Towards a dynamic balance between humans and machines:

Authority, ability, responsibility and control in cooperative control situations

Frank Flemisch, Matthias Heesen,
Johann Kelsch, Johannes Beller

ITS Institute of Transportation Systems Braunschweig

Background: Assistance & Automation in movement control

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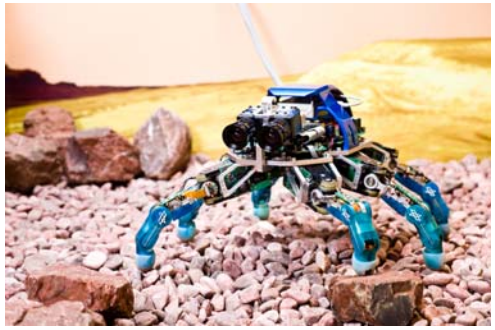
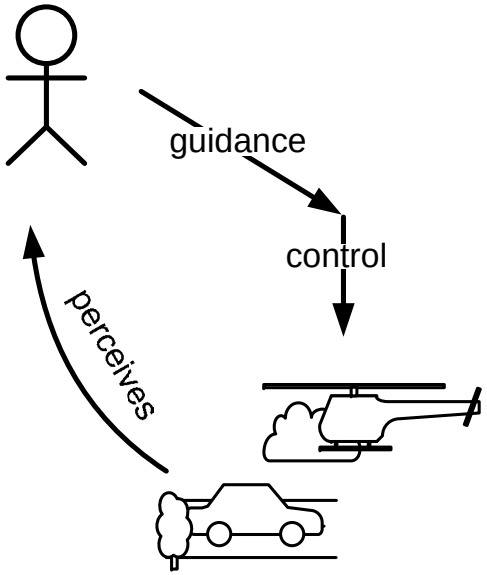
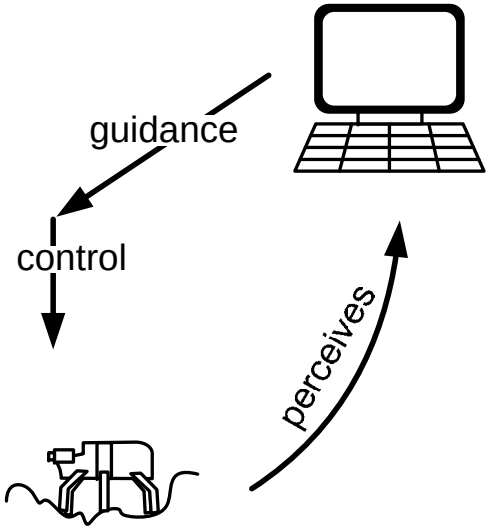
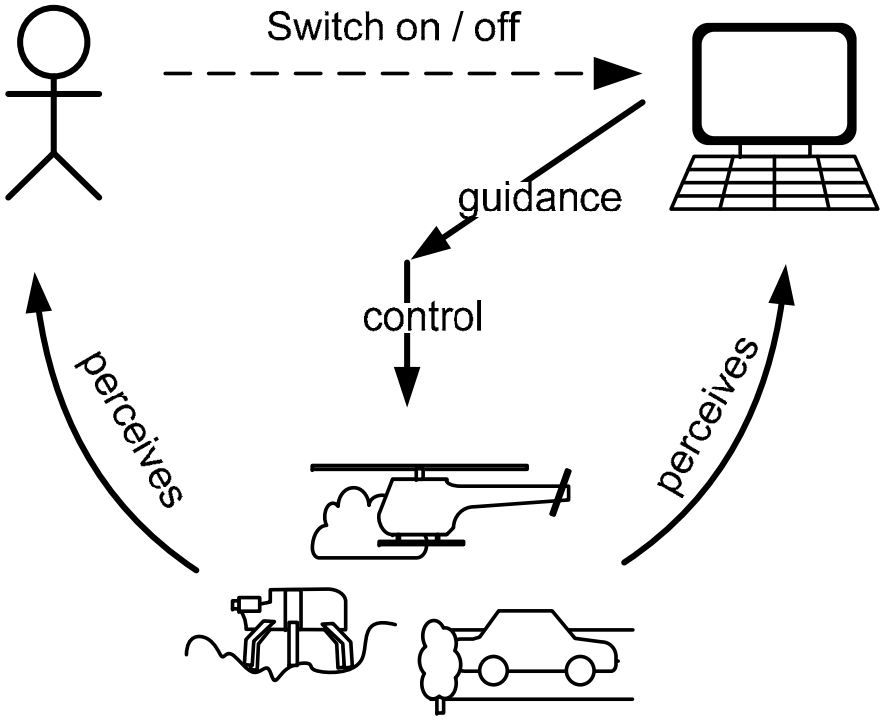


Manual versus robotic guidance and control

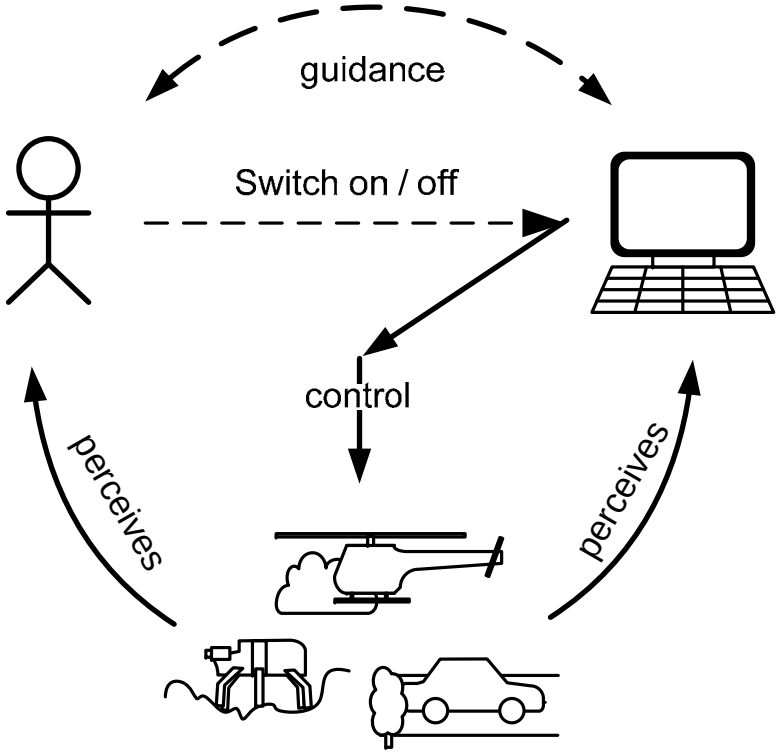




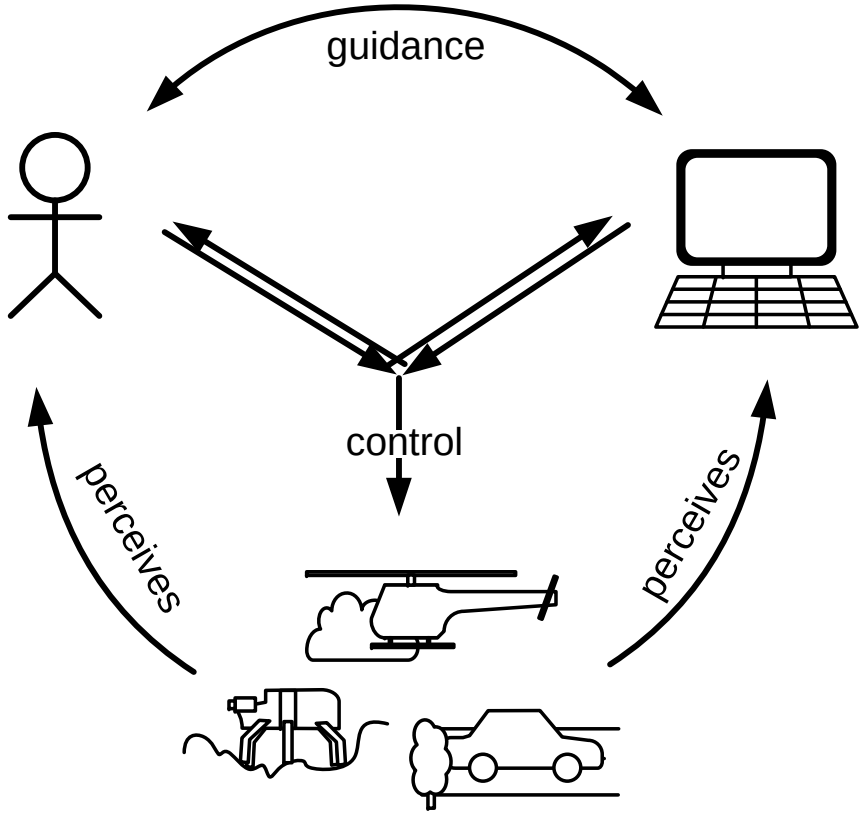
On/Off automation



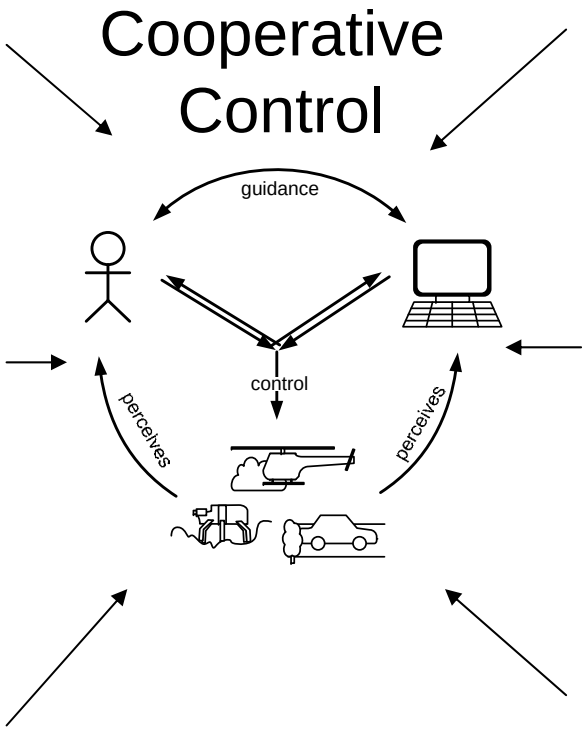
Supervisory Control



Shared & Cooperative Control as a co-agency



Cooperative Control: Examples of everydays lifes


Cooperative
Control
guidance
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03
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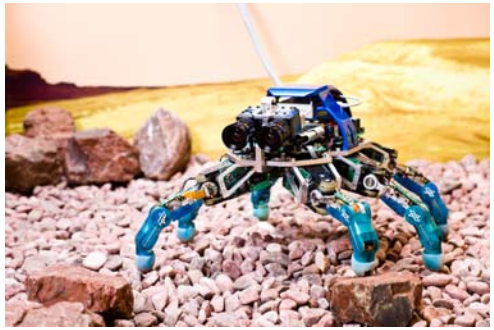
Red Bull



Video

- Video in SmpLab (MaxTension)

From authority, ability, control, responsibility to action

Offline (Meta System) → Online (Human Machine System)

Time ↓

Authority:
„Who is allowed to do what and when?“

Ability:
„Who is able to do what and when?“

Control:

Action:
„Who does what and when?“

„To be in control“
= (dynamically allocated) authority + ability

Responsibility:
„Who gets the blame or fame?“

Authority, ability, responsibility **double- and triple binds**

Offline (Meta System) → Online (Human Machine System)

Authority

„Act only, if you have authority + ability“

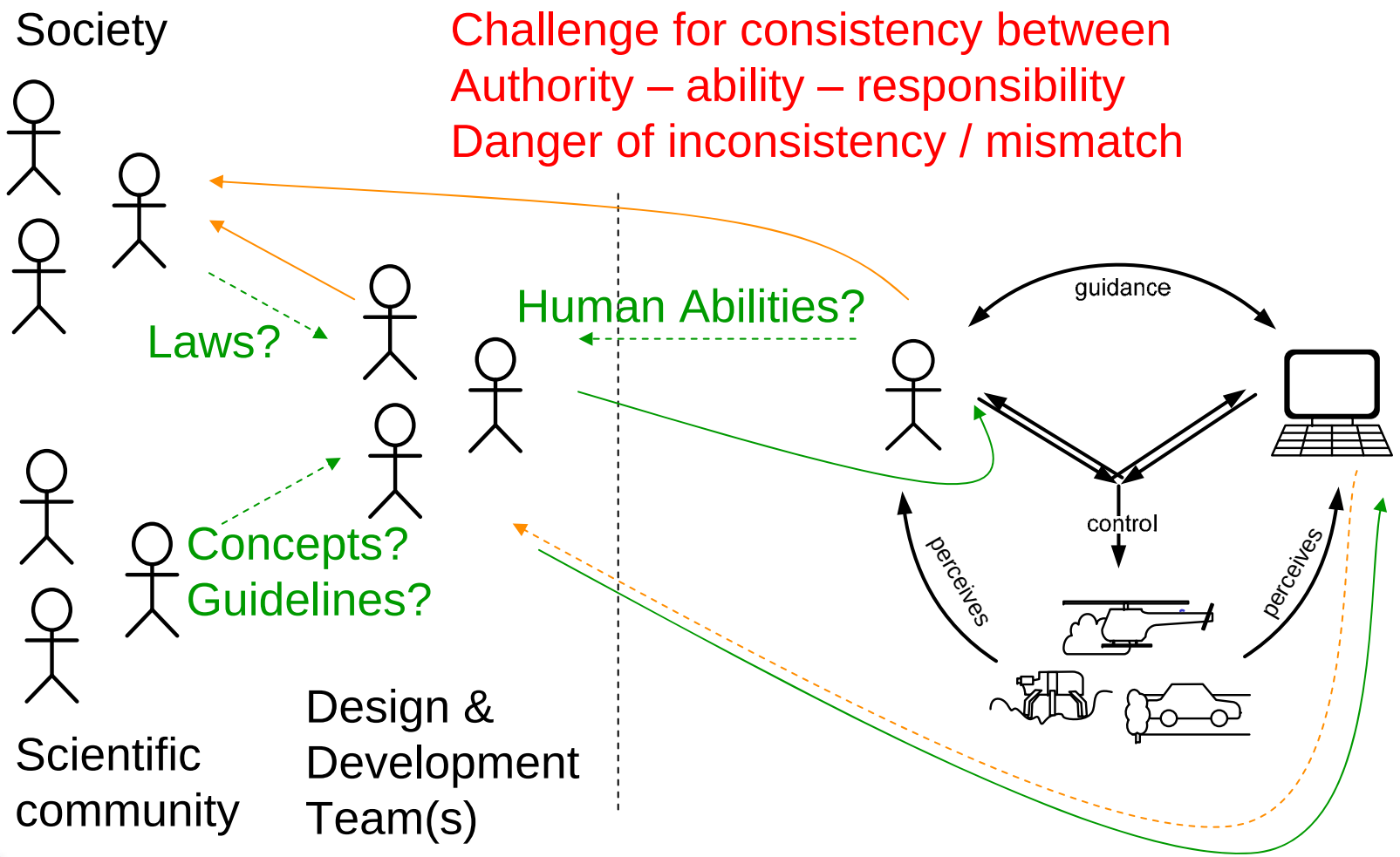
Ability Control Action

„Responsibility make only sense
, if authority + ability (+ action)“

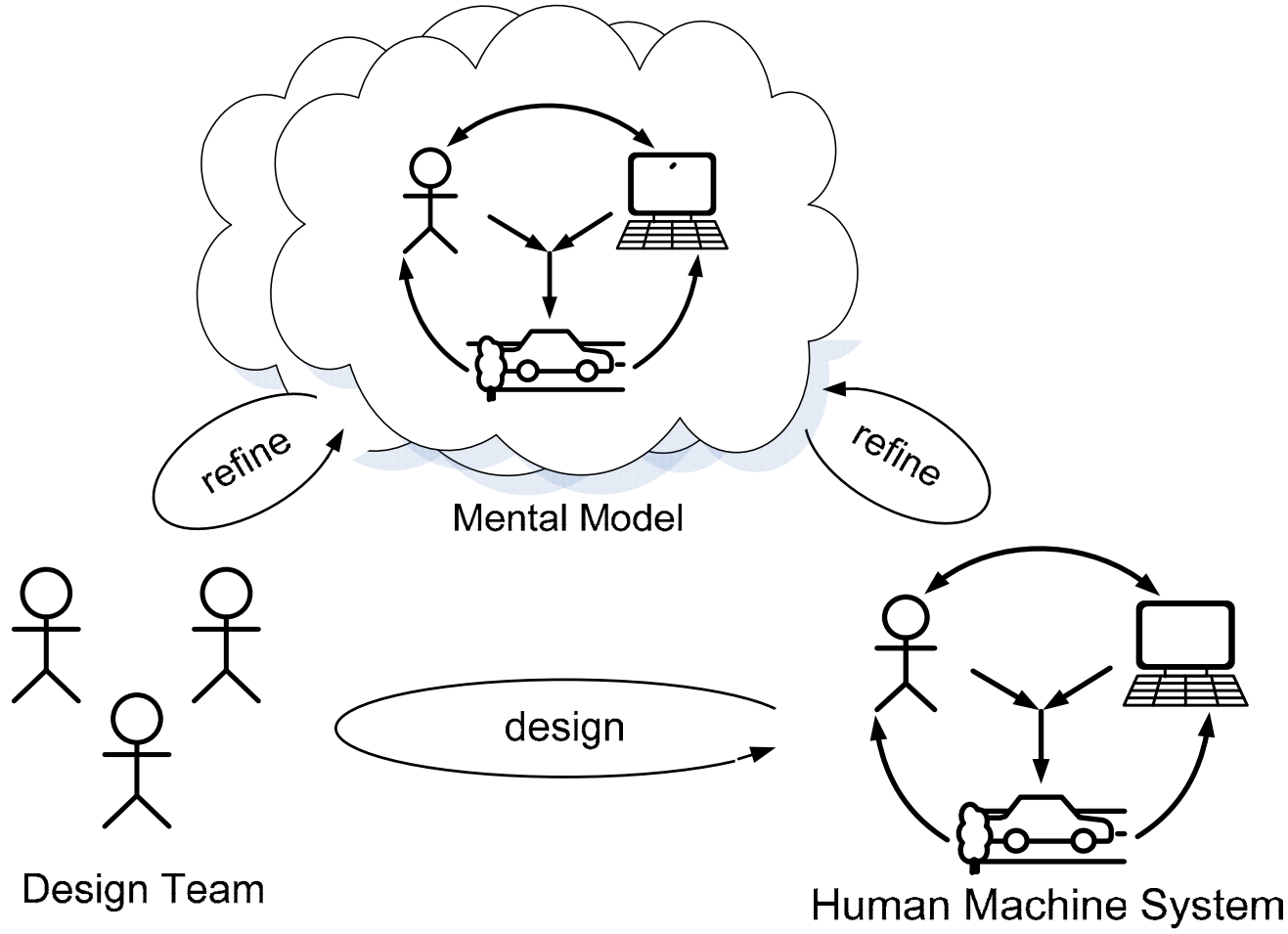
Responsibility

Time

Authority, ability, responsibility and control in metasystem and human machine system



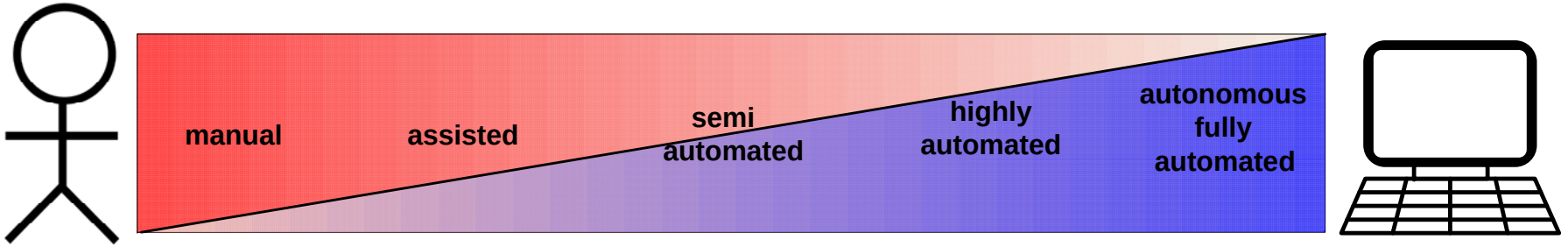
The key to consistency: Shared mental models



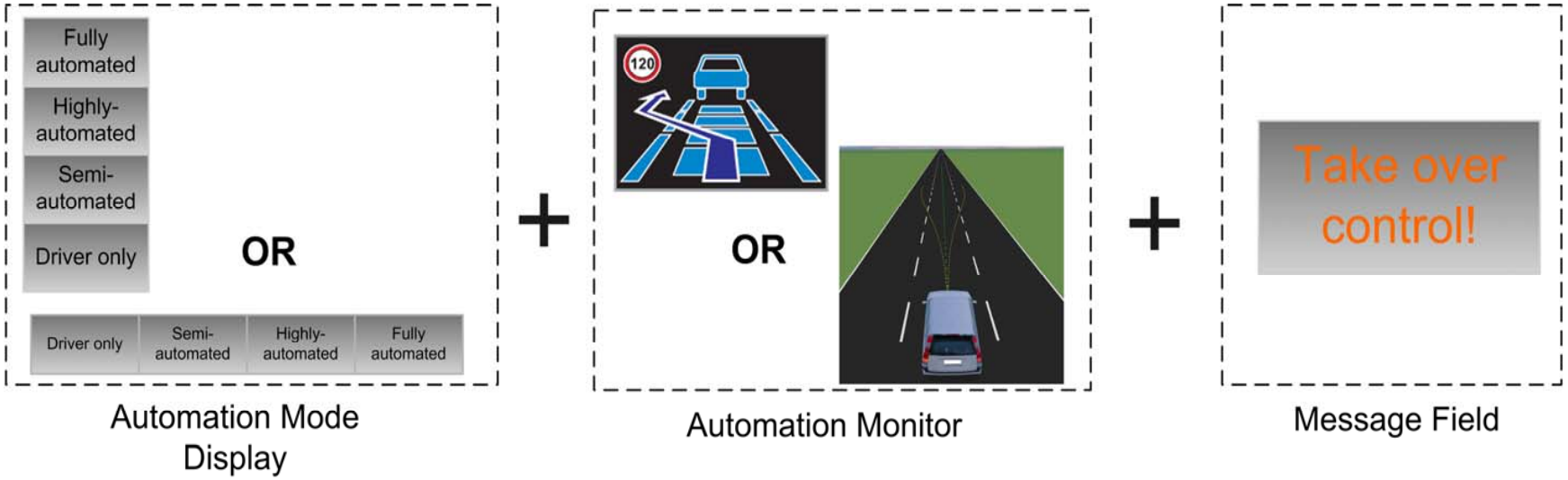
Example for Shared mental models, a key to consistency:
Assistance and automation scale,
a simplified model of control distribution

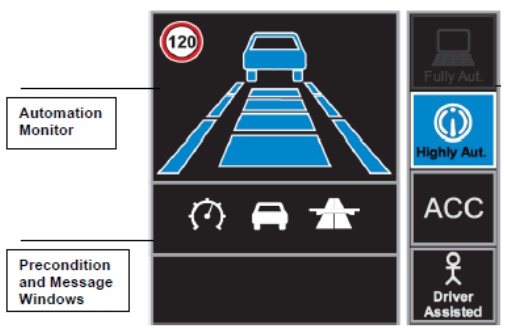
Spectrum / scale of assistance and automation

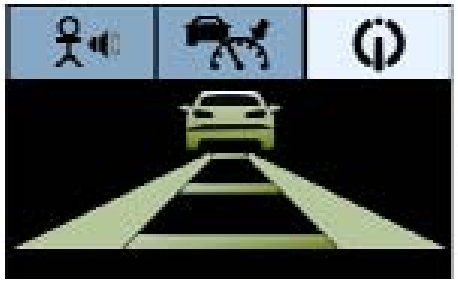




HAVEit Joint System: Interaction & display schemes

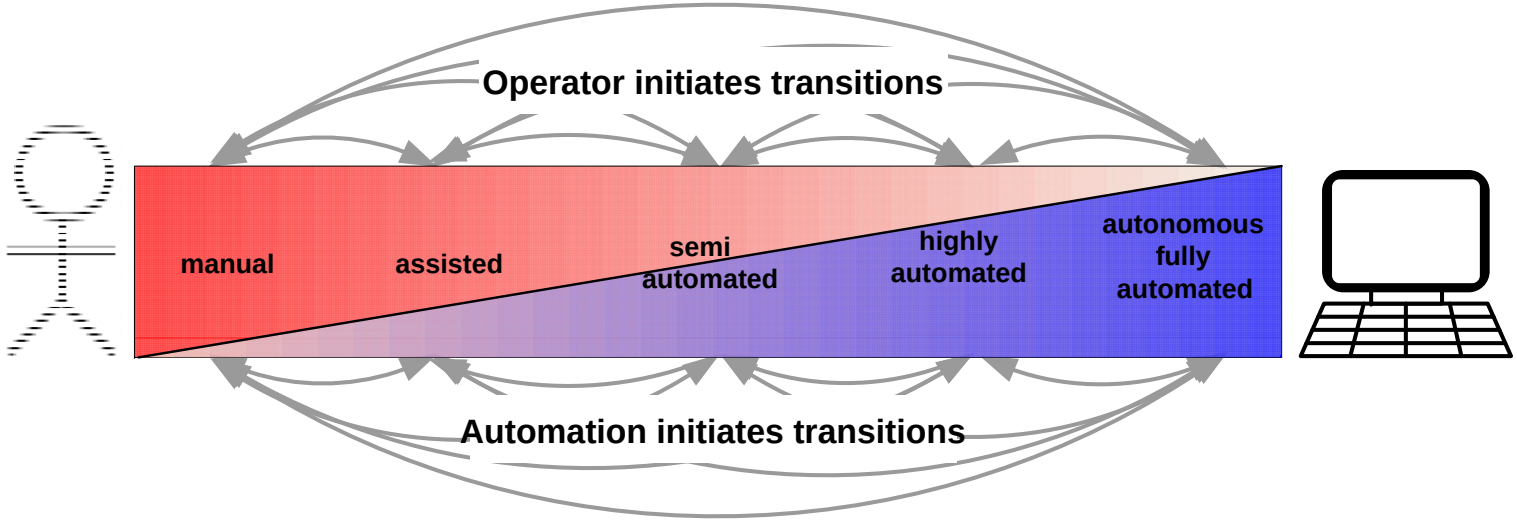




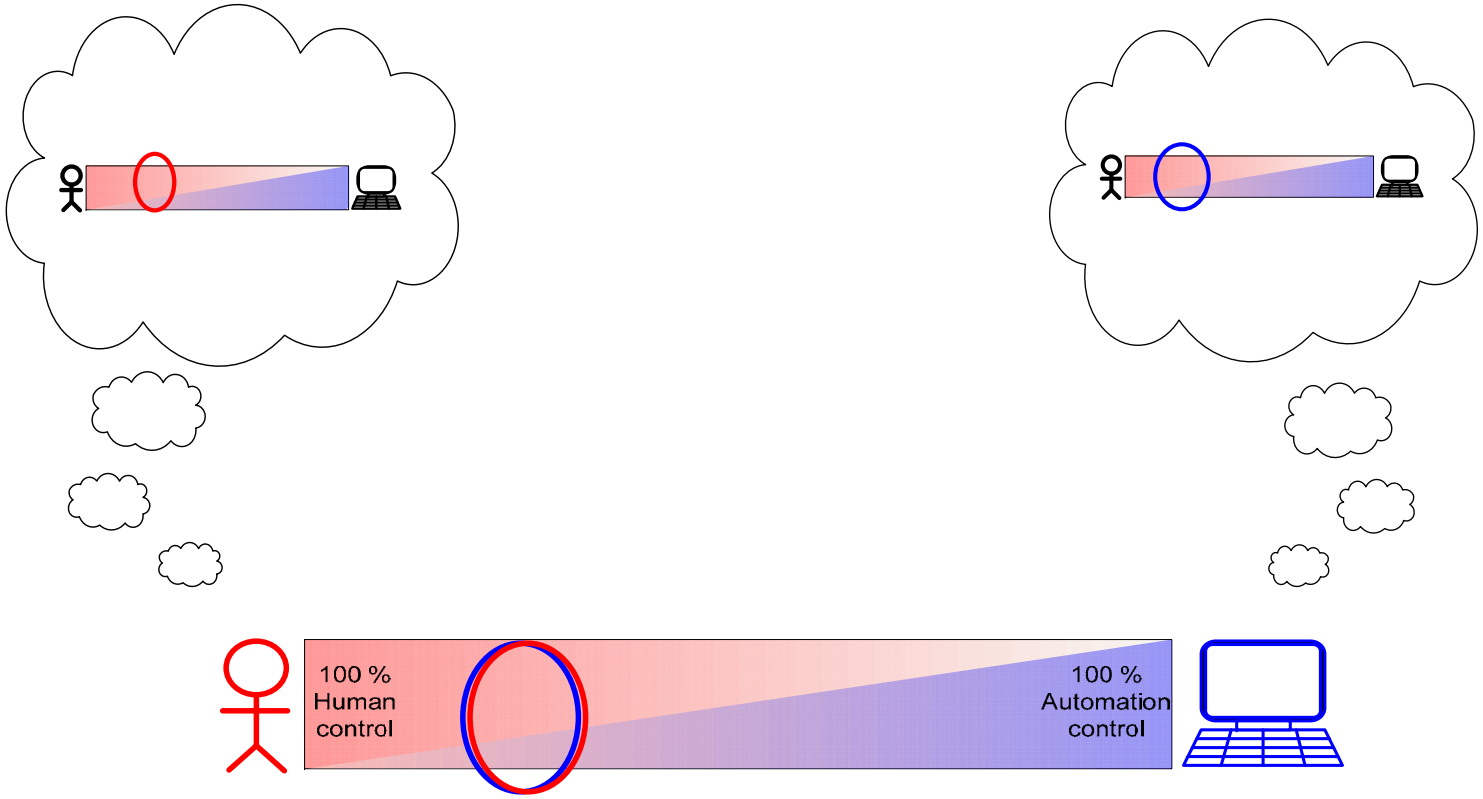


Highly-automated

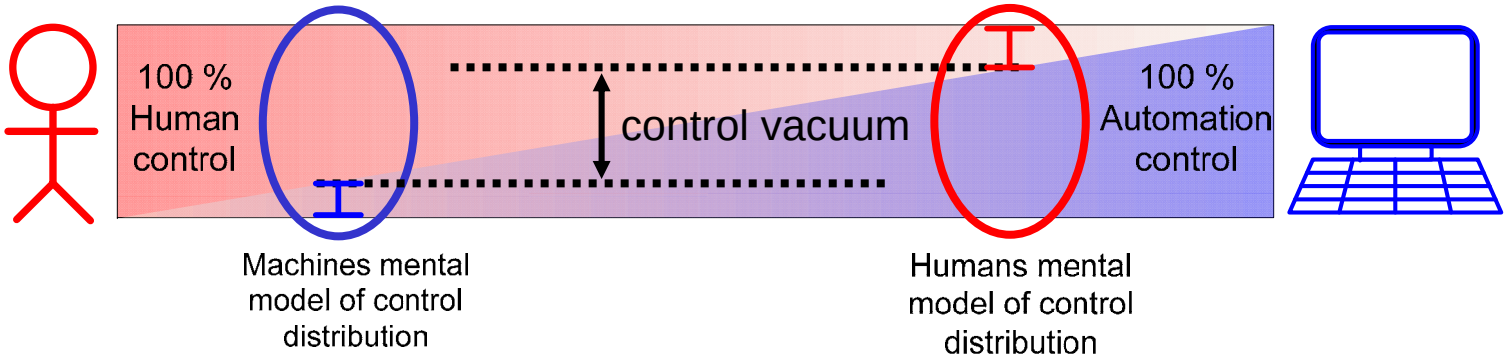
Transitions in control / authority trading are the critical issue



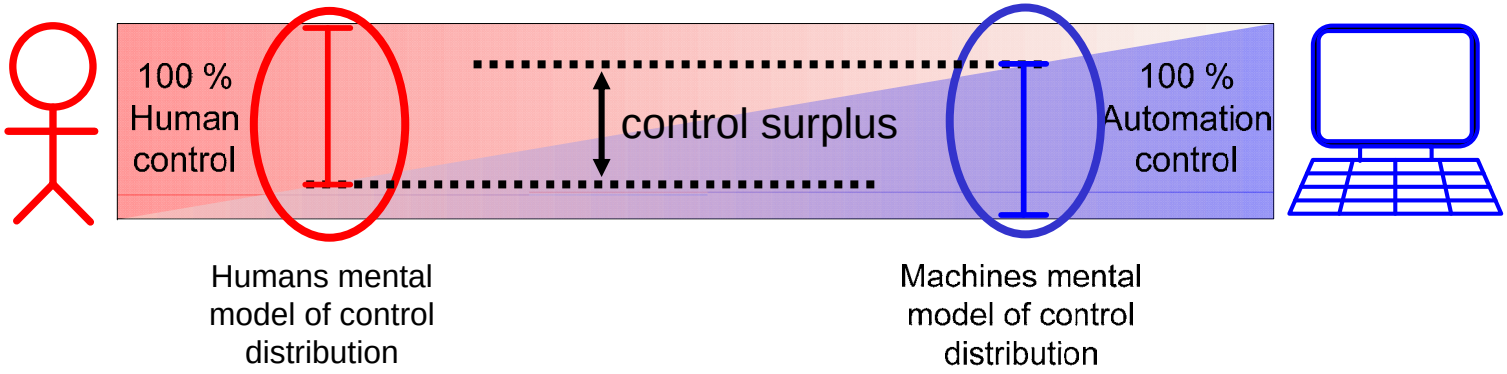
A key to successful control situations and transitions: **Consistency** of Mental models about control (control SA)



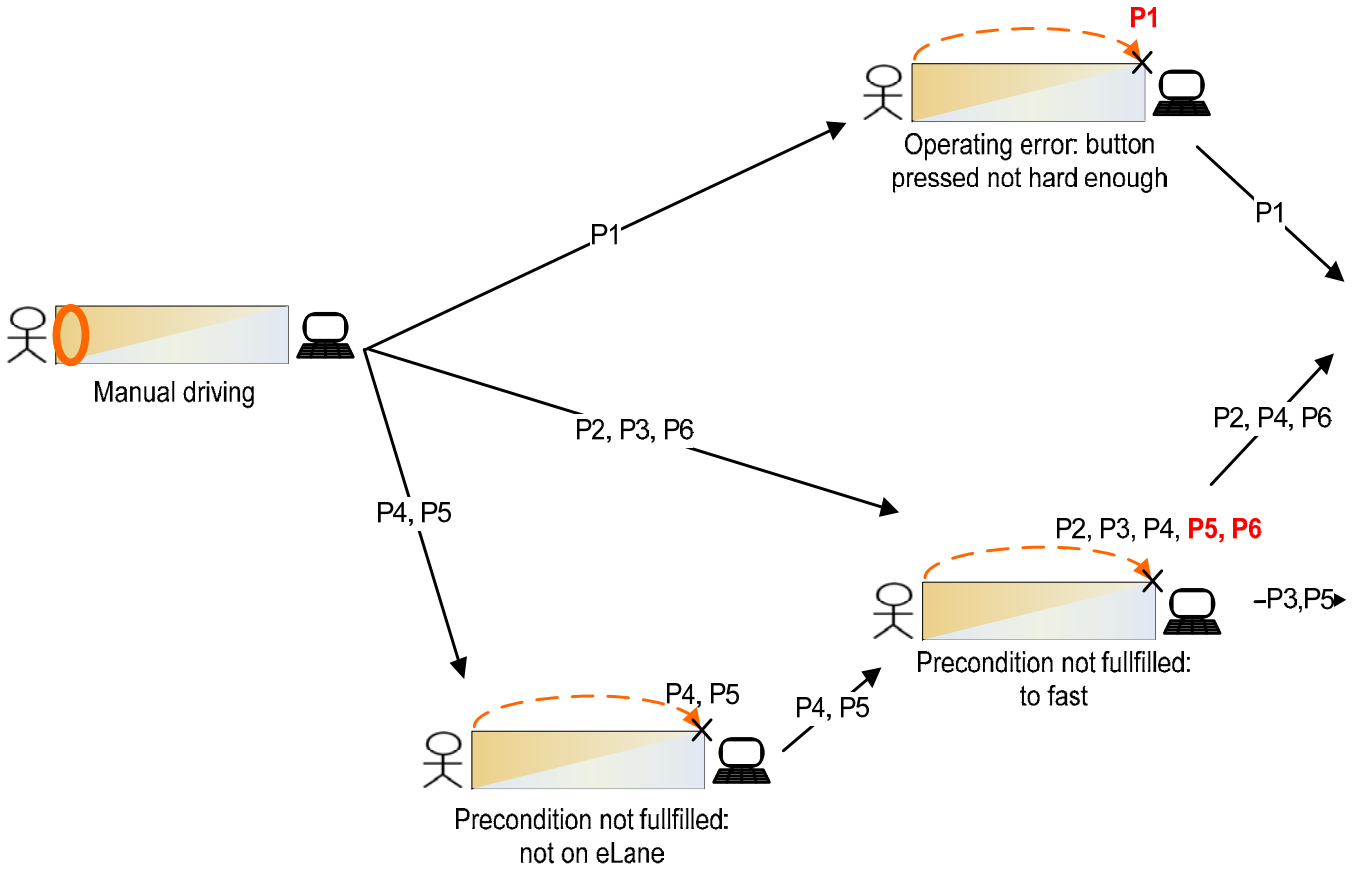
Inconsistent control situation: Control Vacuum



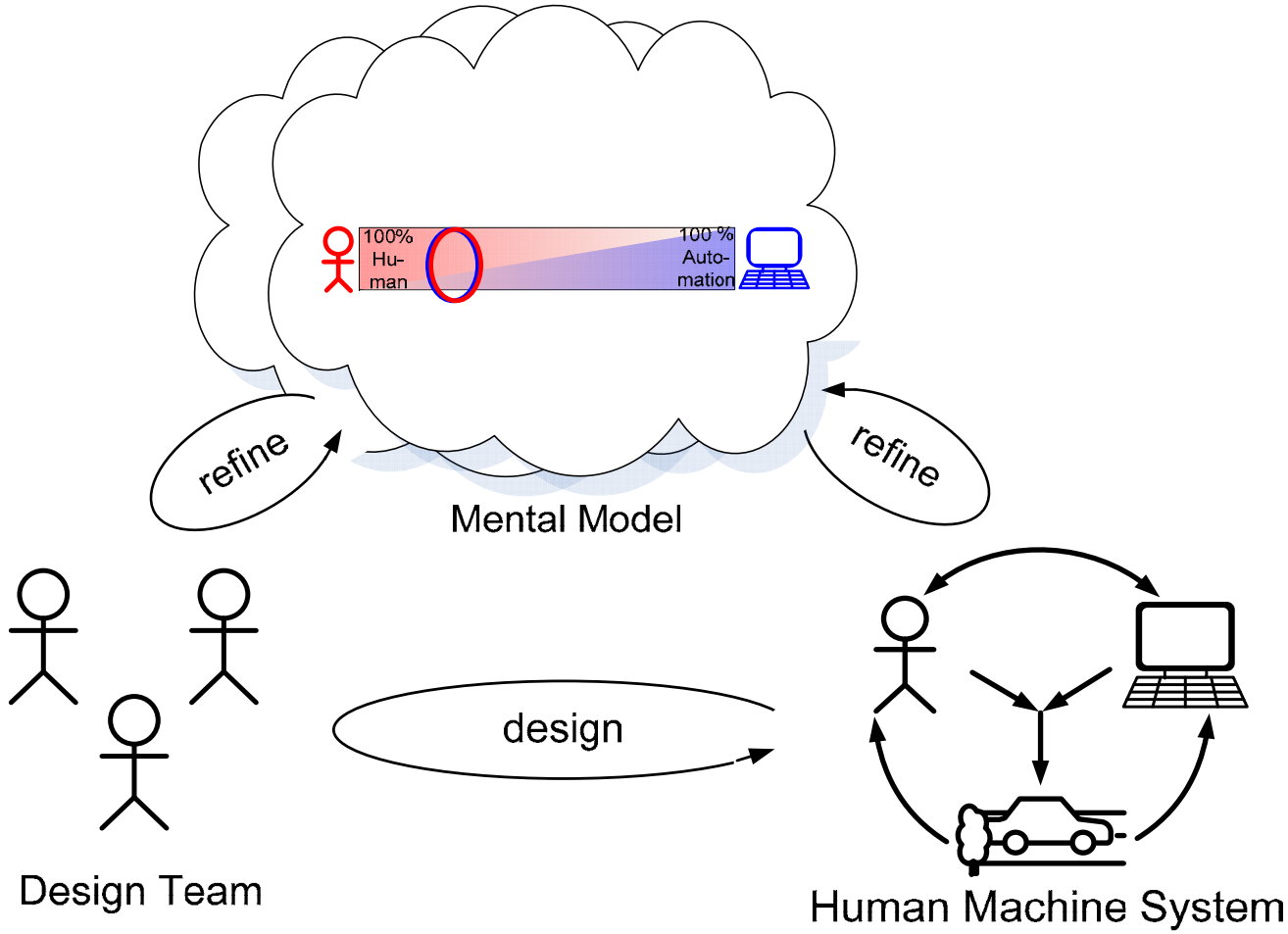
Inconsistent control situation: Control Surplus / excess



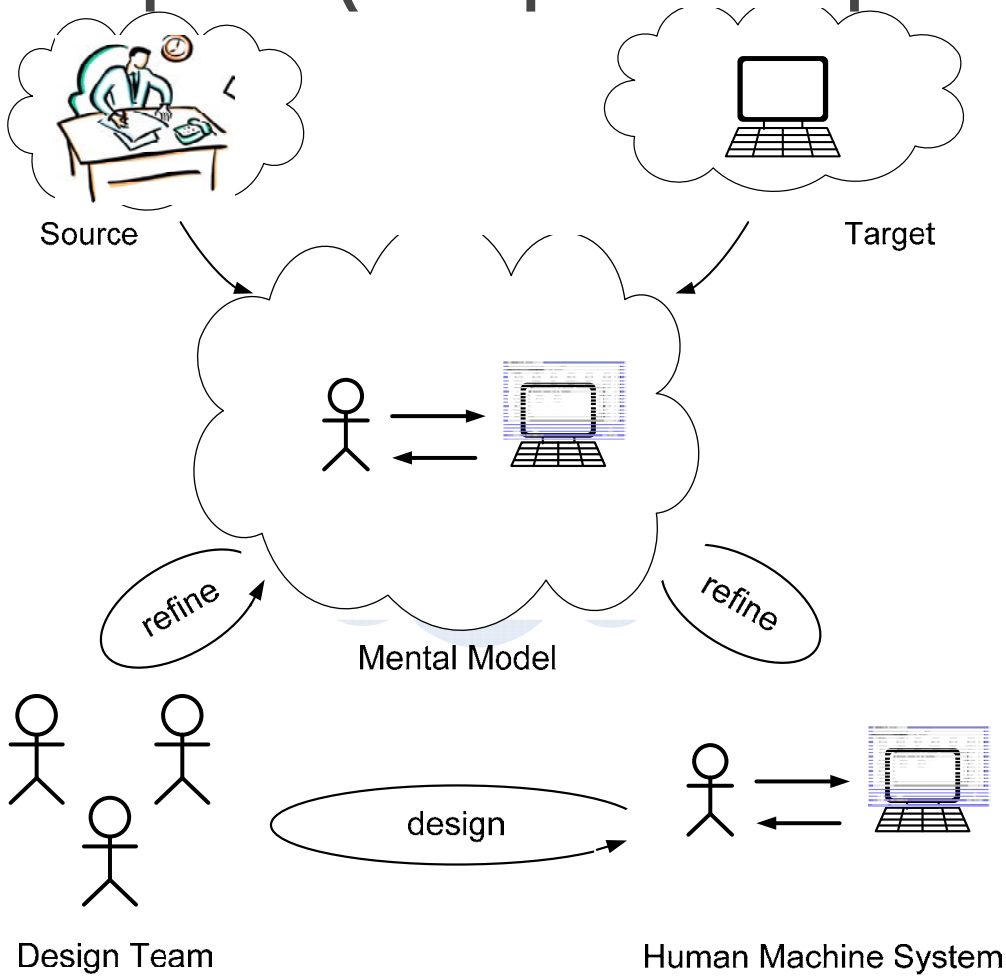
Tracking the authority allocation / transitions: (Schieben et al. 2009)



The key to consistency: A Shared mental model

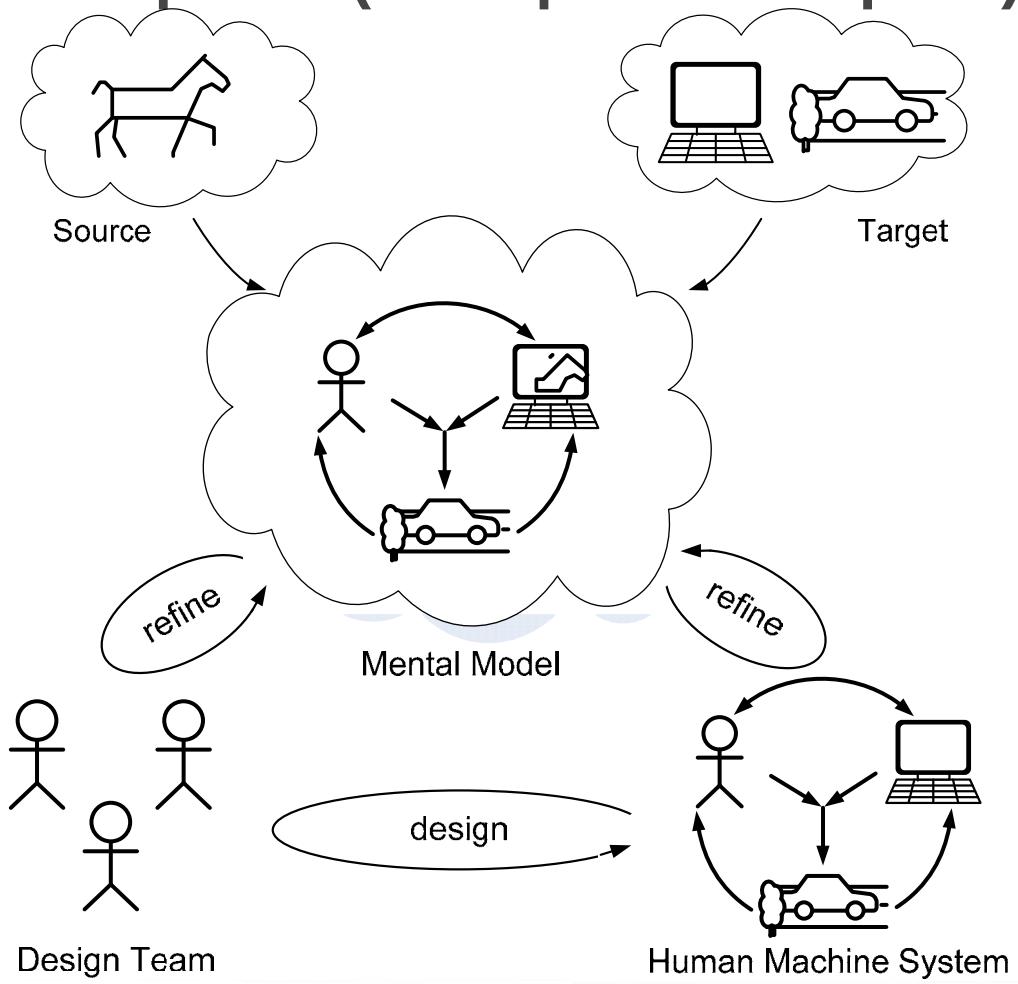


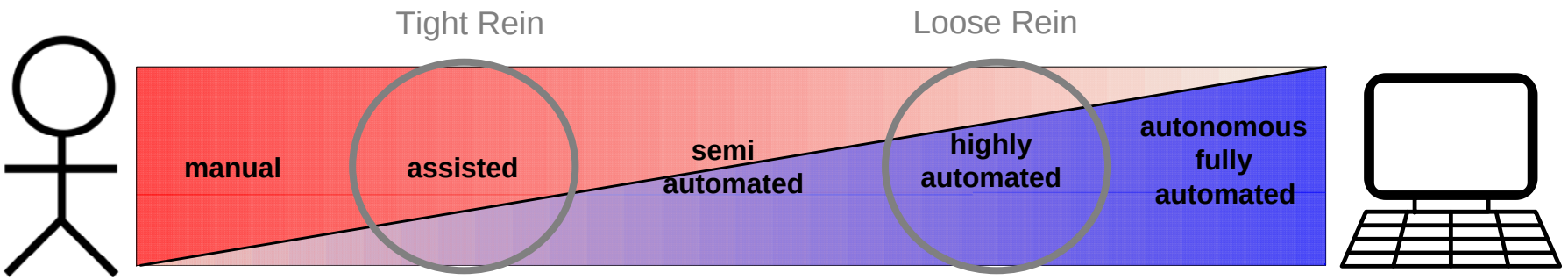
The key to consistency about authority, ability, responsibility: Role models / metaphors (example Desktop metaphor)



Cooperative Control: Examples of everydays lifes

The key to a consistency of Mental models about authority, ability, control and responsibility: Role models / metaphors (example H-Metaphor)




Tight Rein
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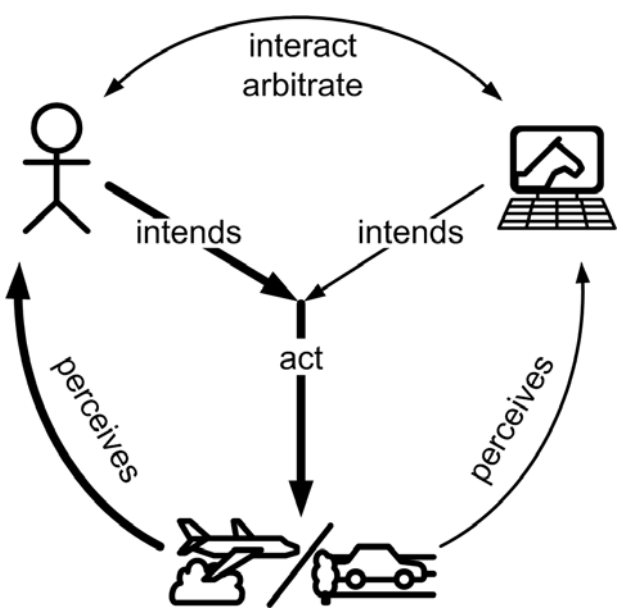
automated
highly
automated
autonomous
fully
automated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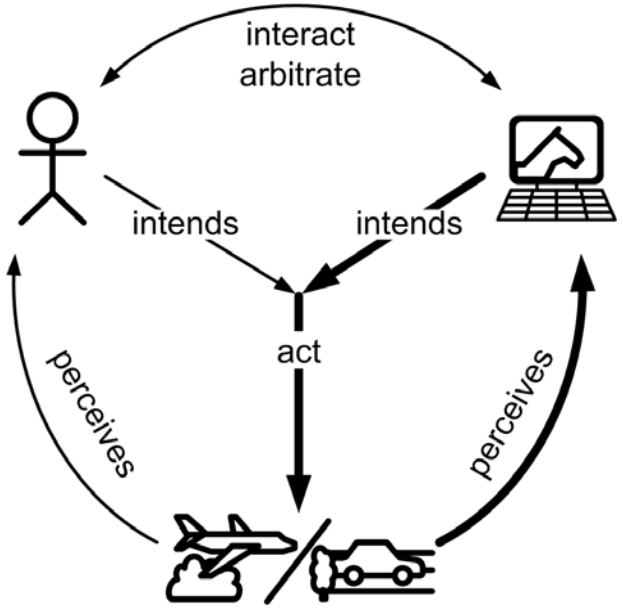
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Summary: Authority, ability, responsibility and control in cooperative control situations

- Cooperative control is one way to instantiate co-agency
- Authority, ability, control and responsibility are key concepts to co-agency
- Control = (dynamically allocated) authority + ability
- In certain cases it can make sense to give machines a high authority
- Transitions of control are crucial
- Meta-System and human machine system are strongly connected
- Challenge of consistency between authority – ability – responsibility (avoid violations of double or triple binds)

Authority, ability, responsibility and control in cooperative control situations

- Need for
  - Schemes of dynamic control allocation / authority trading
  - Role models
  - Guidelines from scientific community (e.g. „Etiquette“ Miller et al.)
  - Rules from society (e.g. Rules of Assistance and Automation in accordance to Rules of Robotics, e.g. Murphy & Woods 2009)
- Authority distribution can be dynamic, but with stable limits
  → Dynamic balance between human and machine

- Authority and control distribution between human and machine should not only be a matter of technical and psychological feasibility, but a conscious design decision. Who do we want to be with technology?

Some references

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