Intelligent User Experience Engineering

Mark Neerincx

situated Cognitive Engineering

Module 13

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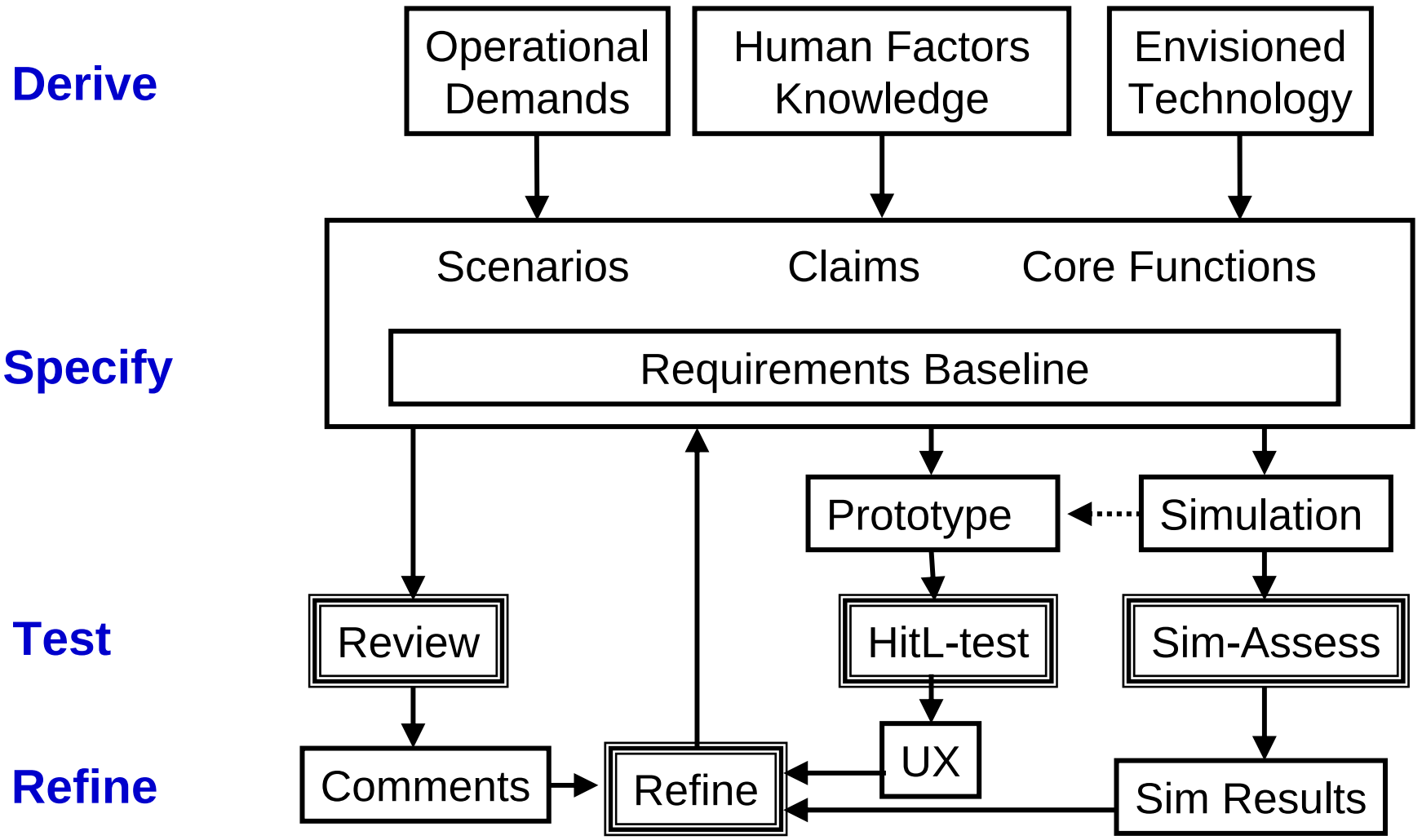
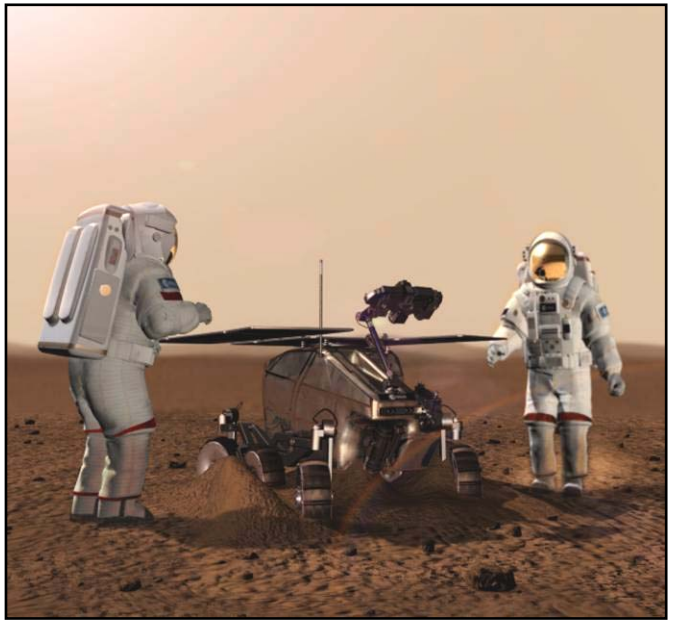
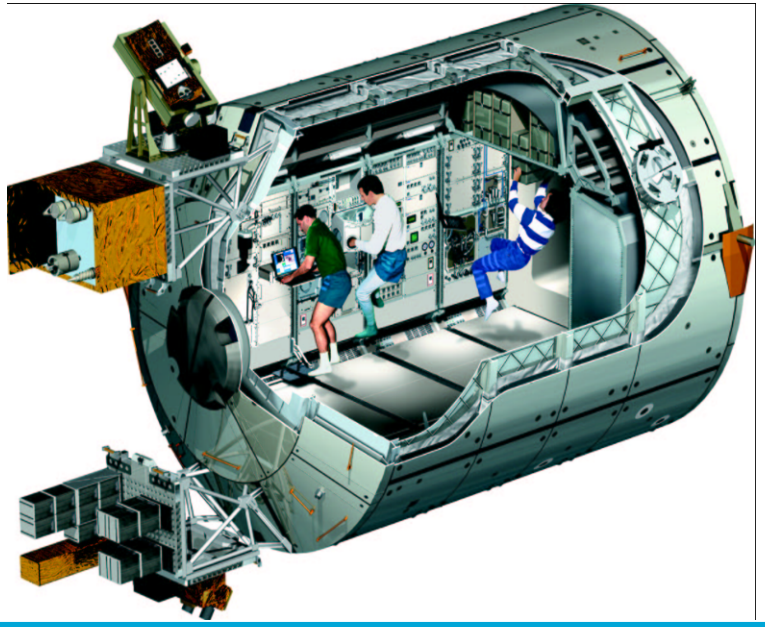
Situated Cognitive Engineering



Human-Machine Collaboration in Space





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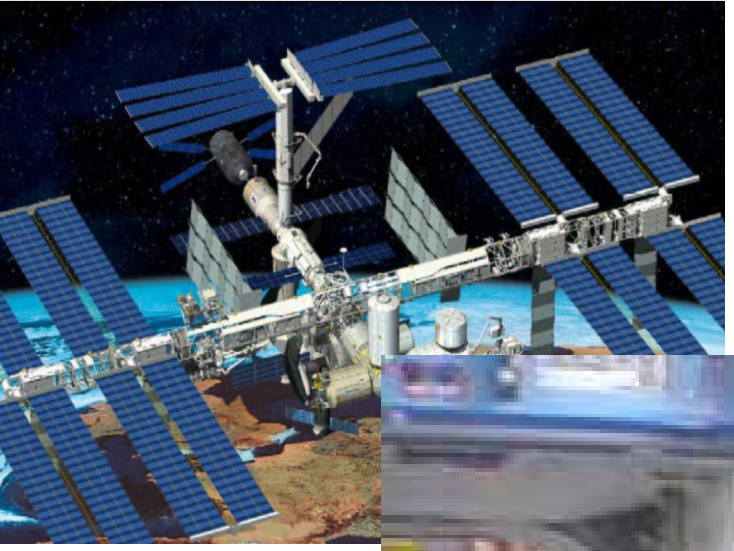

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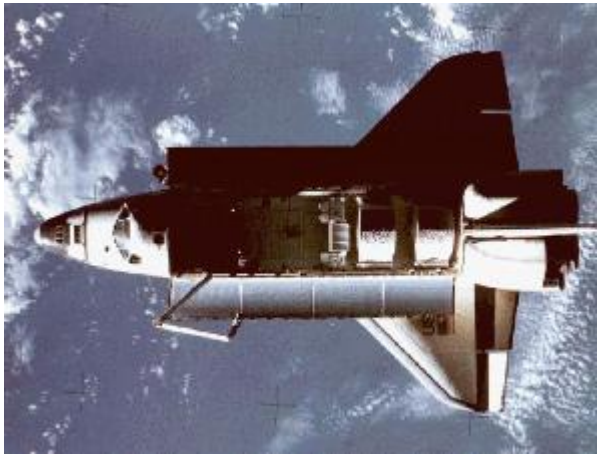
Space Missions



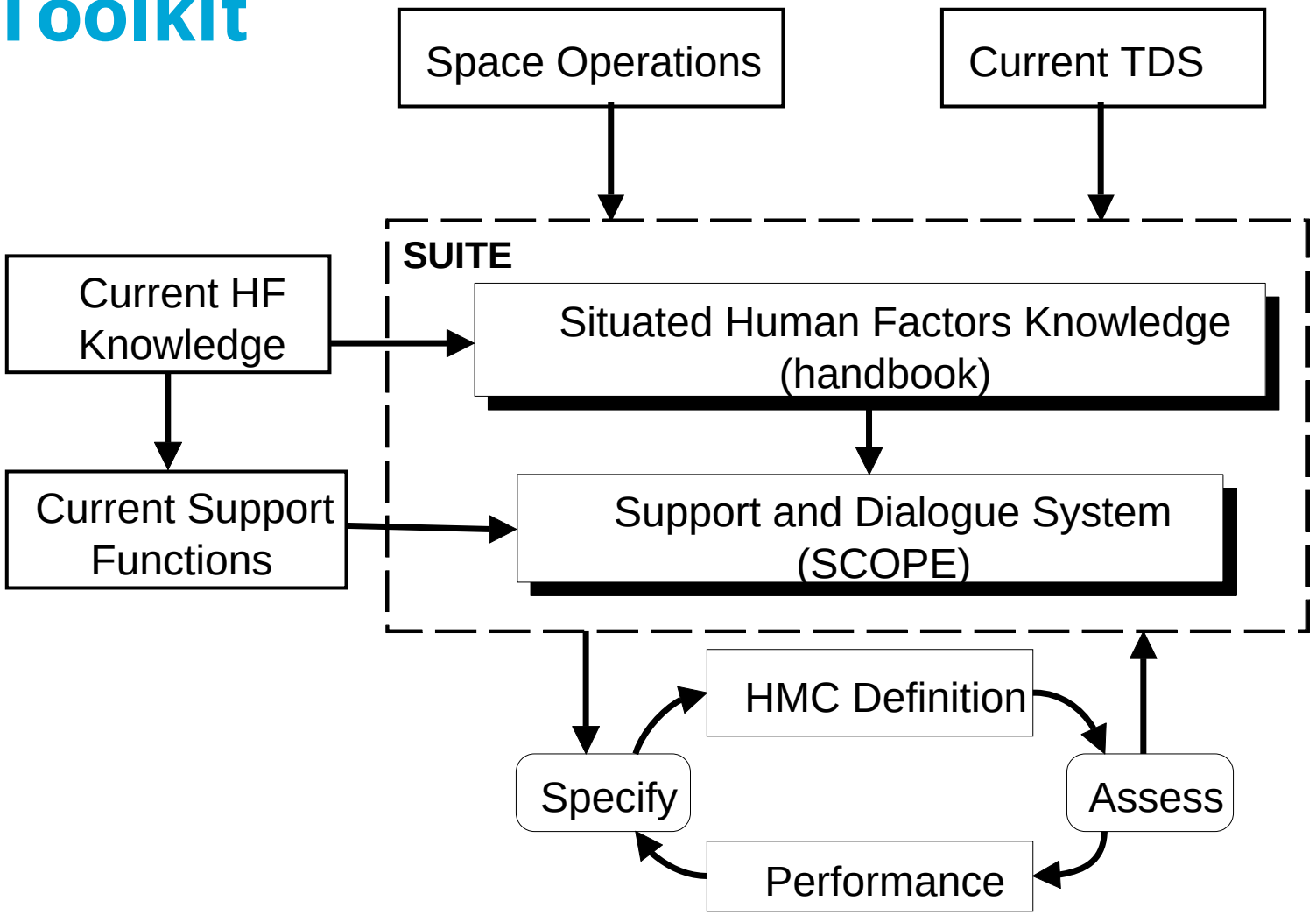
Complex system development environment:

- the involvement of diverse stakeholders,
- the implementation of diverse applications,
- the differences in design approaches,
- the separation of a task and a user-interface design community.

Previous missions showed extensive training and preparation efforts, and non-optimal task performance due to shortcomings in

- the procedural support,
- the mapping of task procedures on the user interfaces,
- the usability of the individual systems,
- the consistency between interfaces.

Situated Cognitive Engineering Toolkit



Homepage Usability Engineering for Payload Interfaces

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USABILITY ENGINEERING FOR PAYLOAD INTERFACES

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View Full view user

- Introduction
- Analysis
- Design
- Implementation

Method

In this table a short explanation about the method and introduces the the sections of the handbook. In this table a short explana tion about the method and introduces the the sections of the handbook.
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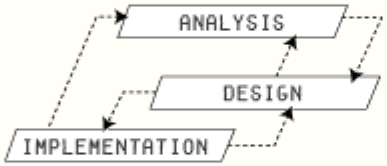


A scheme is shown to clarify the iterative process.

ion about the Introduction.
→ read Introduction

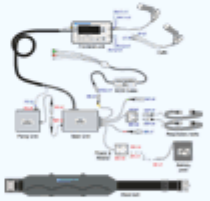
avit. Short explanation about
ase deus caelum.
→ read Analysis

- Short explanation about the Design.
→ read Design

- In principio creavit. Short explanation about the Implementation phase.
→ read Implementation

Examples

The handbook contains a design example of the payload SUIT. Give a short explanantion and refer to e.g. the 1st section of this example.
→ show SUIT



The handbook contains a design example of the payload Cardiopres. Give a short explanantion and refer to e.g. the 1st section of this example.
→ show Cardiopres

The handbook contains a design example of the payload Glovebox. Give a short explanantion and refer to e.g. the 1st section of this example.
→ show Glovebox

Local intranet

Situated HF knowledge: UE Handbook

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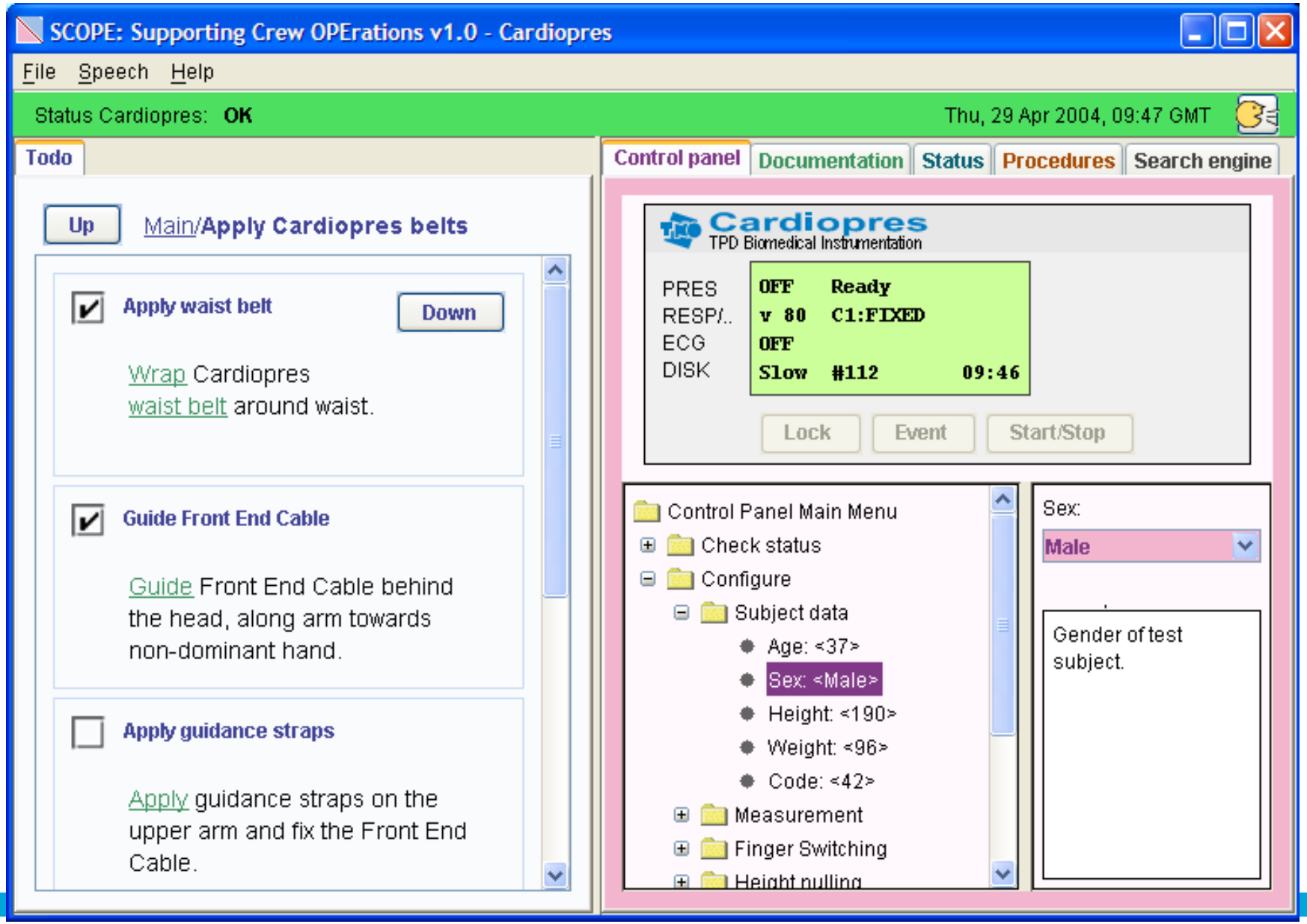
Situated Design Space: SCOPE



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SCOPE: Supporting Crew OPErations v1.0 - Cardiopres

File Speech Help

Status Cardiopres: SCOPE has detected a problem with Cardiopres [2004-Apr-29 09:48:43] Thu, 29 Apr 2004, 09:49 GMT

Todo | Diagnosis

Do you feel a pulsating pressure on the finger cuffs?

Answer: yes no

SCOPE diagnosis:

Cuff Hose Is Not Properly Connected

Suggested solution: execute anomaly procedure "Fix hose to air connector". Click below to add procedure to TODO list.

Add procedure

Control panel | Documentation | Status | Procedures | Search engine

Back Forward Main

Cuffs

Cardiopres comprises a number of units and items. They are described in Paragraph 'Overview Cardiopres components'.

Cuffs

The finger cuff is used for the finger blood pressure measurement. A finger cuff contains an infrared LED (Light Emitting Diode) and a near-infrared plethysmograph, for the measurement of finger artery volume changes, and an inflatable airbladder, electrical shielding, and several layers of plastic and rubber with Velcro at the outside. A cuff cable connector and an air hose connector plug into the Frontend Unit. Cuffs are available in three sizes: small (white), medium (beige) and large (blue).

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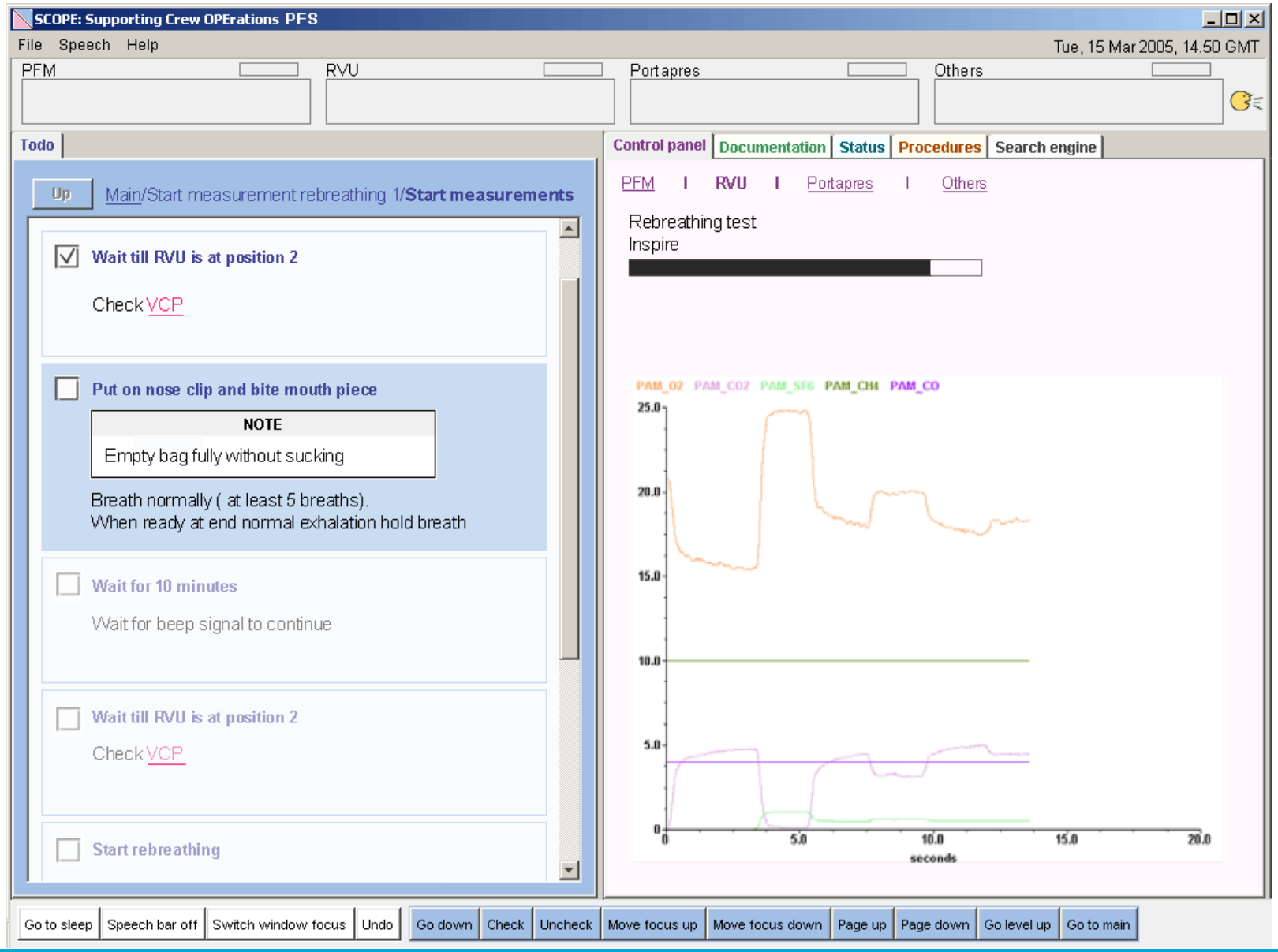
Usability Tests

- Easy to learn
  - substantial performance improvement within two hours,
  - nearly optimal operation in terms of clicks and time on task.
- Effective and efficient
  - good performance time, few errors and no extreme effort
- High satisfaction
  - 38 out of 41 usability statements were judged positively, none negatively and three neutral.
  - to-do list, documentation, and diagnosis judged as being useful, pleasant to use and as not being difficult to use .



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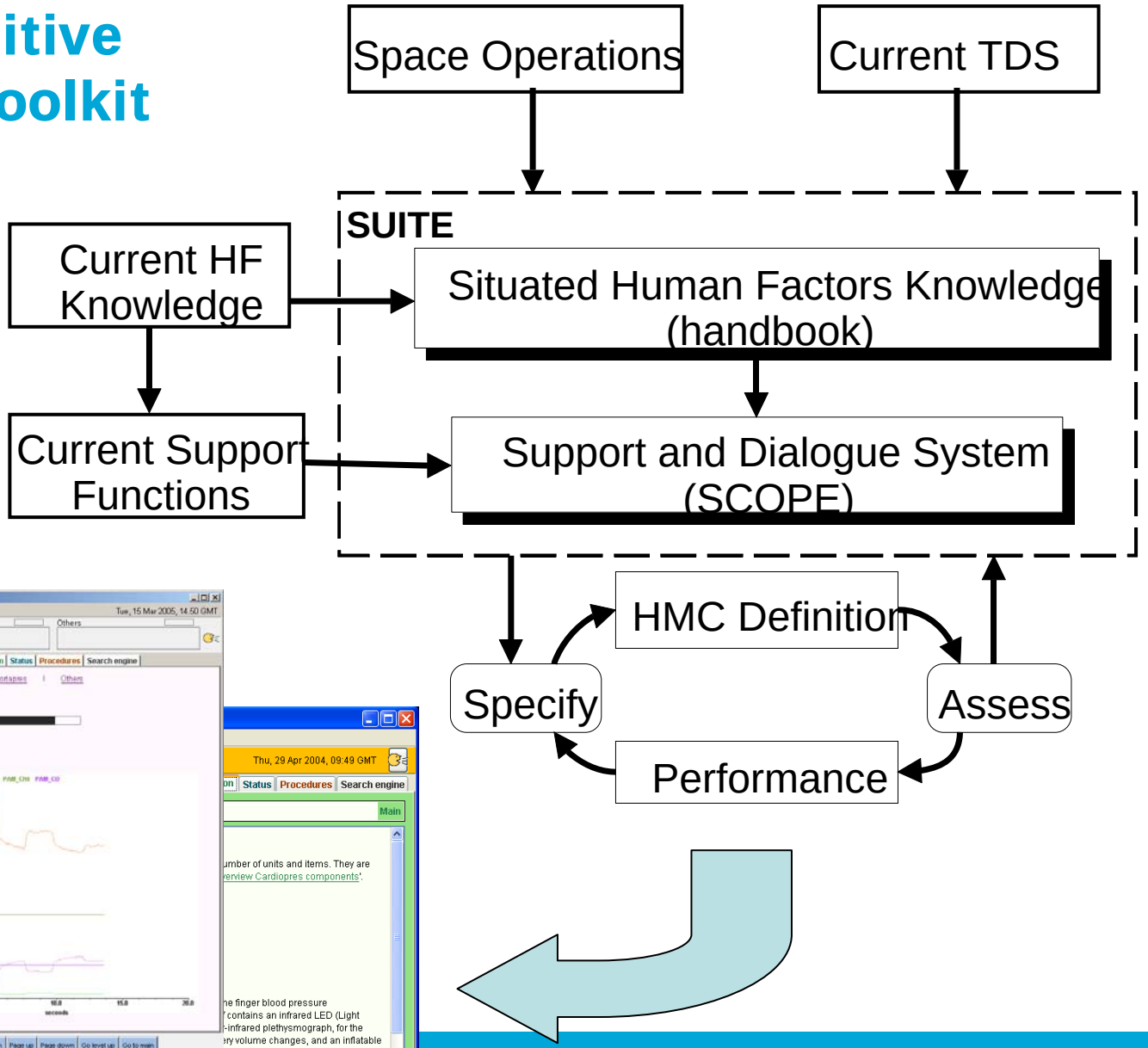
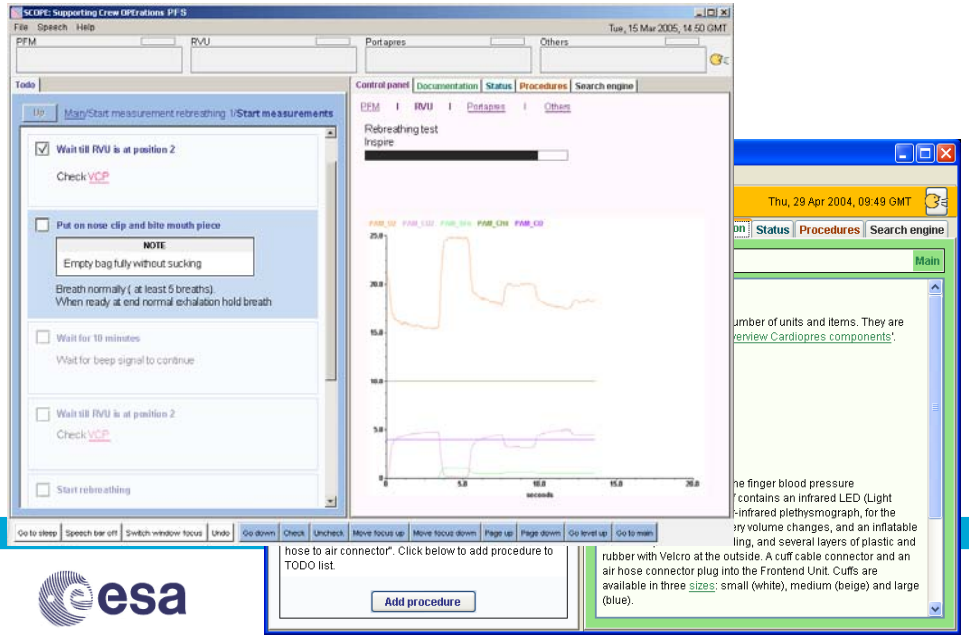
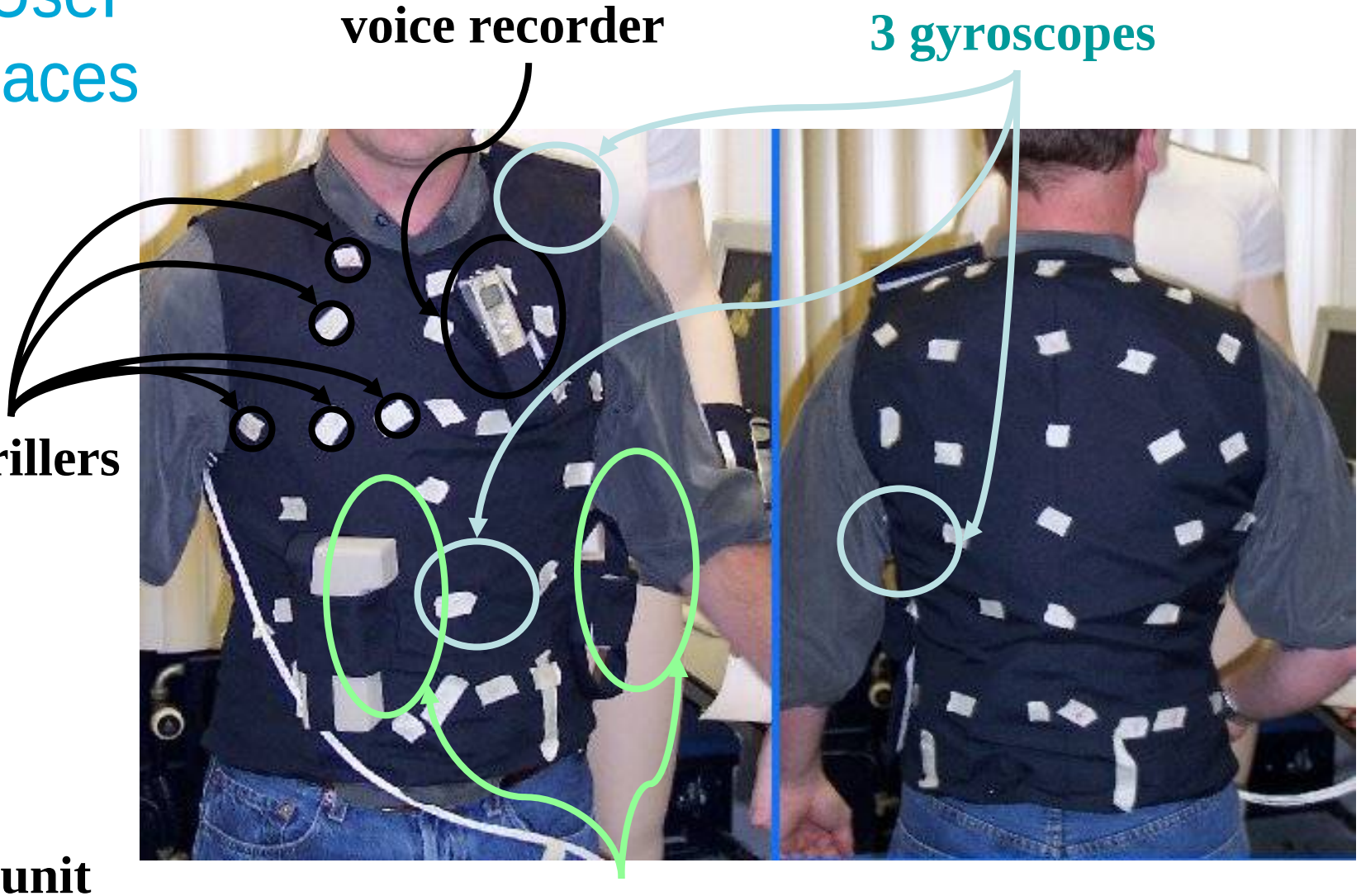
Situated Cognitive Engineering Toolkit





New User Interfaces

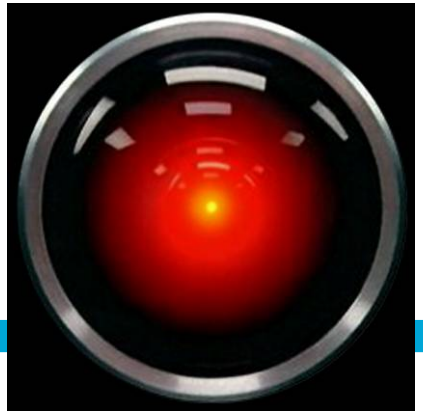


Envisioning User Interfaces for Future Space Missions

2001: A Space Odyssey (1968), Stanley Kubrick

Envisioned Support by HAL

- smart use of multiple modalities
- ‘omni-presence’
- (suggestion of) one integrated entity
- question of trust in automation (in isolated situations)
- personality? buddy? psychological insight?
- quality of health monitoring systems and self-diagnosis
- off-line mission control with copy of exact system



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MECA
Mission Execution Crew Assistant

http://www.CrewAssistant.com

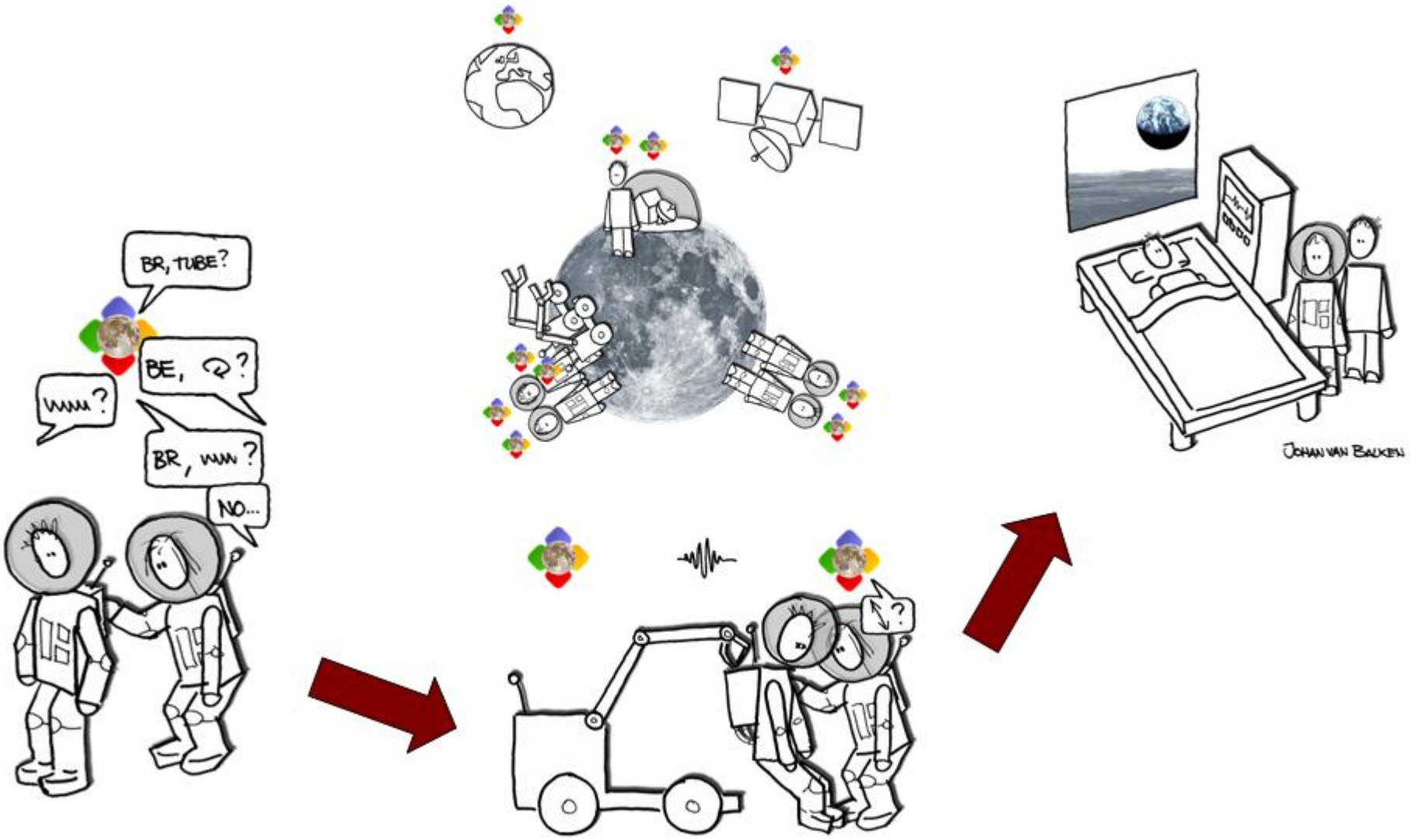
Vision on Joint Cognitive Systems:

- Collection of distributed, connected & personal *e*Partners to support the *h*Partners

Goal:

- to improve human-machine team's resilience and safeguard *h*Partners from failures in unexpected, complex and potentially hazardous situations

MECA Scenario



*e*Partner Concept

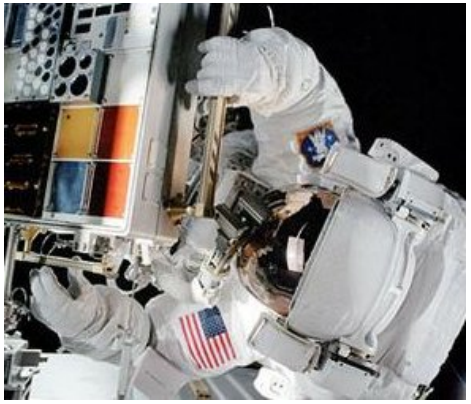
Has ***information*** of its *h*Partner, ***e.g.***

- permanent characteristics (e.g., personality)
- dynamic characteristics (e.g., experience)
- base-line state (e.g., “normal” heart rate)
- momentary state (e.g., current heart rate)
- tasks to do (e.g., alarm handling)
- task performance (e.g. time)
- current context (e.g., location)

Interprets this info, based on ecological models, to

- assess human’s condition for current context
- identify critical situations (e.g. panic)
- apply mitigation strategies to reduce the negative effects (e.g. reschedule tasks, notify colleague, ...)

*e*Partner's knowledge



- Easy to share with its *h*Partner
- Trustworthy
- Based on practical theories:
  - face validity
  - accepted features of human cognition & emotion
  - refined and tested for application domain
- Modular (sub-models):
  - cognitive task load
  - emotional state
  - fitness
  - team involvement

- Continuously updating the models via human input, and automatic sensing of human behavior, physiology and context

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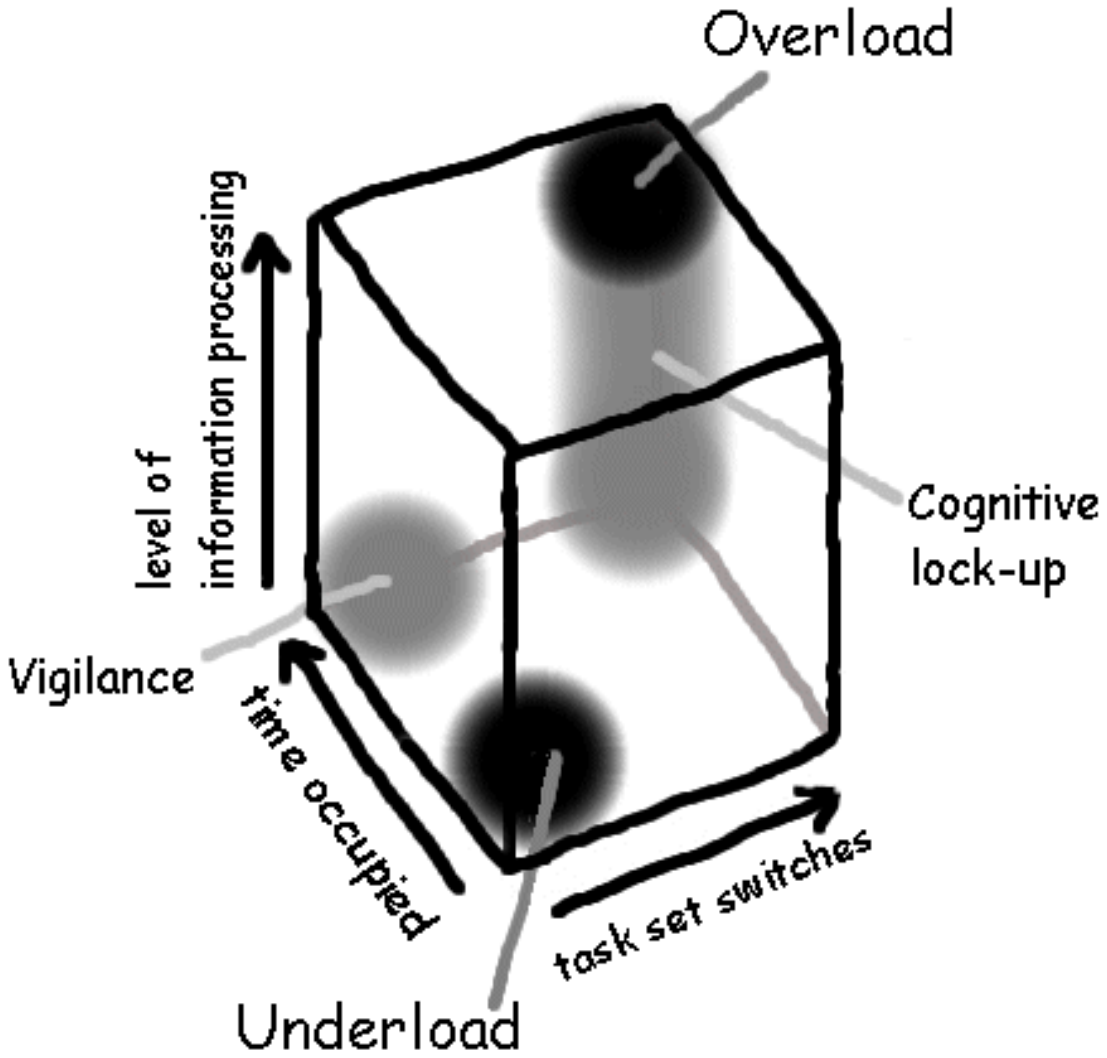
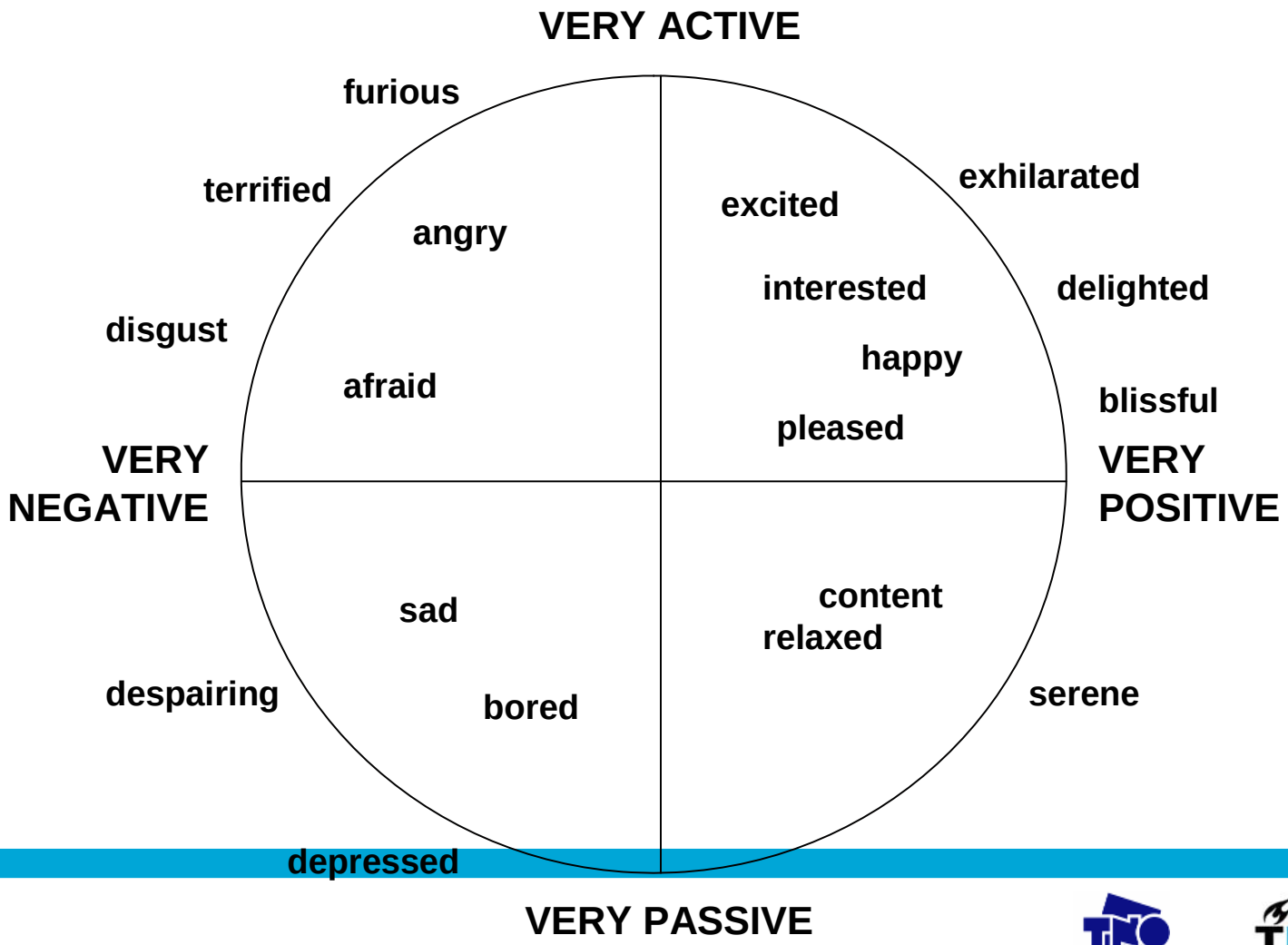
Cognitive Task Load (CTL)



Emotional State (ES)

- Two Dimensions: arousal and valence



*e*Partner's Support

Identification of critical states per sub-model,

and for combination of states, e.g.

- high Cognitive Task Load & "relaxed" Emotional State
- ...

Mitigation Strategies:

- Dialogue Style
- Feedback
- Crew Notification
- Information Filter
- Task Allocation
- Automation Level
- …

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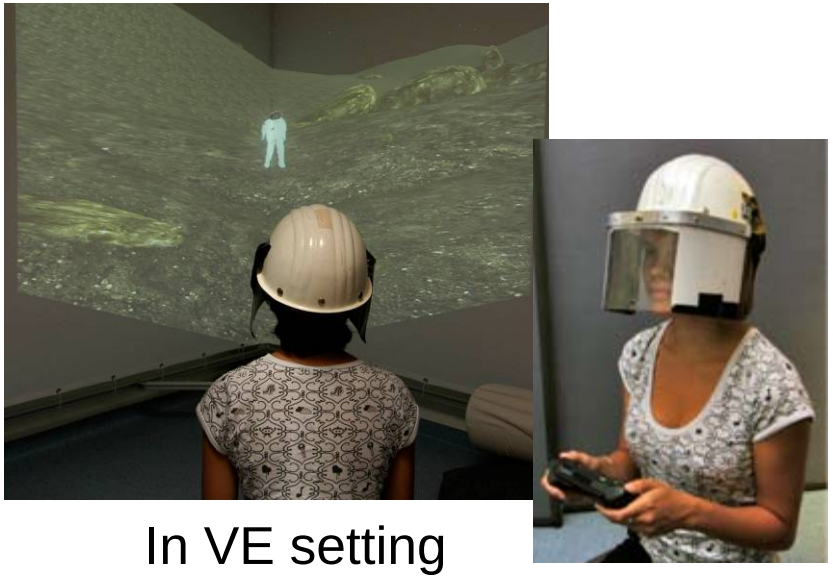
HitL Evaluation
(lecture Nanja Smets)

Provide Scenarios

Support Task Involvement
- Cognitive Load
- Situation awareness
- Presence
- Emotion

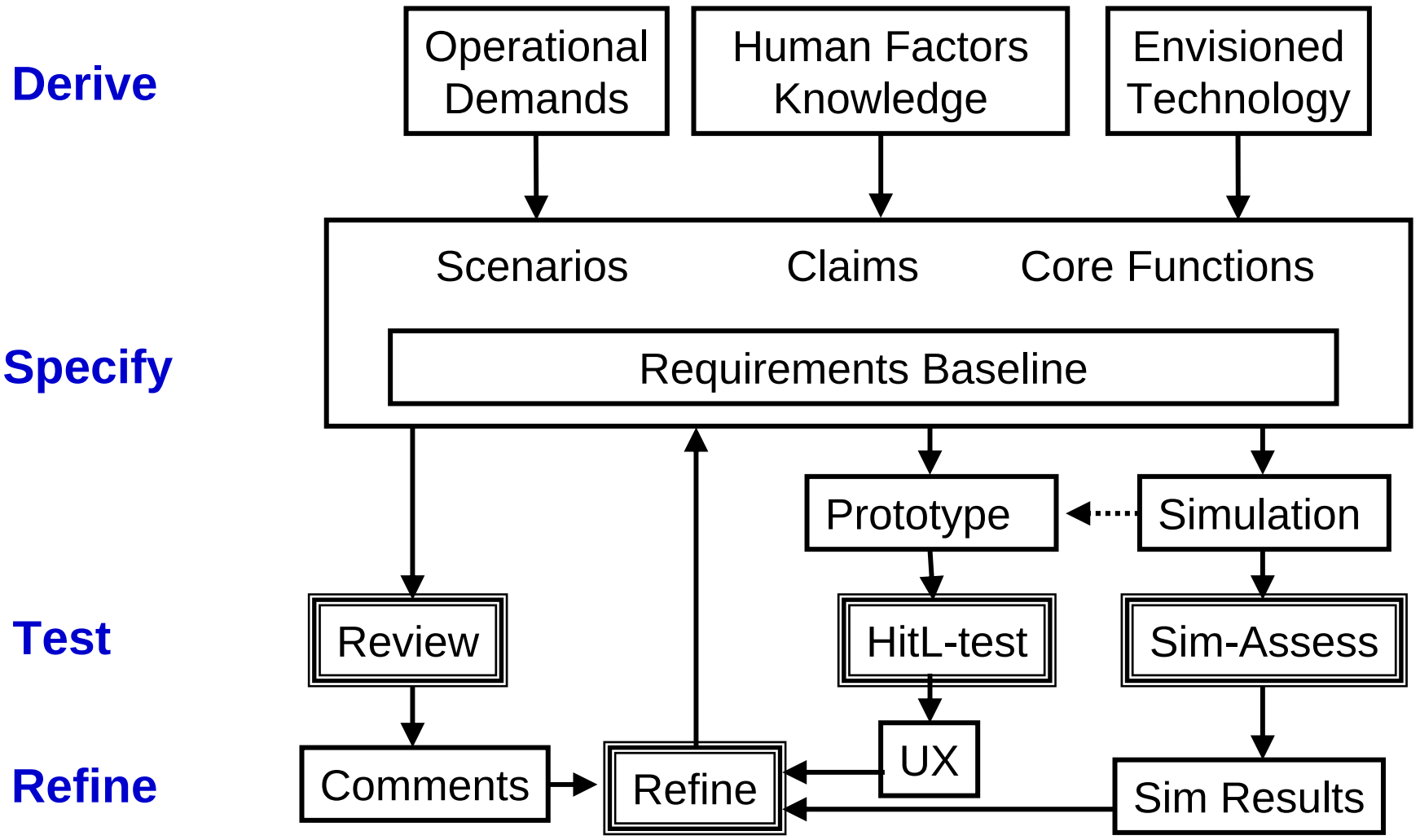
Measure
- Performance
- (Physiology)
- Opinion

In desk-top setting

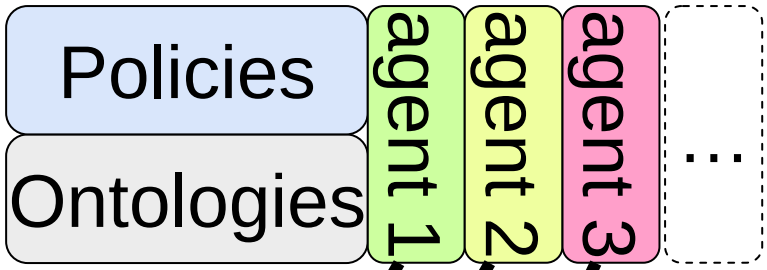


In VE setting

sCE and simulations

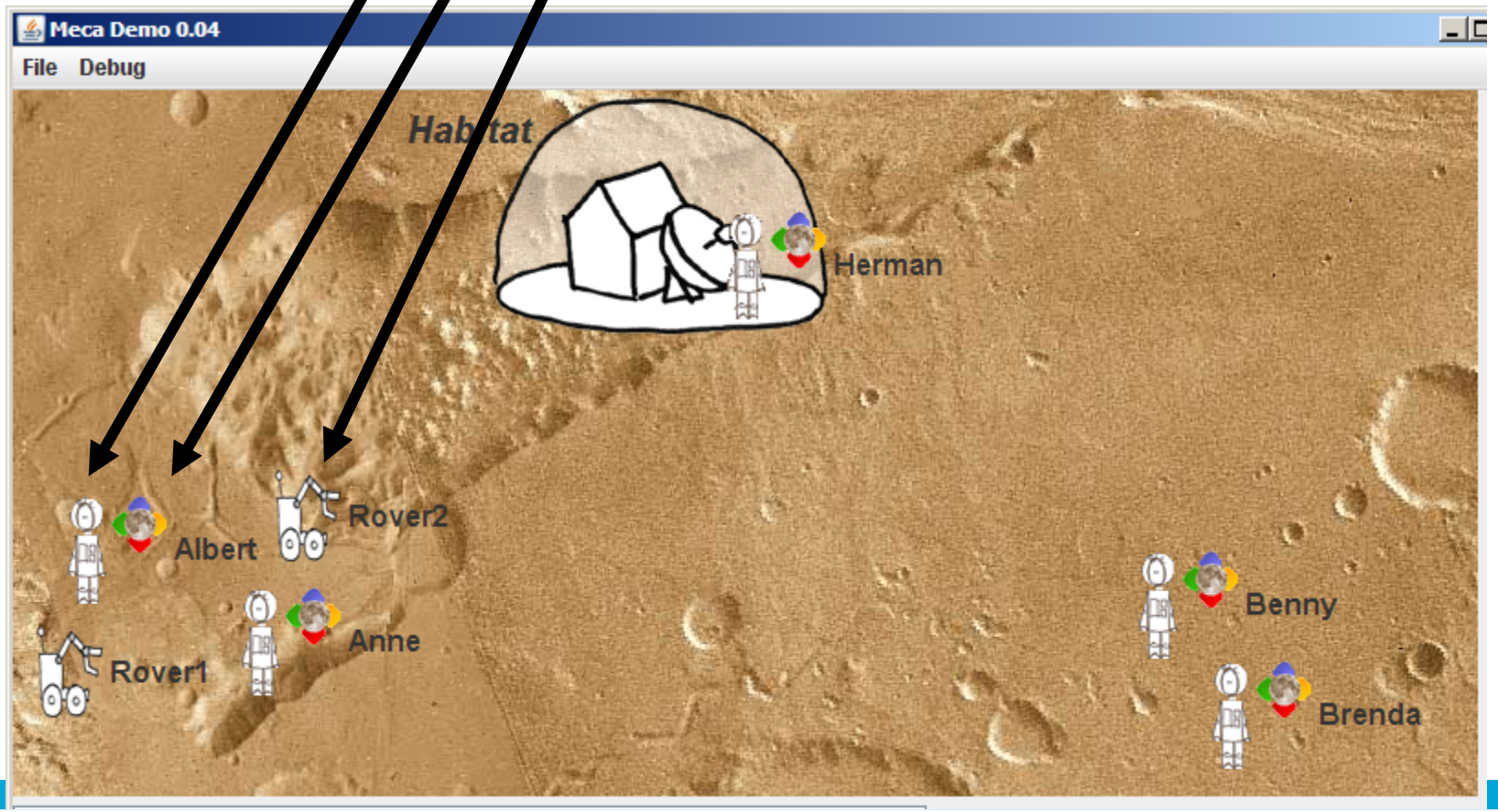


Simulation of Human-Machine Collaboration



KAOS: Policies define which actions are

- obligated or not
- authorized or not



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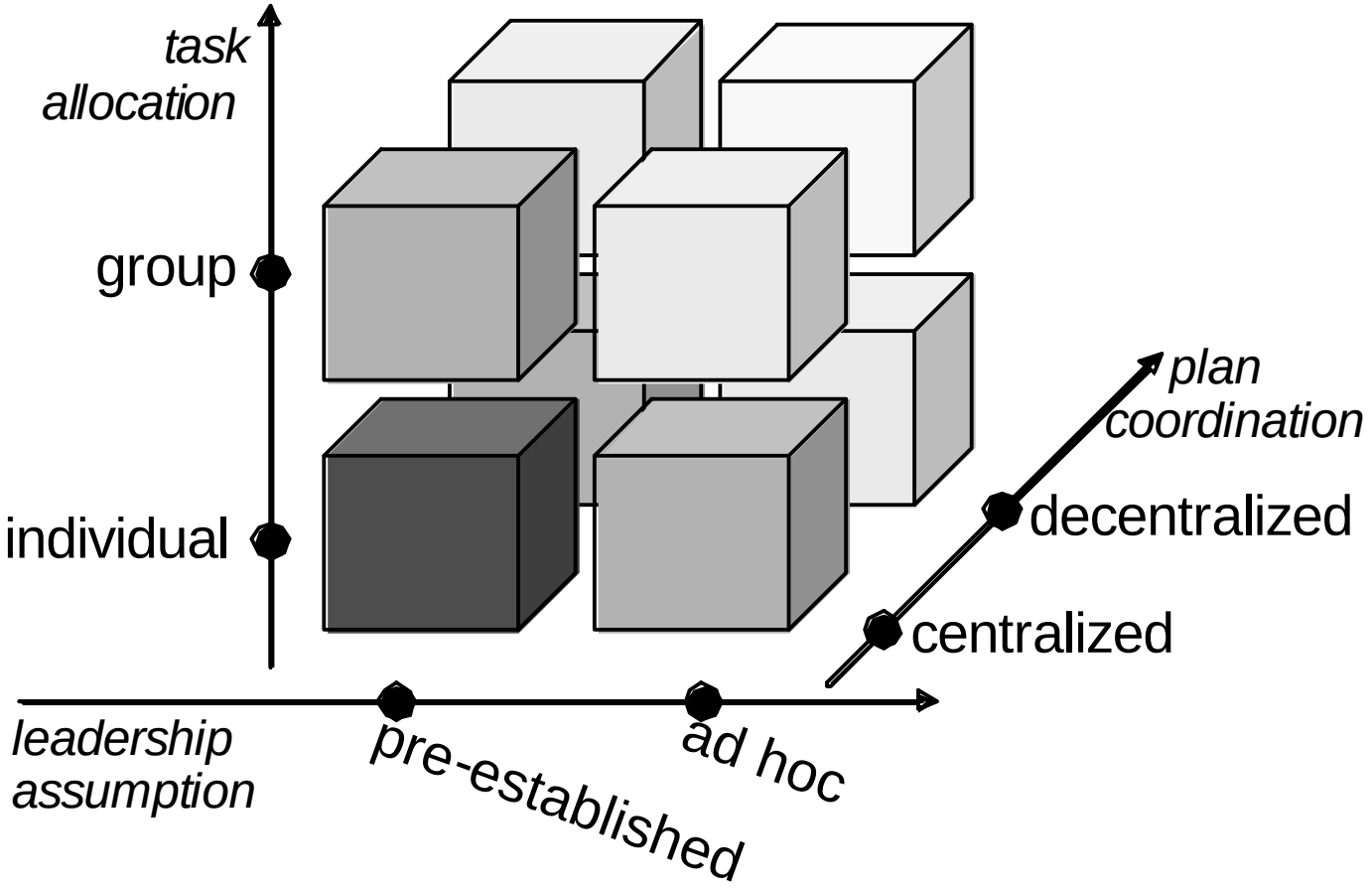
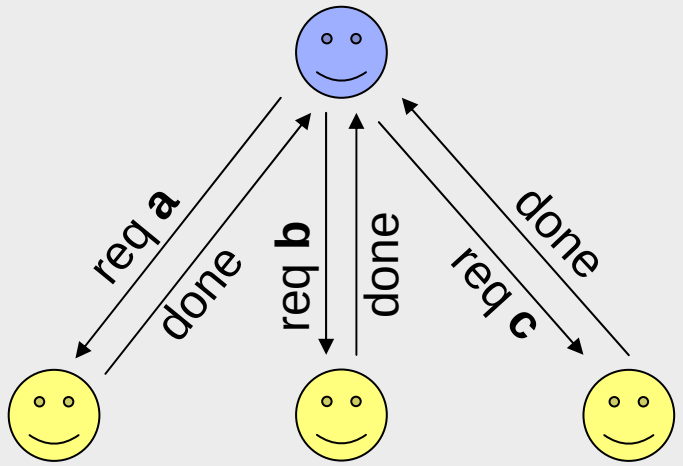
HMC: Team Design



E.g., for plan coordination

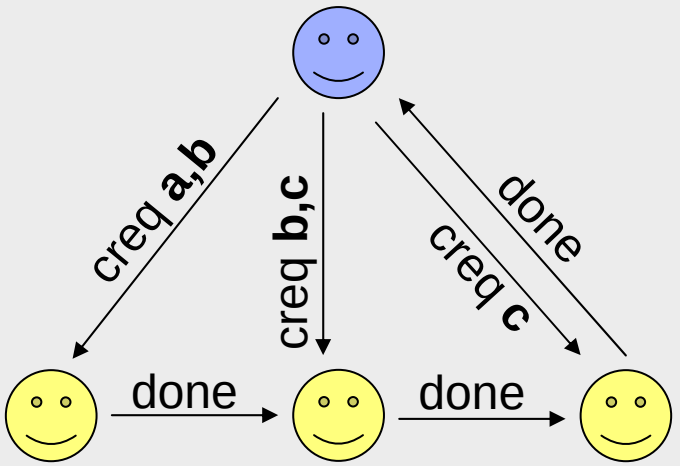
A plan **a;b;c** can be coordinated in 2 ways:

Centralized



+ NoCoordinatedActionRequests
+ NotifyWhenRequestedActionFinished

Decentralized



- NoCoordinatedActionRequests
+ NotifyAgentOfFollowUpAction
+ NotifyWhenRequestedActionFinished

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Example coordination policies

- If the agent does not know who will perform the subsequent action, it should notify the requester after it has performed a requested action
- If the agent knows who will perform the subsequent action, it should notify that agent after it finishes performing its own action

Applications of Policies

MECA requirements:

- The MECA ePartner should monitor the astronaut's compliance with the policies
- If the astronaut breaks an obligation, the ePartner should try to fulfill the obligation itself

General applications of KAoS teamwork policies.

- MECA facilitates teamwork between humans by aiding communication, coordination, and focus of attention (e.g., llet MECA take over these notification tasks).
- Enactment of agents as an "equal" team member. By sharing some important team characteristics with humans, they become more predictable and understandable to humans.
- As a model of nominal team behavior, using this to detect off-nominal situations. For example, if someone breaks a policy by failing to give a timely answer, this could be a sign that something is wrong.

Discussion & Conclusions

Incremental design-test of *e*Partner prototypes, based on

- (foreseen) technological developments (e.g. ambient intelligence, affective computing)
- (foreseen) human-machine team operational demands in the concerning domains
- current models and methods of cognition, emotion, fitness and team involvement

Situated models:

- easy to share between human and machine
- trustworthy, acceptance?

Both the *e*Partners and *h*Partners are fallible

- facilitate mutual correction & supplementation
- implement learning mechanisms

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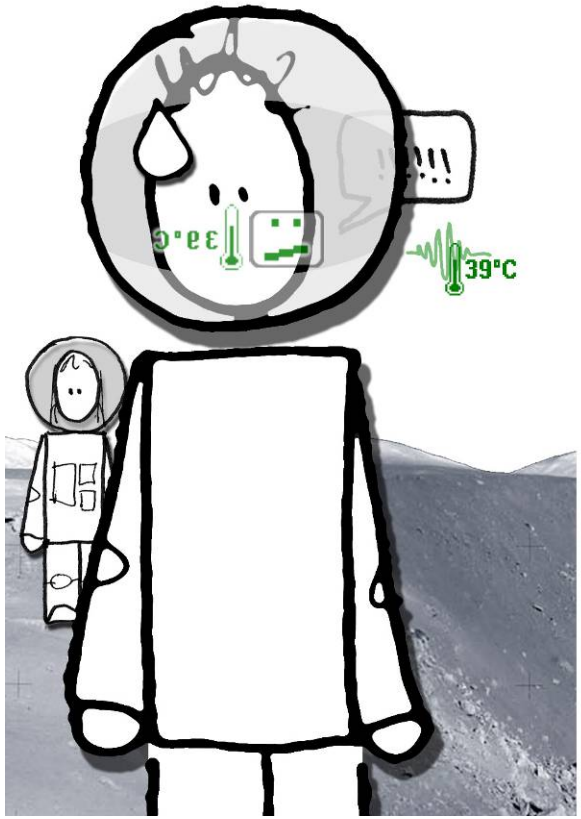
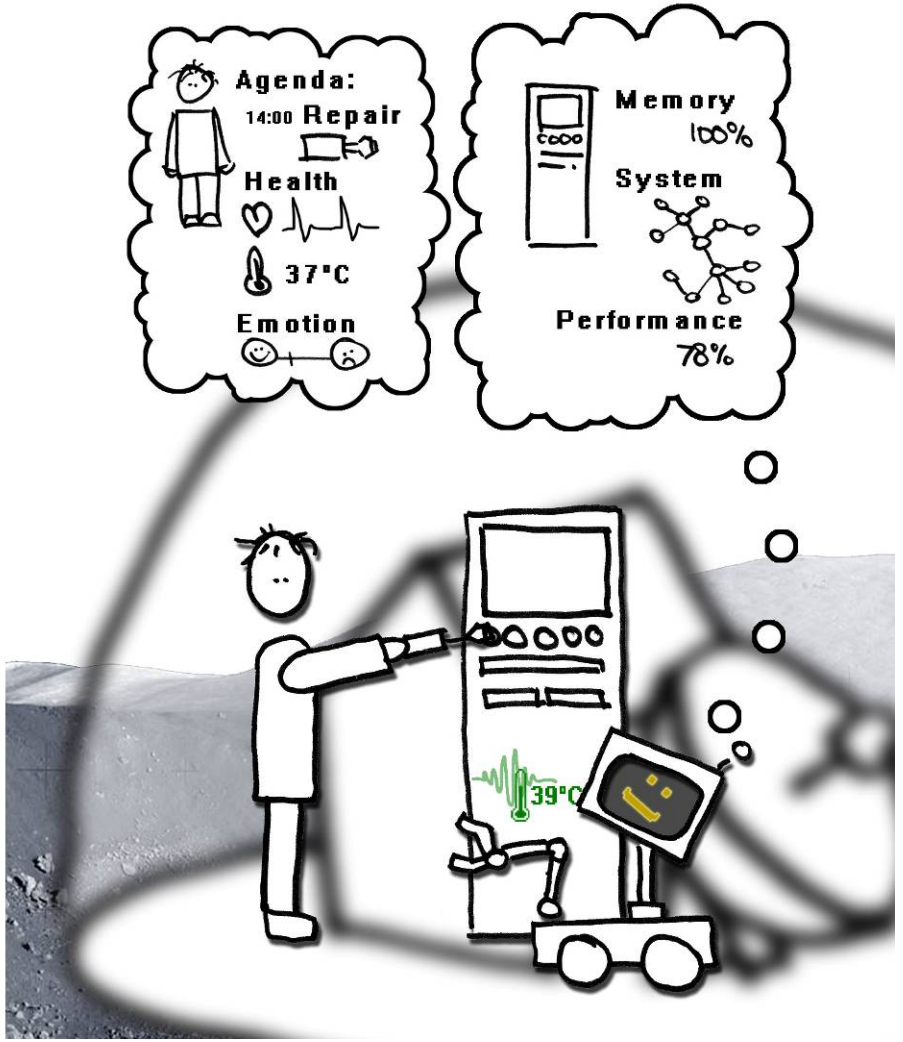
Questions Space Research?





IUXE Course

UX: User Experience?

- Rational and emotional aspects of HCI

E: Engineering?

- Theories, models and methods for design and evaluation.

I: Intelligent?

- Attuning the interaction to person, tasks and contexts.
- Application of tools.

Application Domains?

- ...

UX Design & Test

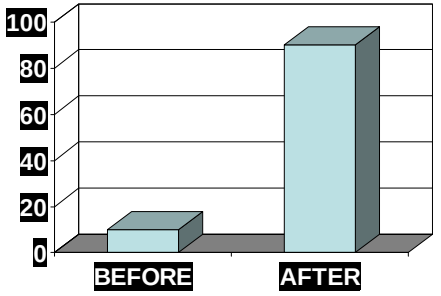
- Performance & knowledge
  - Effectiveness
  - Efficiency
  - Situation awareness
  - Learning
- Judgment & feelings
  - Satisfaction
  - Trust
  - Emotion

UX Engineers in Organizations

- UXE integrated part of development team
  - efficient, domain & project constraints
  - less objectivity
- UXE separated from development team
  - communication and coordination overhead
  - more open-minded, “expertise center”

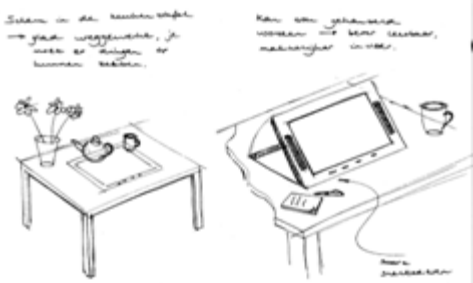
So, IUXE results into…

Performance & Acceptance Improvement:
UX Engineering leads to enhanced
user performance and acceptance.



Quality Assurance:
UX Engineering is an important condition
for realising high-quality products and services.

Innovative Solutions:
UX Engineering helps to develop
innovative interaction concepts.



If……..

...if the IUXE is coherently situated...

Customisation:
Adequate selection and application of well-founded HCI theories, guidelines and methods.

Coherence and completeness by application of an integrated approach, e.g.
- task analysis for design *and* test
- complementary test methods
- correspondence theory, guidelines and methods

Empirical foundation in the application domain

Literature

Current Lecture (module 13):

- Neerincx, M.A. (forthcoming). Situated Cognitive Engineering for Crew Support in Space. Personal and Ubiquitous Computing.