



## Work System Design in Machine and System Safety with a Focus on Human-System Interaction

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## Agenda

- **Human Factors, Ergonomics and Safe Machines**
- **OSH calls for work system design in digital transformation**
- **Design requirements and recommendations**
  - Work system design issues
  - Work organisation design issues
  - Work place design issues
  - Work equipment design issues
- **Design for future human-system interaction**



## Human Factors, Ergonomics and Safe Machines

- Working Group Human Factors, Ergonomics and Safe Machines
  - ISSA international prevention sections
  - Machine and system safety (MSS)
  
- Work system design in digital transformation
- Inclusion of human factors goes beyond anthropometry and biomechanics
- Digitisation mandates design for human information processing

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**Activities Human Factors, Ergonomics and Safe Machines**

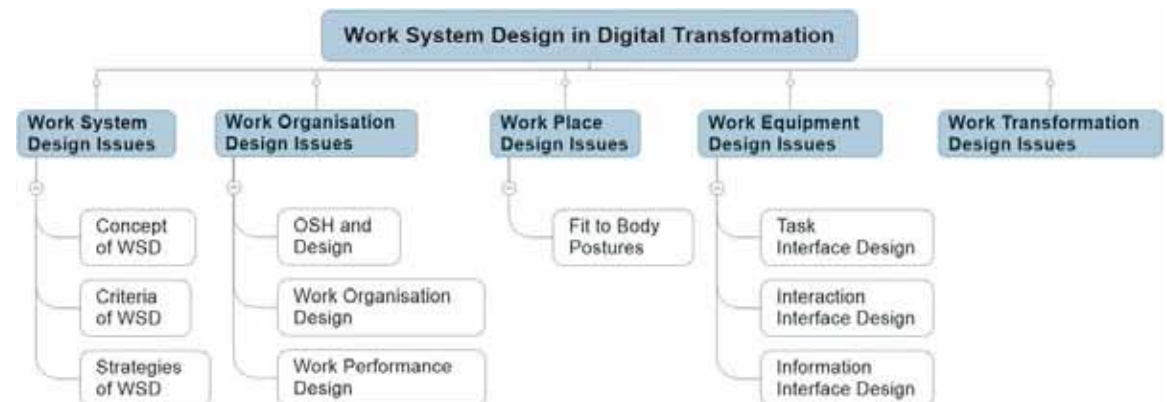
The working group reviews, selects, and presents design requirements and recommendations according to Occupational Safety and Health as well as Human Factors and Ergonomics. This is to inform about how to integrate Human Factors and Ergonomics design requirements into machinery construction, in workplace and equipment design and in human-system interaction in practice.

Human Factors and Ergonomics in Occupational Safety and Health aims at improving work systems design. Therefore, work system components and their interactions are designed to safeguard operational safety, effectiveness and efficiency of human-system interaction as well as to optimise human workload, which in turn will contribute to operational safety and health in work systems.

With some future work systems remaining unchanged, others in the context of digital manufacturing may develop into new systems. For Human Factors

# Human Factors, Ergonomics and Safe Machines

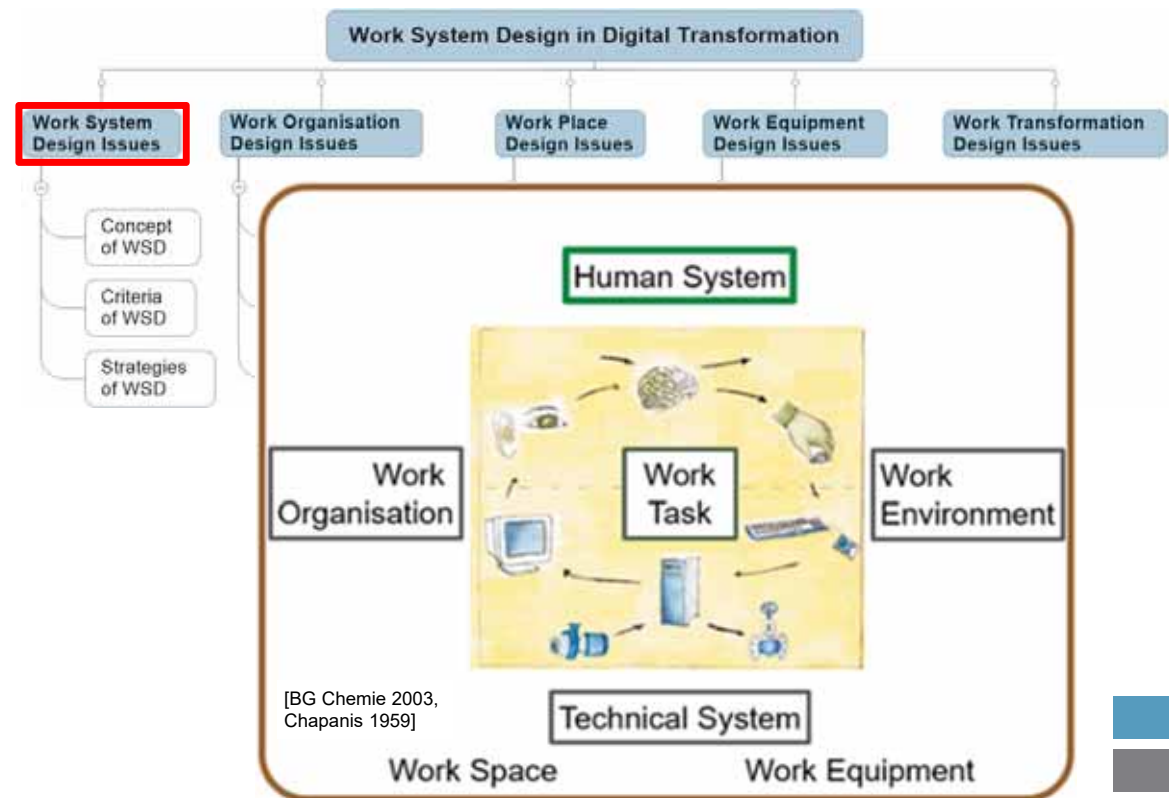
- Design requirements and recommendations
  - Work system design issues
  - Work organisation design issues
  - Work place design issues
  - Work equipment design issues



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## Work System Design Issues

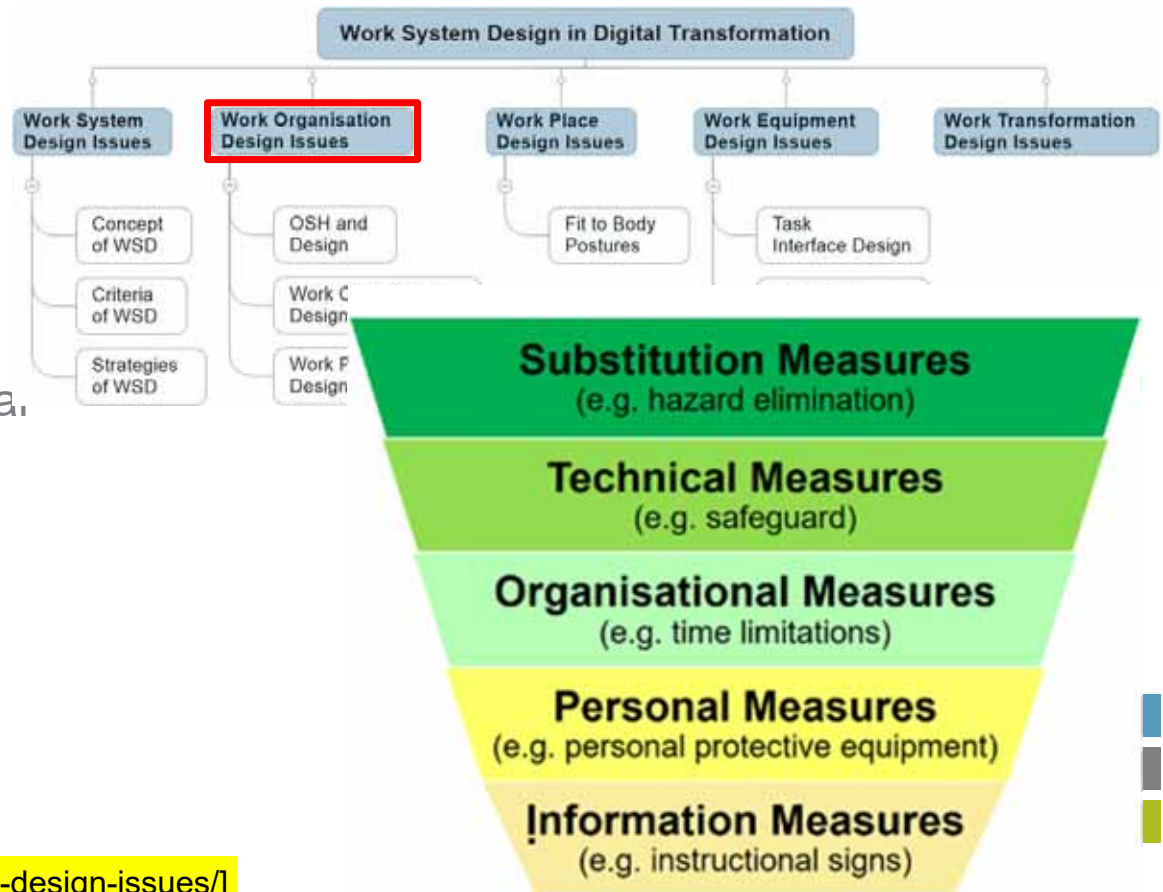
- **Concept of work system design**
  - Work task, work organisation, work place, work equipment, work environment
- **Criteria of work system design**
  - Feasibility of work, freedom from harm, from impairments, development of health
- **Strategies of work system design**
  - Task orientation in work system design
  - Design for percentiles and for all
  - Prospective versus corrective design



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## Work Organisation Design Issues

- **OSH hierarchy of controls**
  - STOP! selection of measures reduce hazards and risks.
  - STOP! measures protect all humans through design
  - STOP! measures provide additional potential.
  - Internationally, hierarchy of controls is the same at higher levels
- **Work scheduling**
  - Work load and working time
- **Work performance**
  - Human workload and human error

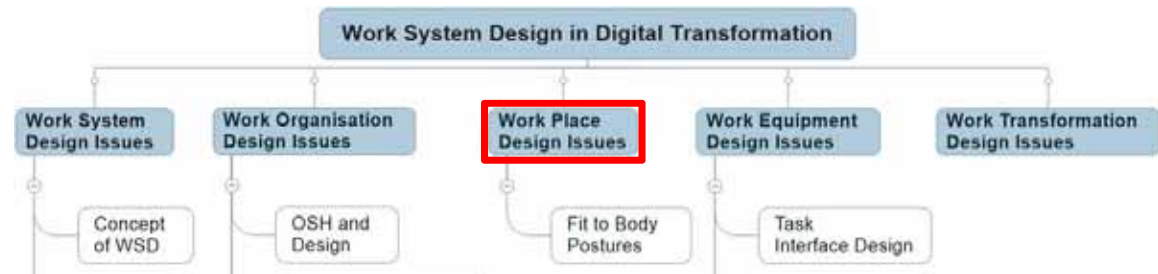


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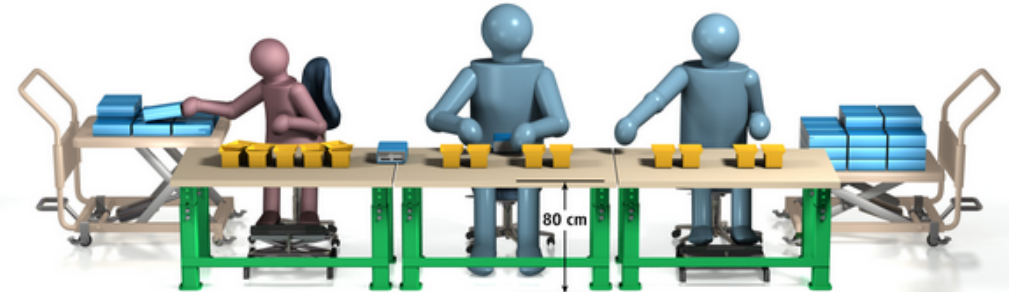
## Work Place Design Issues

### ■ Dynamics in work place design

- Line assembly works at sedentary work places with similar working height
- Adaptation measures



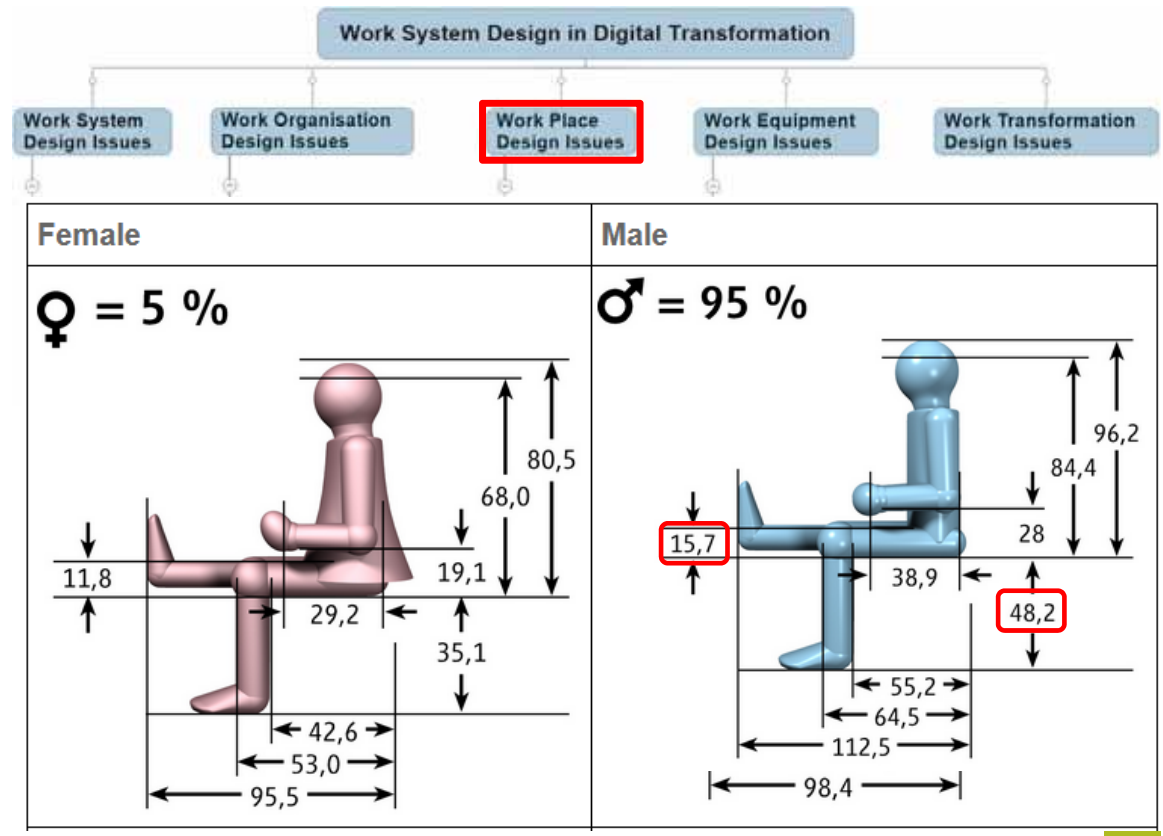
1. The height of the elbows of tall men (95%) in sitting position define in most cases the height of the dominant hand activity, which is at +/- 80 cm. The height of the work surface depends also on the workpiece and/or the tools that are used.
2. Leave enough room under the table for the knees of a tall man (95%), at least 67cm high.



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## Work Place Design Issues

- Dynamics in work place design
  - Anthropometry
  - Example: m95 knee-level for table height
    - ▶ 67 cm = 48.2 + 15.7 + 3.1

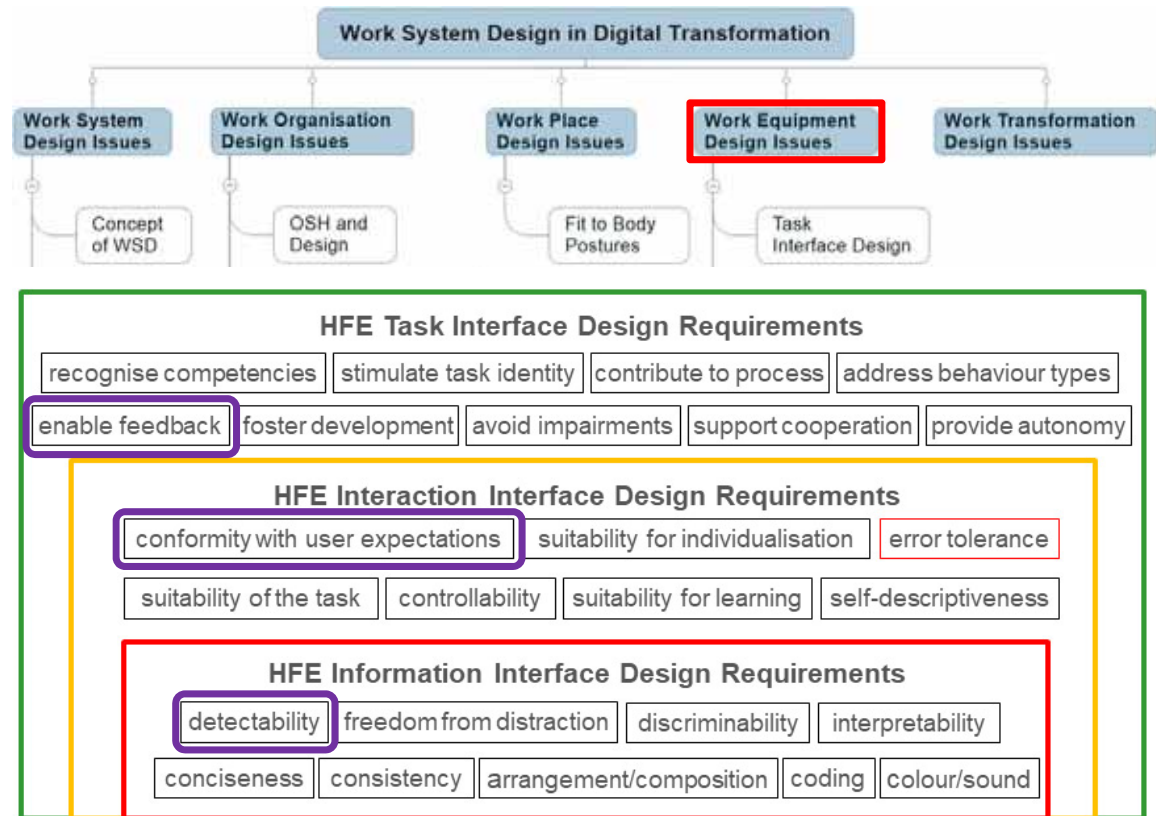


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# Work Equipment Design Issues

- Human-system interface design
  - Task interface design (EN 614-2)
  - Interaction interface design (ISO 9355-1)
  - Information interface design (ISO 9355-1)



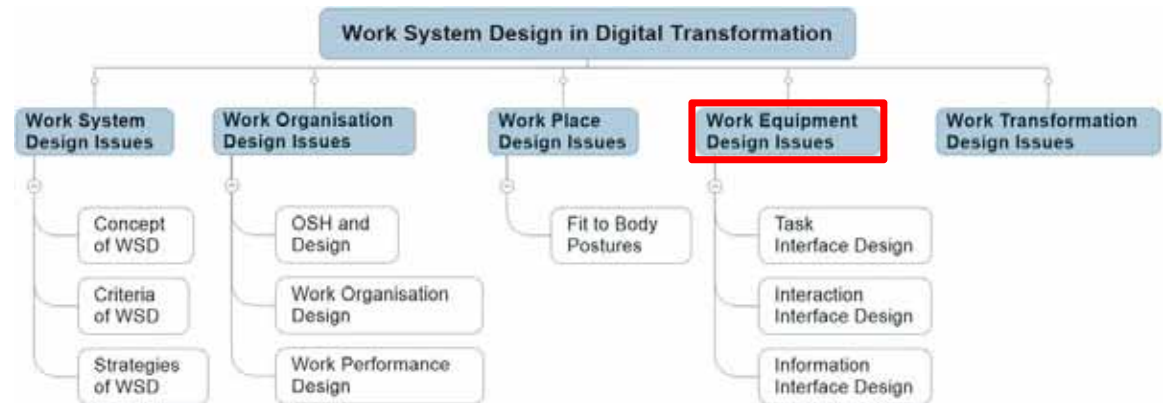
[Picture: DGUV Information 215-450 (2021)]

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## Work Equipment Design – Task Interface Design

### Principles of work task design

- Enable feedback (EN 614-2) is giving information on task performance to the worker to allow for assessments and adjustments.
- Example:
  - enable human view to danger zone (direct view or mirror or camera-monitors-system),
  - control machine movements without compromising well-being of passers-by



[Photo: Justin Morgan "Female construction worker in India" (CC BY-SA 2.0)]



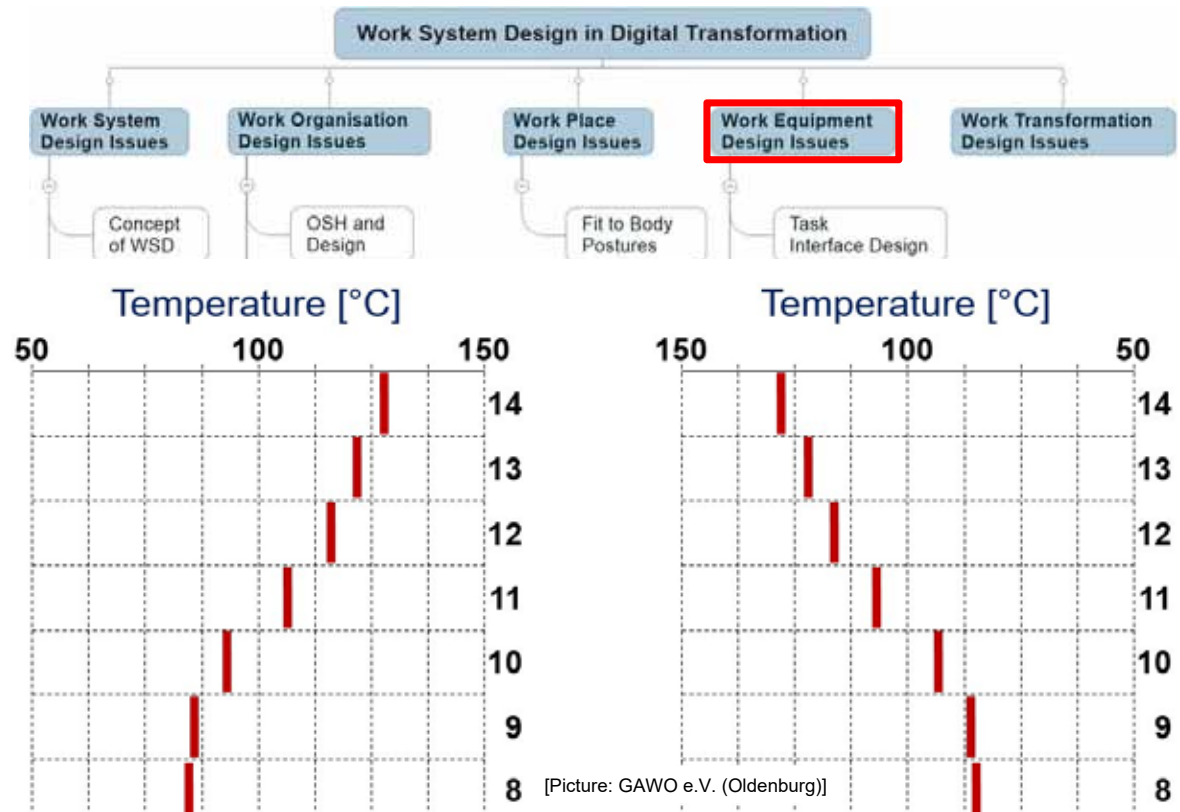
[Photo: IFA]

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## Work Equipment Design – Interaction Interface Design

### Principles of interaction design

- Conformity to user expectations (ISO 9355-1) of function, movement and position of displays and controls.
- Example:
  - population stereotypes
  - scales for temperature increase and decrease (see left and right picture)
  - reasonably foreseeable human error during operation may lead to hazardous situations.

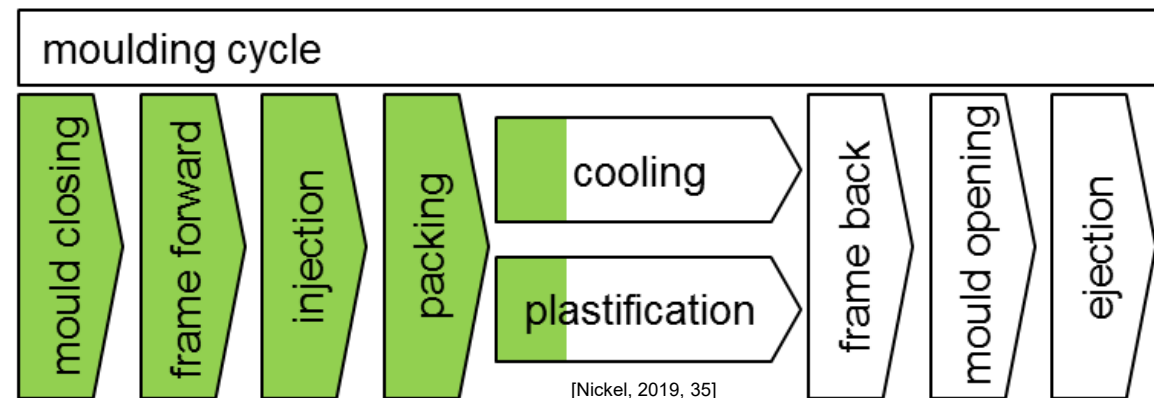
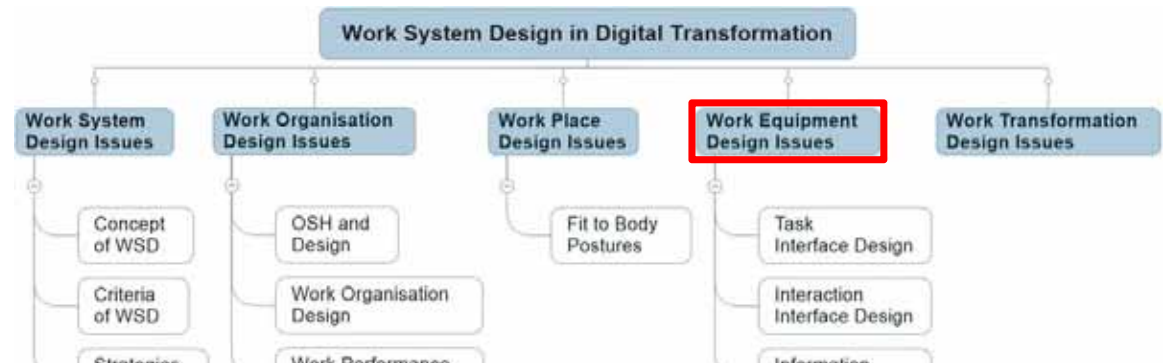


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## Work Equipment Design – Information Interface Design

### Principles of information design

- Detectability (ISO 9355-1)
  - un-intrusively inform about actual
  - information is available, i.e.
    - attract attention
    - inform about temporal sequence
    - show continuity
    - indicate controls

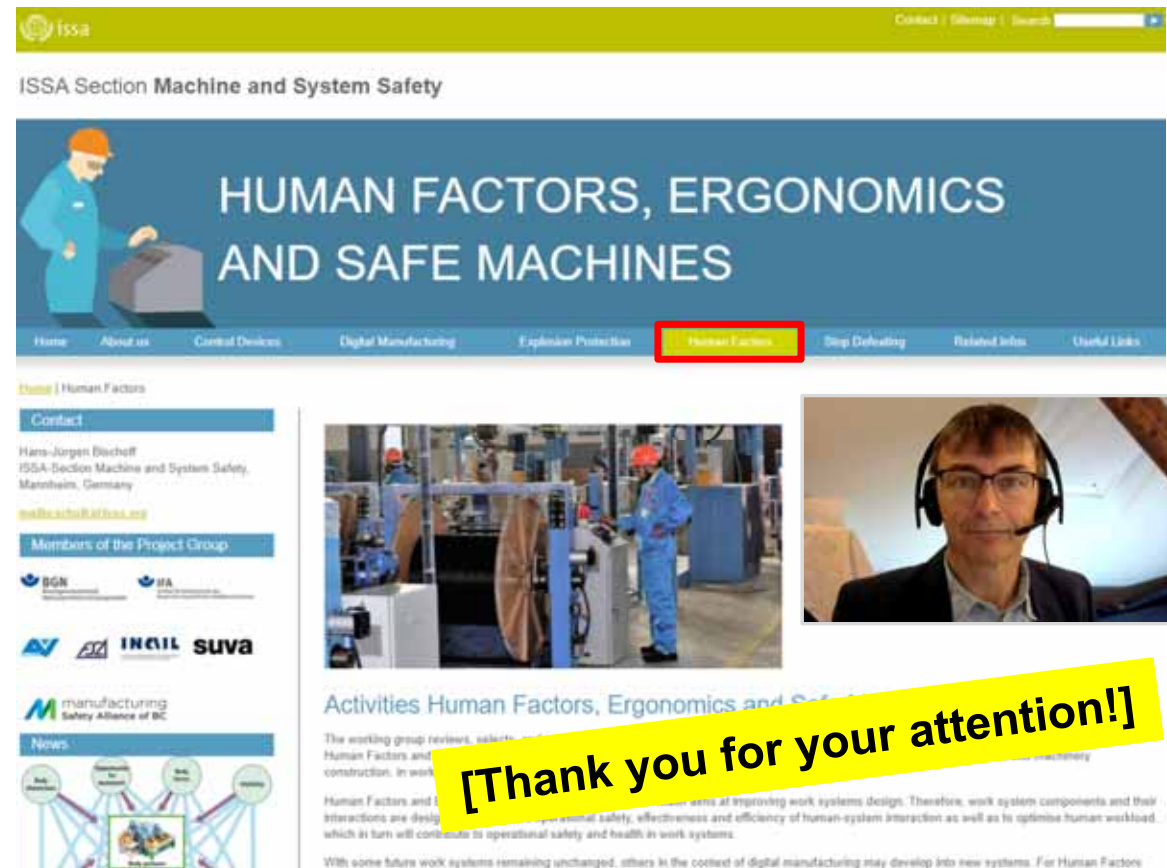


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## Design for Future Human-System Interaction

- **Internet platform available**
  - More content under development
  - Design, structure, layout, editorial group
- **Invitation to participate**
  - Reading, commenting
  - Using, contributing
- **Contact and information**
  - doi:10.1007/978-3-030-74611-7\_21
  - scholl@ivss.org

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**Activities Human Factors, Ergonomics and Safe Machines**

The working group reviews, selects and disseminates research results in the field of Human Factors and Ergonomics in the context of machine and system safety in manufacturing and construction. In work systems, human factors and ergonomics play a central role in the design of work systems. Human Factors and Ergonomics research aims at improving work systems design. Therefore, work system components and their interactions are designed to ensure professional safety, effectiveness and efficiency of human-system interaction as well as to optimize human workload, which in turn will contribute to operational safety and health in work systems.

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**[Thank you for your attention!]**