

Technology for Socio-technical System Design (STS)

Harald Kviecien, KOHS



36. ERGONÓMIAI NYÁRI EGYETEM, 2024



Technology for Socio-technical System Design (STS)

Intro ...

- **Question: What is ergonomics?**

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Intro ...

- **Question: How does an ergonomist looks like?**

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- **2 ergonomists who met each other for the first time (@ Summer University 2015)**



Technology for Socio-technical System Design (STS) Overview

- **Part A: Introduction**
- Part B: Integrated Learning
- Part C: Socio-technical System Design (STS)
- Part D: Advanced concept

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KOHS

<<< towards human centered AI >>>
<<< → Industry/Society 5.0 >>>



KOHS is an independent organisation, performing research in the field of occupational safety and health and ergonomics since 1997. KOHS offers solutions for promoting safety and health at work.

***PIMEX** is an internationally highly recognised and powerful method.*

*The **kohs.PIMEX.system** is used worldwide by leading institutions to improve health of working people.*

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Introduction

Contact information

Harald Kviecien: researcher @ KOHS – technology/AI, human factors/ergonomics, integrated learning (> 25 years)

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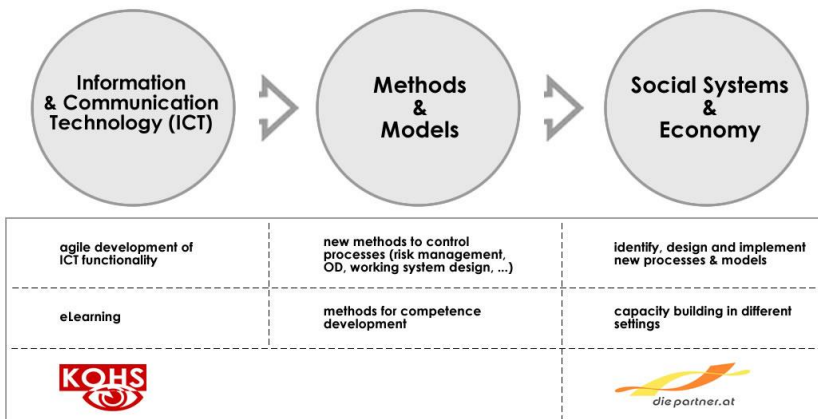
hk@kohs.at



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KOHS – Working areas

Technology → Ergonomics → OH → health care → active life



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Mission / R&D strategy

XIM (cross vertical mission): learning ORG

Mission:

Empowering people for engagement in learning organisations for a prospective society.

hypothesis: this could be a suitable inter-professional mission.

(Some) Conditions and requirements:

- Need: Knowledge reproduction (→ CoX)
- Need: Open interfaces (technically, methodically)
- Need: Integrated processes / integrated pathways

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Mission / R&D strategy

~ practical „definiton“ of cognition

„simplifying“:

Empowering people for engagement in learning organisations for a prospective society ~ (contains a lot of) **Cognition**

Cognition → **Computations of** (Heinz v. Foerster)



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definition of: technology

[definitions]

Relevant definitions by: **Günter Ropohl**

- Technics = the total set of useful, artificial, concrete objects (artifacts or object systems); the total set of human actions and institutions, in which object systems originate; and the total set of human actions, in which object systems are applied (VDI standard 3780, 1991, Ropohl 1997)
- Technology = ~ engineering science (Ropohl 1997)

+ “Technologies” (?):

(Pragmatically:) **Technics used to develop technics (HK)**

(Should not be necessary, but due to common use ...)

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definition of: machine

[definitions]

Two types of the „transclassic machine“ (introduced by Gotthard Günther, 1963).

definition of: machine

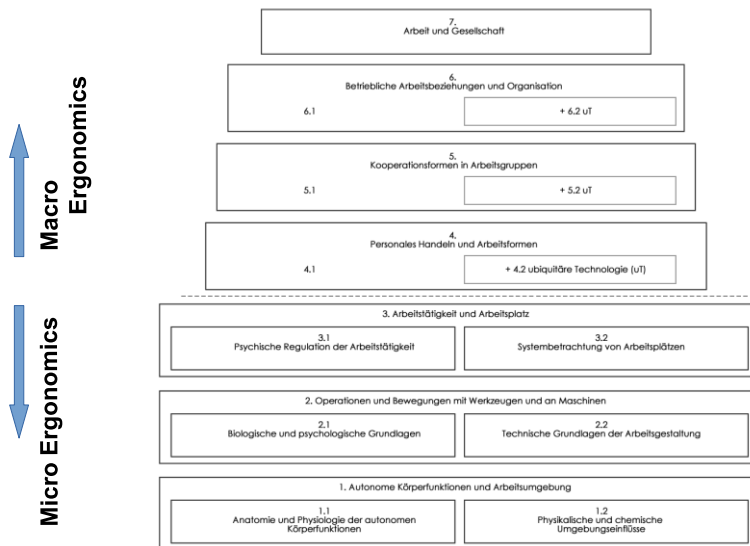
- m₃: machine = the behaviour of a system (if somehow predictable) (~ Joint cognitive system (JCS))
- m₂: machine = an algorithm/software, independent from the device (~ virtual machine)
- m₁: classic machine (e.g. Machinery Directive (Directive 2006/42/EC) / Machinery Regulation (EU) 2023/1230)

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Classification

Ergonomic Layer HK7+1 (nach Luczak7)



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Introduction

“Integrated ... Learning ... Coping ... Transitions ... Health Care“

- **Kvieceien, H.: Integrated and Virtual Learning as Element of Coping with Multiple Transitions in Health Care.** In: Auer, M.E., Pachatz, W., Rüttemann, T. (eds.) Learning in the Age of Digital and Green Transition. ICL 2022. vol. 634, pp. 87–98. Springer (2023)
- **a step further** into the **upcoming approach of integrated pathways** in health care
- Two newly established and **certified learning arrangements** in health care (learning modules)
- Advanced concept: aims at the enhancement of **continuous learning in organizations**
- **Combine formal & informal learning**

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Context (1)

“Integrated ... Learning ... Coping ... Transitions ... Health Care“

- The European social systems face several **transitions** causing a **higher demand** to cope with them for **health care organizations**
- **Transitions:**
 - 1 The core processes of health care
 - 2 “New” approaches of care (i.e. community health care, primary health care)
 - 3 Occupational health management
 - 4 The use of technology (or even the involvement in processes of agile development)

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Context

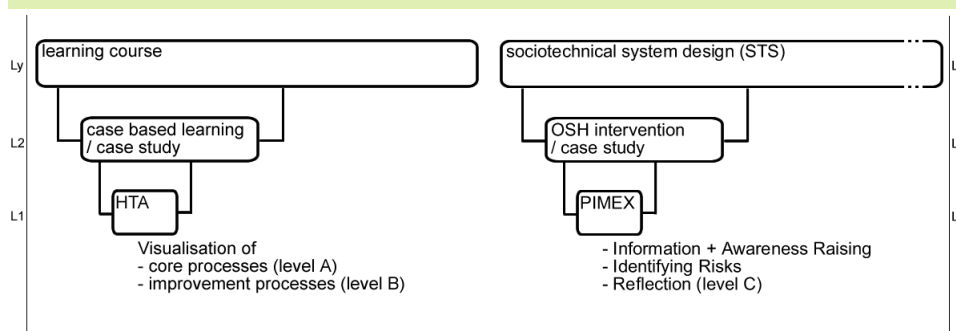
Objectives

- **Objectives:**
 - allow individuals to co-work on health
 - enable health professionals to improve care processes
- Transition to be mentioned: new model of care introducing the **health of health care worker** as a relevant factor. (proposed in the 1990s this “social innovation” could not be implemented so far in the mobile care)
- **To converge:** integrated learning including collaborative technology

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Integrated Learning: 2 parts



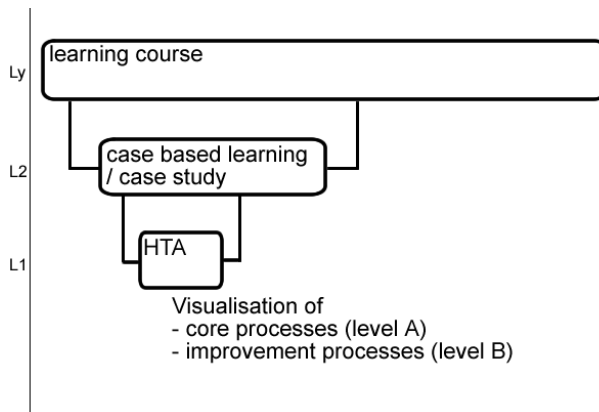
The two parts of integrated learning. Left: the integrated learning in health care organizations. Right: the integrated learning embedded in sociotechnical system design and occupational health (intervention approach).

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Integrated Learning in mobile health care

The approach

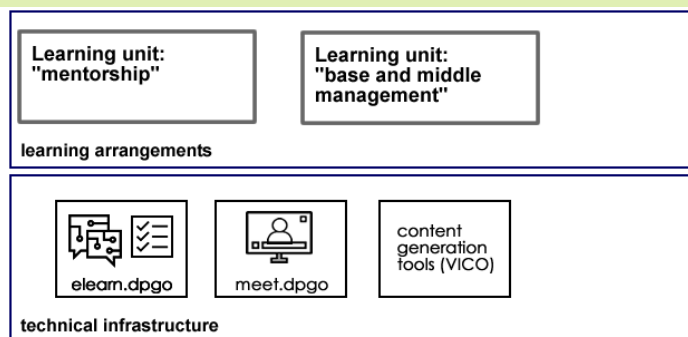


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Actual outcome

“Integrated ... Learning ... Coping ... Transitions ... Health Care“



- 2 certified learning arrangements
- Virtual learning concept

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Actual outcome

Learning module: “base and middle management”

- Level 1: Structured into 6 modules and 9 blocks mixing presence and virtual phases. total 21 days.
- Completed by a final examination before a board (including representatives of public authority)
- Mainly levels A and B of the 3x-meta model are addressed (see: Advanced concept)

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Integrated Working science Approach

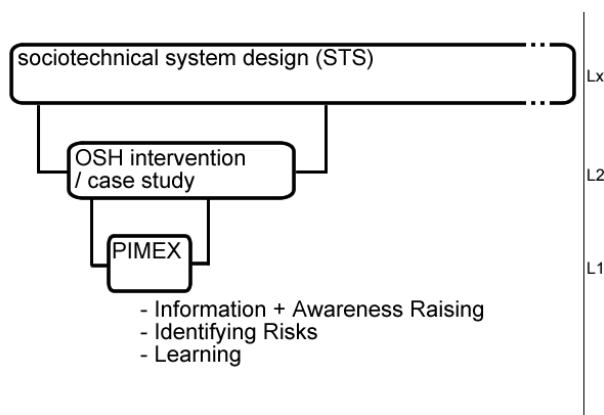
- new modes of working needs new dynamic processes to push the OSH-system to be really prospective
- Researchers of different disciplines need to cooperate with practical OSH acteurs during an intervention project (under the umbrella of ergonomics)
- Interfaces of interaction (procedures + technology) need to be standardised (step by step + keeping the dynamics of the approach)
- Increasing relevance of sociotechnical system design (STS)
 - DIN/DKE-AI roadmap (DIN/DKE 2022 (standardising roadmap in Germany)

Harald Kwiecien, 2015

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Socio-technical system design (STS) “Wiener approach“



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„Wiener“ approach of STS

Development

- Developed since 1997 (in cooperation with OH institutions)
- Started with the „PIMEX method“ (visualisation), thus high relevance of:
 - . → participatory ergonomics
 - . → technology / agile development / (measurement) data (structures)
 - . → intervention process
- Publications so far with focus on PIMEX, OH cases, intervention / publications on the whole „Wiener“ approach of STS pending

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Key characteristics of STS

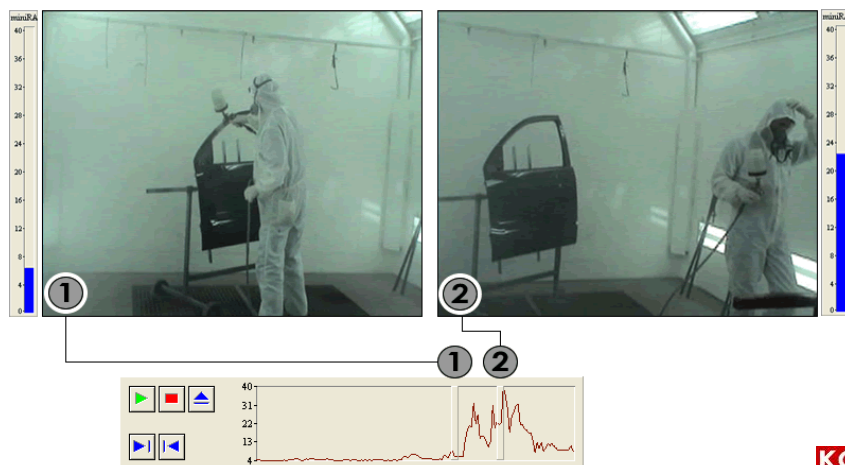
In context to approach [iL+STS]

- Division in subsystems (the classical working systems) and their interrelations
- Normative procedure (pursue productivity and health promoting work at the same time)
- Central subject of design: **the work task**
- The employees themselves become co-designer of the working systems (requires additional competences)
 - . → = demand to initiate & control **learning process** → [iL+STS]

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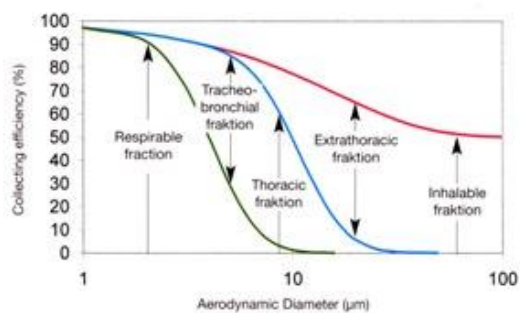
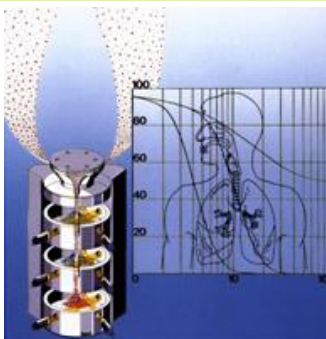
Identifying risks at work with PIMEX Using technology (wearable sensors ...)



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Research in Progress in aerosol measurement and the PIMEX method



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Heat stress, thermic comfort

Assessment of heat stress, thermic comfort and physiological parameters



- measurement of several parameters (heat, climate, ECG, ...) at the same time

-> Basis for expert opinion (heavy heat work)

1. Heat load in paper mill



Extreme high heart rate.

2. Heat load in rail manufacturing



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Heat stress, thermic comfort

Aspects of Measurement

- ISO 9886 (2004)
- Participation is relevant for assessment (Parsons 2003).



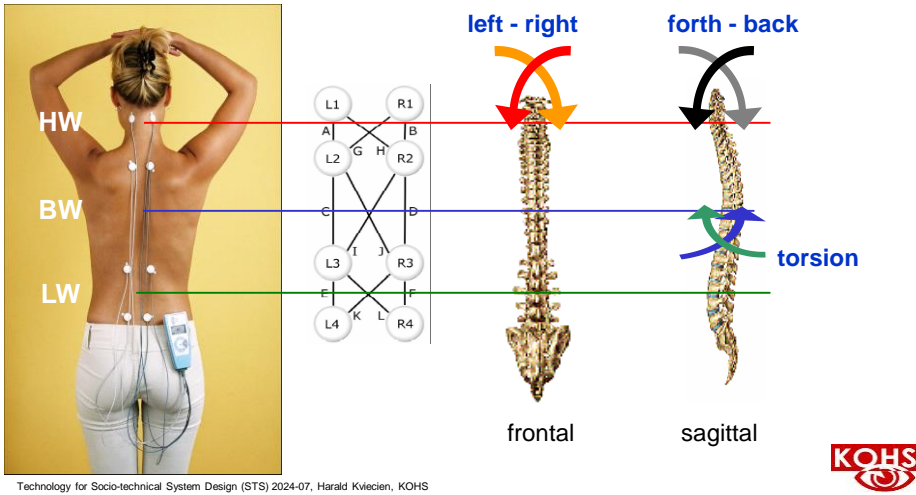
- MDRM (not available any more)
→ demand of new instrument

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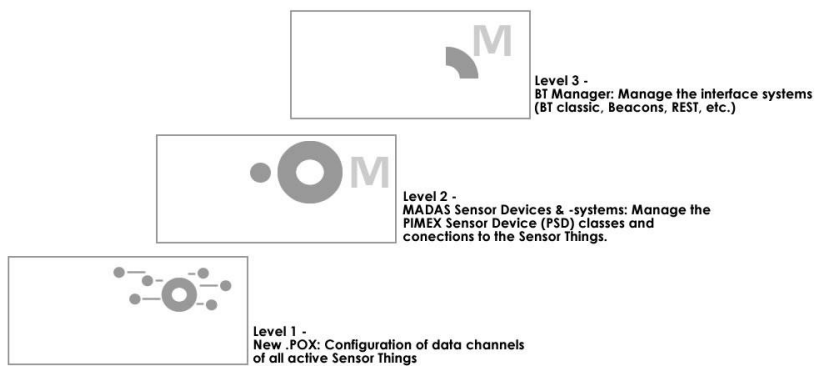
Mobile body motion analysis

A) Technological research and development



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MADAS - the data aquisition layer implemented at three levels in kohs.PIMEX



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PIMEX based learning at the job

Safety and health as learning process –
promoting learning outcomes



PIMEX is a medium for learning and knowledge – on the job as well
as in virtual learning spaces

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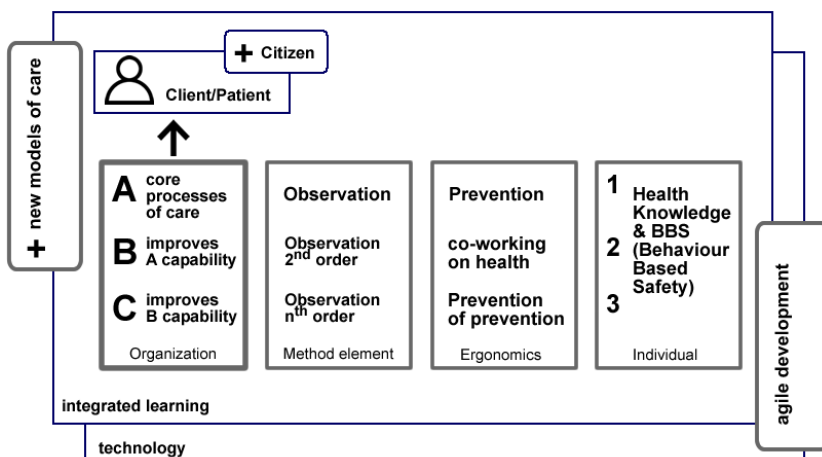
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Advanced concept (4)

"3x-meta" model (in progress)

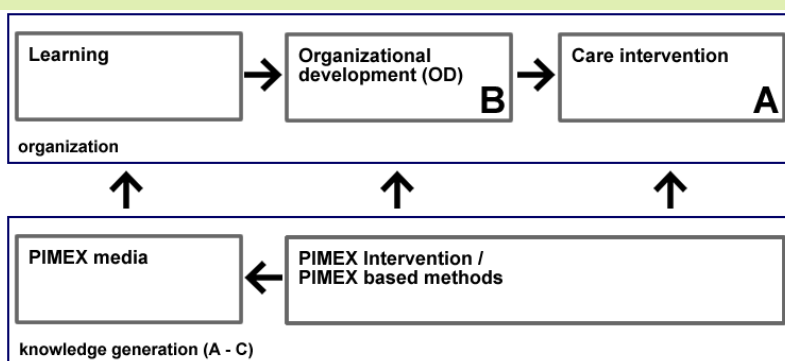


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Advanced concept (4)

PIMEX based mixed-method approach for risk assessment and knowledge generation



PIMEX Intervention: observe working systems and processes (at A level) (focus: occupational health, process quality) + organizational structures (B level) + reflect organizations and learning processes (C level)

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Conclusions & Discussion

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- In recent years: more interest to implement approaches of digital learning (in health care domain). Still high knowledge gap regarding the implementation of new care approaches & approaches of integrated learning & STS.
- Insights for people involved in management of education/organizational development in health care to implement integrated learning - but still needs further explanation
- Next steps: new learning approaches based on the advanced concept → demand new roles within organization (= research demand **& new roles for ergonomics**)

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Conclusions & Discussion

Different contexts of STS (where KOHS is involved)

- STS with focus on **OH institution** → **ORG**
- Development of **analysis instruments for STS**
- Innovation / Development of **technical artefact** – to be used in organisation / socio-technical system
- Technology: Development of **system core elements** (M2M communication ($m_{1,2,3}$ to $m_{1,2,3}$))

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