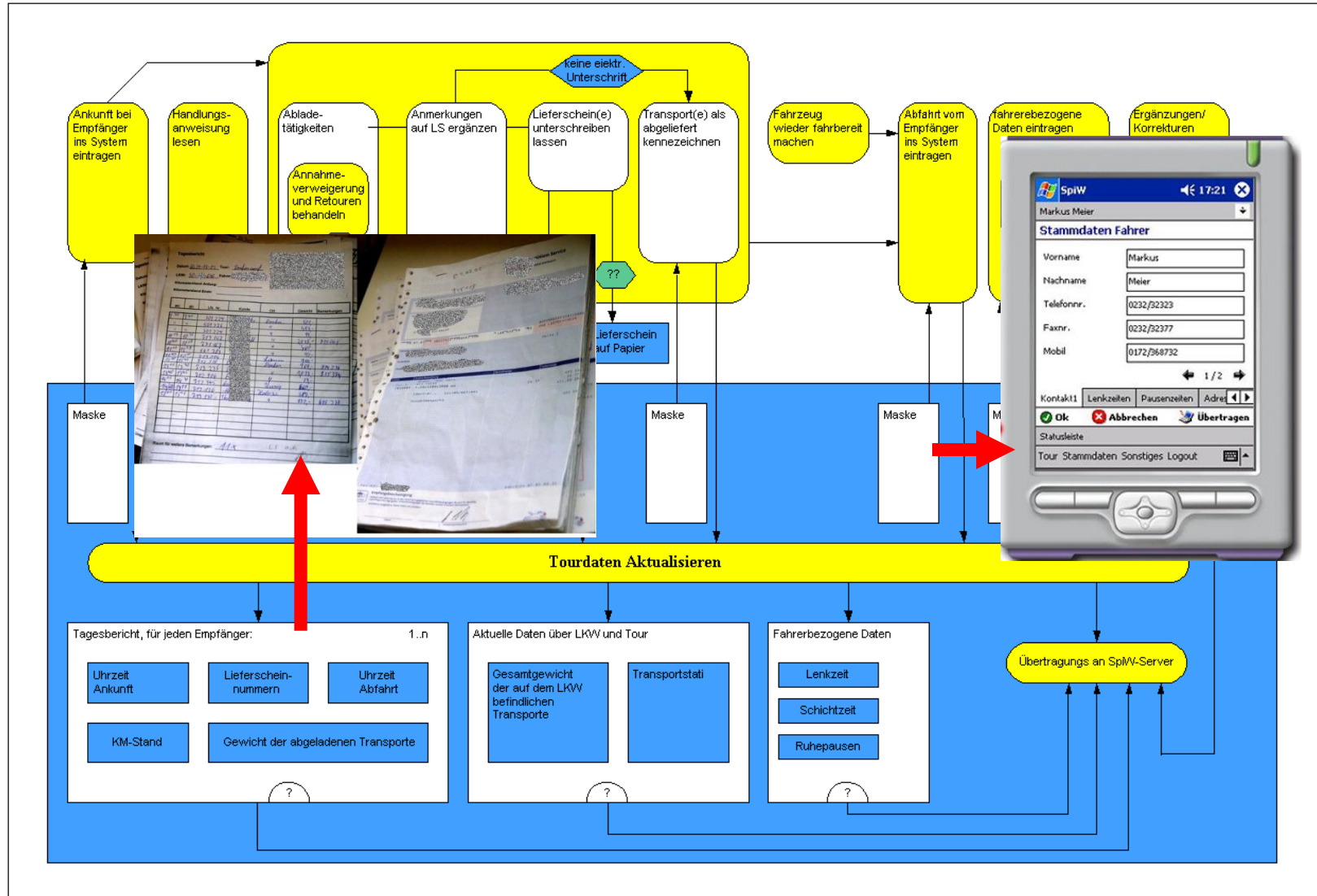
- of tacit knowledge and
- freedom of decision



# The socio-technical walkthrough – emphasizing facilitation and distributed control



# Contextualized process models

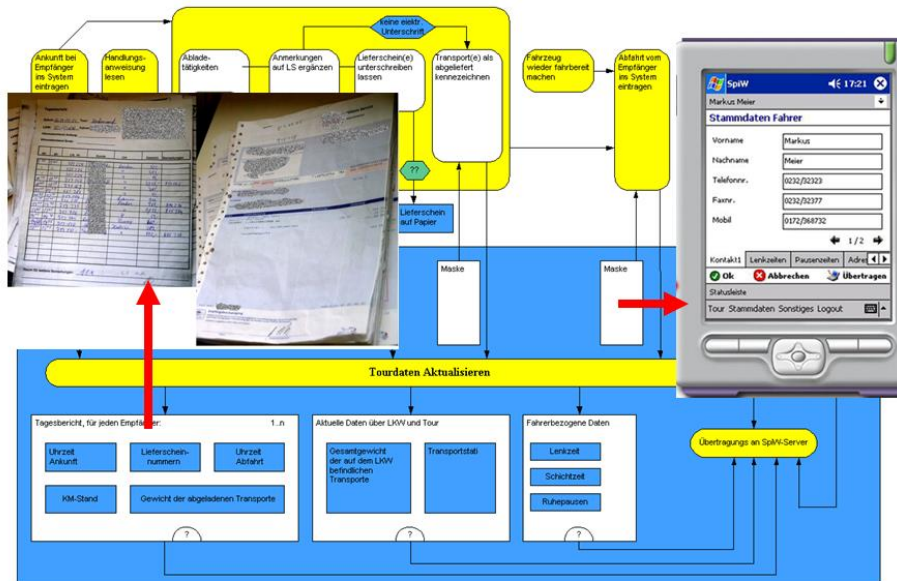


# Usage of Guiding Questions

Which tasks and effort does your job include?

What will be the next step?

Which information is needed / produced?



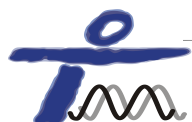
## Task of the facilitator

Asking prepared questions

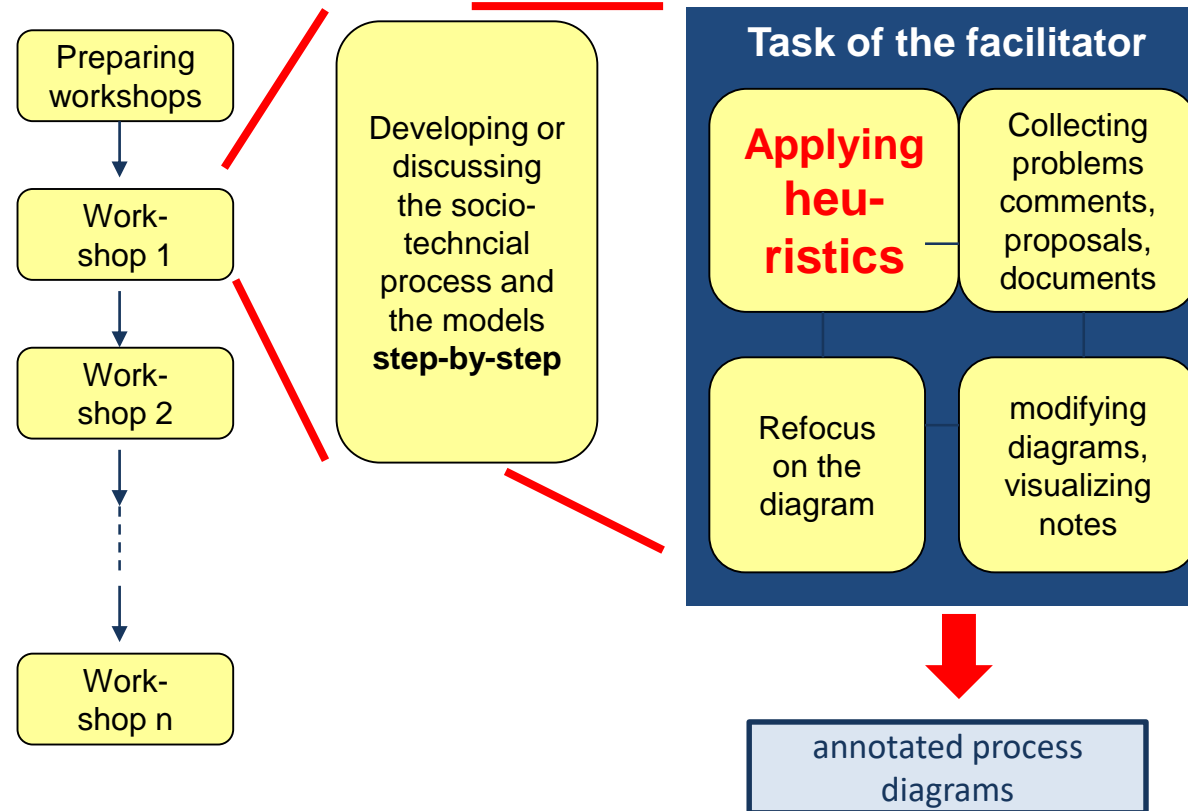
Collecting problems comments, proposals, documents

Refocus on the diagram

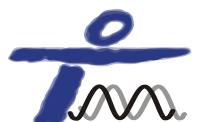
modifying diagrams, visualizing flipchart notes



# The socio-technical walkthrough – emphasizing facilitation and distributed control



# Socio-technical heuristics as a Basis for Questions that guide the evaluation



# Heuristics of Human-Computer-Interaction ...

## ... to be extended to socio-technical heuristics

### Nielsen & Molich:

1. Visibility of system status:
2. Match between system and the real world:
3. User control and freedom:
4. Consistency and standards
5. Error prevention
6. Recognition rather than recall
7. Flexibility and efficiency of use
8. Aesthetic and minimalist design
9. Help users recognize, diagnose, and recover from errors
10. Help and documentation



Thomas Herrmann



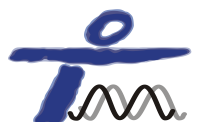
Oldenburg, 15.1.2020

# Areas to be taken into account and getting focussed

- Human-Computer Interaction (HCI)

+

- Socio-technical Design (STD)
- Computer-Supported Cooperative Work (CSCW)
- Job Re-Design (JRD)
- Privacy (PRIV)
- Process Re-Design (PRD)





# Areas to be taken into account .... and getting focussed

- Human-Computer Interaction (HCI)
- Socio-technical Design (STD)
- Computer-Supported Cooperative Work (CSCW)
- Job Re-Design (JRD)
- Privacy (PRIV)
- Process Re-Design (PRD)

→ 174 Heuristic-Items were derived

→ Grouping into 13 Heuristics

Testing by assigning a list of 223 problems to the heuristics

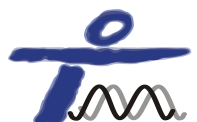


1. Smart glasses for coordination of dentistry students and supervisors during practical training (Workplace Learning) (13)
2. Continuous assessment of working climate in regard to creativity (Organization Studies) (11)
3. Supporting orientation for new students via augmented reality technology (College Orientation) (19)
4. Data-based strategic improvement planning at a school (Schools) (64)
5. Remotely controlled experimentation learning system for engineering students (Engineering Education) (12)
6. Coordination of health care services for the older adults (Health Care) (59)
7. Continuous updates of small organizational units' websites (Small Business, Cooperative Work) (5)
8. Digital systems in health care (Health care technologies) (29)
9. Supporting the reflection of conversations with relatives of stroke patients (Health Care) (11)



# Considered cases (smart factories... )

- 10. Predictive maintenance in car manufacturing (77)
- 11. Digital Diary for handovers between shifts (33).
- 12. Self-Learning manufacturing workplace related to the coordination of maintenance, to visualization of trends for identifying expectable defects, and to possible solution (10)
- 13. Future WorkLab: Assistance for controlling and maintaining manufacturing machines (14)
- 14. Manufacturing of components for dental implants with variable production series (19)



# Areas to be taken into account ... and getting focussed

- Human-Computer Interaction (HCI)
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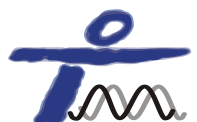
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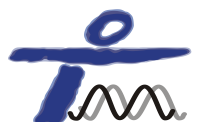
→ Further Summarization → 8 Heuristics

→ Heuristik 4.0. Heuristiken zur Evaluation digitalisierter Arbeit bei Industrie-4.0 und KI-basierten Systemen aus soziotechnischer Perspektive  
[www.fgw-nrw.de/fileadmin/user\\_upload/FGW-Studie\\_DvA16\\_Herrmann\\_Nierhoff\\_web\\_mit\\_Anhang.pdf](http://www.fgw-nrw.de/fileadmin/user_upload/FGW-Studie_DvA16_Herrmann_Nierhoff_web_mit_Anhang.pdf).



# 8 Heuristics

1. **Visibility and feedback about task progress**
2. ***Flexibility* for variable task handling leading to a participatory evolution of the system**
3. ***Communication support* for task handling and social interaction**
4. **Purpose orientated *information exchange* to facilitate mental work**
5. ***Balance* between perceived effort and benefit by task design**
6. ***Efficient organization* of task handling for holistic goals**
7. ***Compatibility* between requirements, development of competences and the system's features**
8. ***Supportive technology* and resources for productive and flawless work**



# 1. Visibility and feedback about task progress

- Focused information is continuously offered about the progress of technical processes and – as far as permitted – about collaborative task handling. This helps to understand which further steps are possible or not and why, and how far the expectations of other people are met.



## Example

- You can not only comprehend how many parts have passed a forming press, but you also see, whether and when a specialist is available to do maintenance work.

# Comparison: Usability vs. Socio-technical perspective I



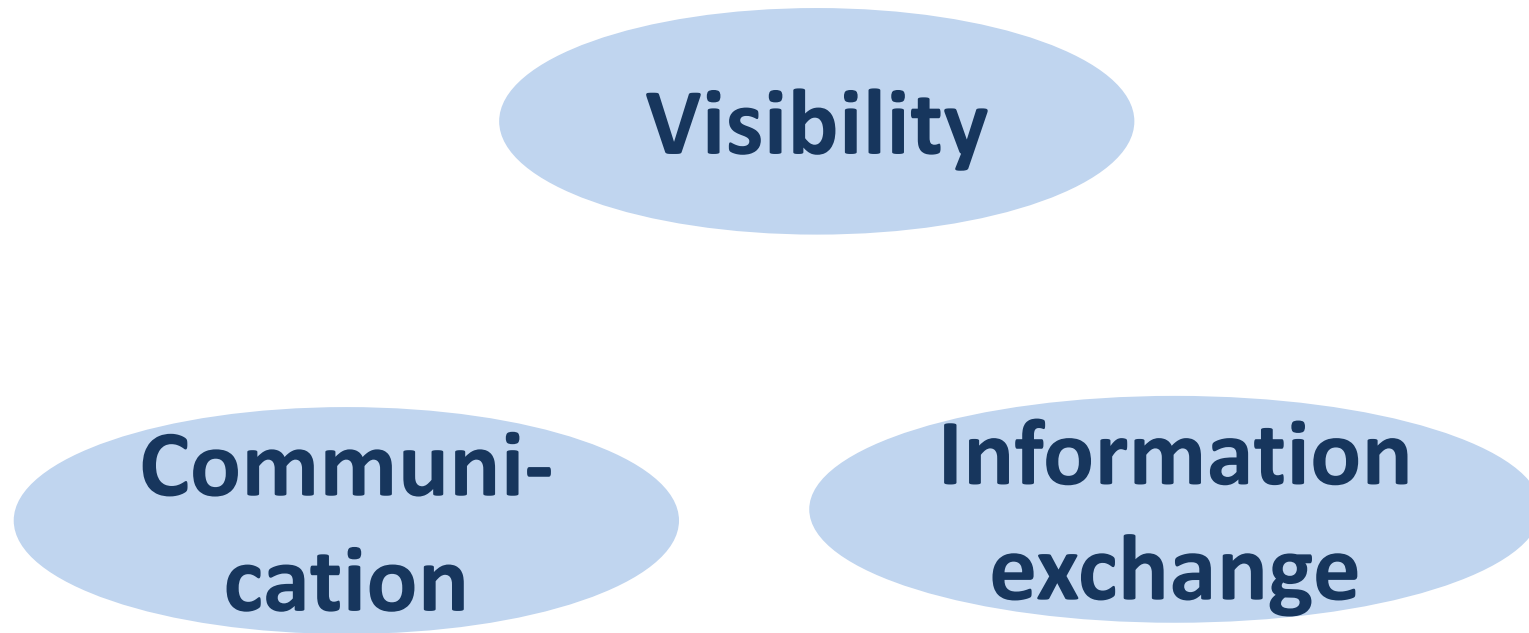
## **Visibility of system status:**

The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

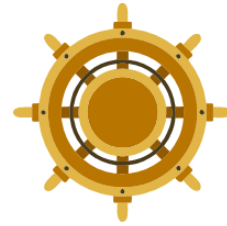
## **Visibility and feedback about task progress**

Focused information is continuously offered about the progress of technical processes and – as far as permitted – about collaborative task handling. This helps to understand which further steps are possible or not and why, and how far the expectations of other people are met.

# Different perspectives on STS - I







## **Flexibility and efficiency of use**

Accelerators — unseen by the novice user — may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

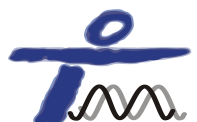
## ***Flexibility* for variable task handling leading to a participatory evolution of the system**

One can vary manifold options of task handling and can flexibly decide about technology usage, time management, sharing of tasks etc. Consequently, one can develop a wide range of competences that promote participation in the ongoing evolution of the whole system.

# Perspectives on STS - II

**Balance  
between  
effort and  
benefit**

**Efficiency**



## Concluding remarks

**1) The socio-technical perspective includes more than human-machine interaction and the design of technology:**

- Influencing the organization and social interaction in processes**
- Focus on reciprocal complementary completion**

**2) Usage of heuristics to**

- ... evaluate and reflect socio-technical concepts quickly and in a participatory manner**
- Implementing flexibility and evolution**
- optimize without understanding everything in detail**

**3) Socio-technical approaches that do not address the effect of and the influencing of social interaction are not socio-technical.**



# Next steps: Applying and improving the heuristics

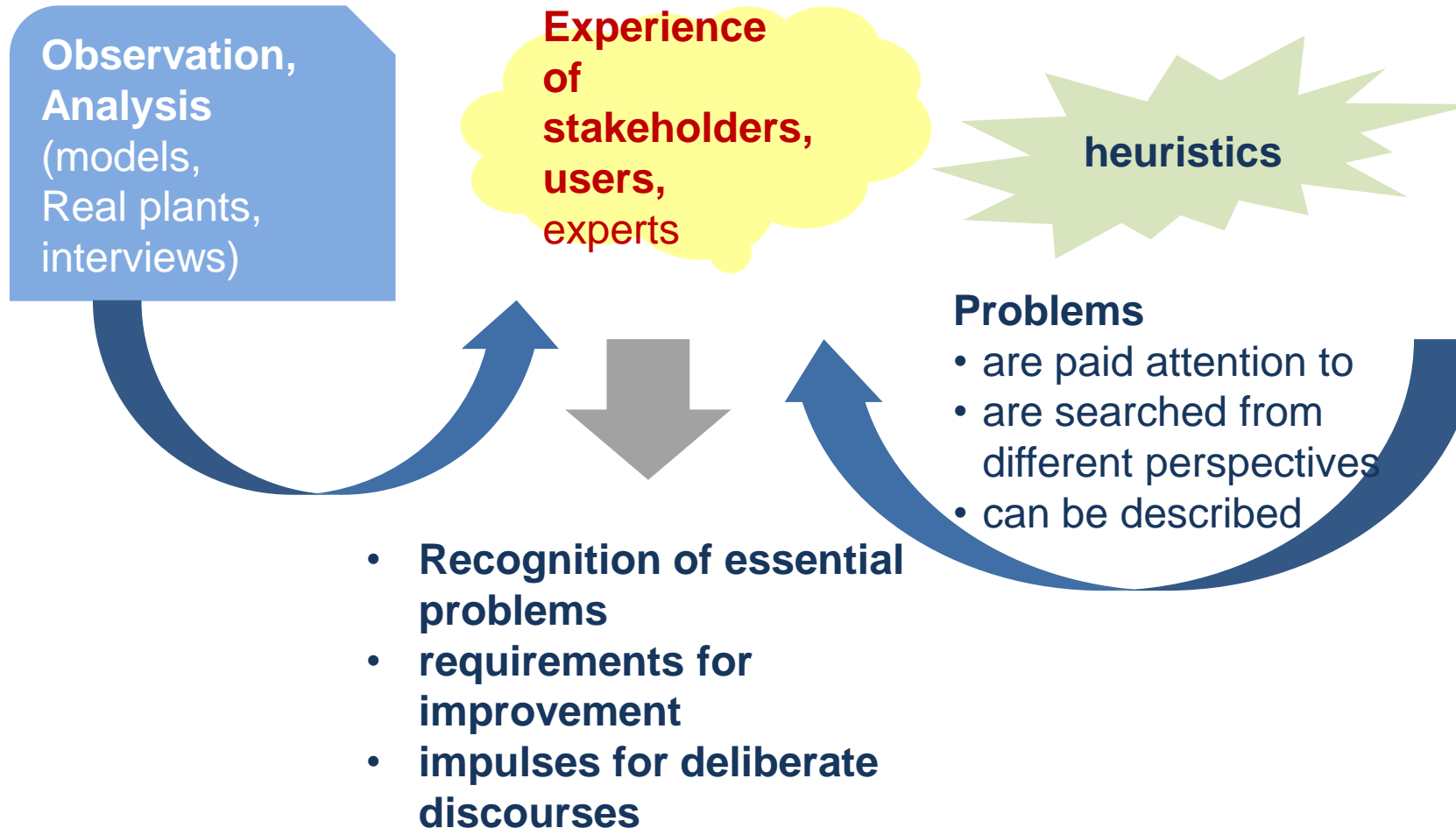
Thank you!

[Thomas.herrmann@rub.de](mailto:Thomas.herrmann@rub.de);

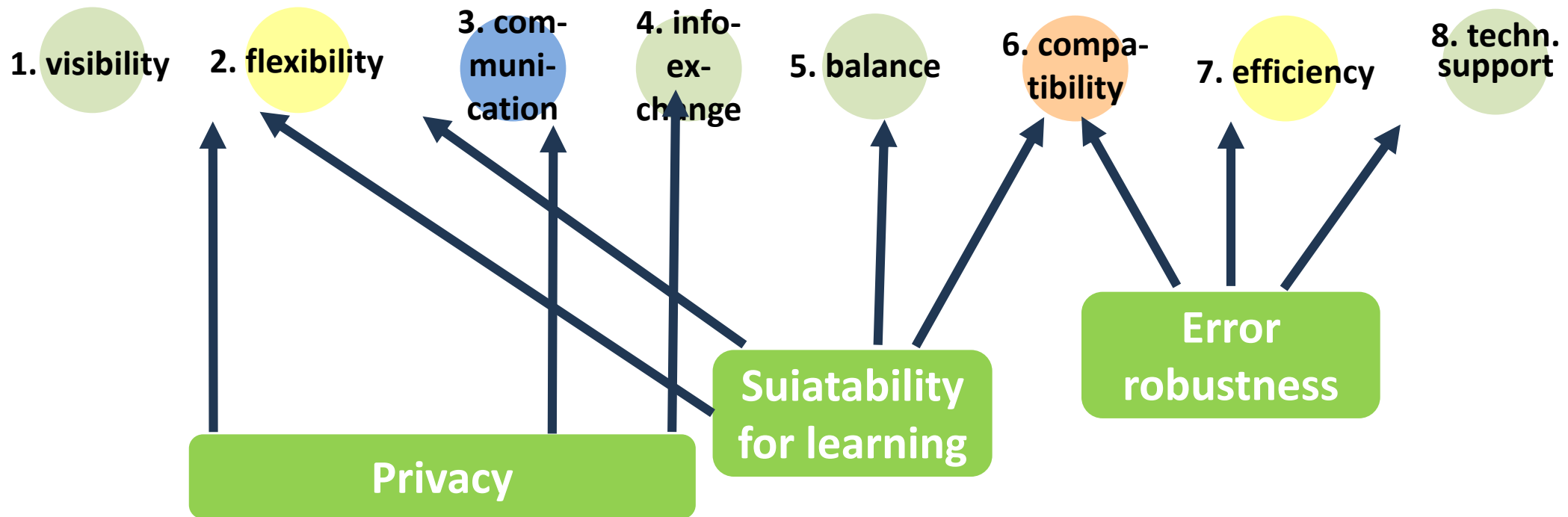
<https://hi4.iaw.rub.de/#!/heuristics>



# Heuristics ... the way they work is relevant ...



# Further aspects to be assigned



# Essence of STWT

- Semi-structured modeling and STWT lead to successful design of socio-technical processes
- diving into the work processes instead of staying with a birds-eye view
- systematical consideration of the work and task context of a systems usage
- support of the communication between various stakeholders
- Decision making about which aspects of a process have to be formally specified and which can be a subject of flexibility

