

## Employee satisfaction with the adaptive HMI and working conditions questionnaire

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## INCLUSIVE project: aims

- Smart and adaptive interfaces for the INCLUSIVE work environment
- A new concept of user-machine interactions in which the behaviour of the automated systems adapts to human capabilities
- Development of **an adaptive Human-Machine Interface (HMI)** based on the measurement of physiological indicators of cognitive load and capabilities;
- To be introduced in the industrial environment
- Inclusive for **different user groups** i.e.,:
  - ☐ Inexperienced workers
  - ☐ Elderly workers
  - ☐ With disabilities



The innovation should ensure worker satisfaction with work in general and with HMI in particular

## Modules of the adaptive HMI

### Adapt Module

- An *a priori*, „Off-line“ profiling of the user
- Creating user profile:
  - Age
  - Education
  - Impairments
  - Computer Skills
  - Language
- Adapting HMI features according to the real time measurement of cognitive load



### Measure Module

- Real time measurement of the operator strain data
- Measurement of physiological parameters: GSR, HR, speech analysis, eye tracking

### Teach Module

- Off-line
- On-line

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## Target group

- Ca. **60 HMI operators** from 3 different factories located in Germany, Italy and Turkey
- Different education level, computer skills
- With & without physical and cognitive disabilities
- Different Age & Level of Experience
- Nationalities

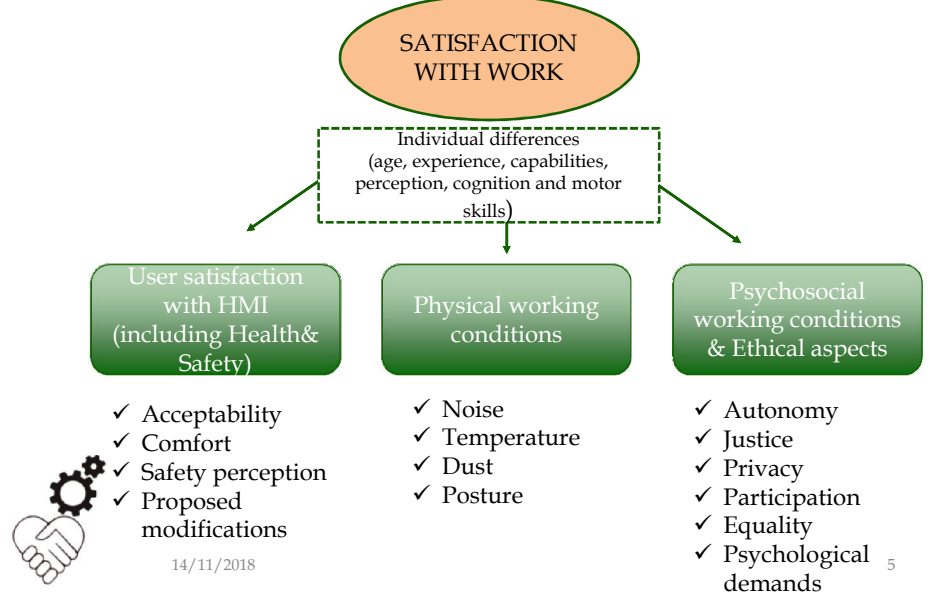


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## Proposed model of worker satisfaction in the INCLUSIVE project framework

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## Creating the questionnaire

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No	STEPS	AIM
1.	Literature review on user satisfaction and existing assessment tools	<ul style="list-style-type: none"> <li>Which factors should be taken into consideration during the assessment?</li> </ul>
2.	Selection of the initial quota of the questions for the questionnaire	<ul style="list-style-type: none"> <li>Cover as many aspects of the satisfaction with HMI as possible</li> </ul>
3.	Sending the draft questionnaires to the partners for review	<ul style="list-style-type: none"> <li>Feedback from the HMI designers and companies participating in the project</li> <li>Does the questionnaire cover all aspects of the HMI?</li> <li>Do the questions correspond to HMI features</li> </ul>
4.	Translation of the corrected version of the questionnaire	<ul style="list-style-type: none"> <li>Translated to the native languages: Greek, Turkish, Italian, German</li> </ul>
5.	Sending the translated versions of the questionnaire for the final verification ( <b>this is where we are</b> )	<ul style="list-style-type: none"> <li>Final verification</li> </ul>
6.	Pilot study	<ul style="list-style-type: none"> <li>Choosing the most relevant questions</li> </ul>
7.	Performing the user satisfaction assessment	

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## Literature review on the existing assessment of usability/satisfaction with HMI

### USABILITY DEFINITIONS:

- the extent to which a product can be used by a specified user to achieve a specified goal with effectiveness, efficiency and satisfaction of a context of use (ISO 9241)
- ensuring that interactive products are easy to learn, effective to use and enjoyable from the user perspective (Rogers et al., 2011)
- multidimensional characteristic in the context of users performing tasks with a product in a specific environment (Bevan, Kirakowski & Maissel, 1991)

### Usability (ISO 9241)

#### Effectiveness

The accuracy and completeness with which specified users can achieve specified goals in a particular environment

#### Efficiency

The resources expended in relation to the accuracy and completeness of goals achieved

#### Satisfaction

The comfort and acceptability of the work system for its users and other people affected by its use



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## Literature review on the existing assessment of usability/satisfaction with HMI

### Review of the existing methods:

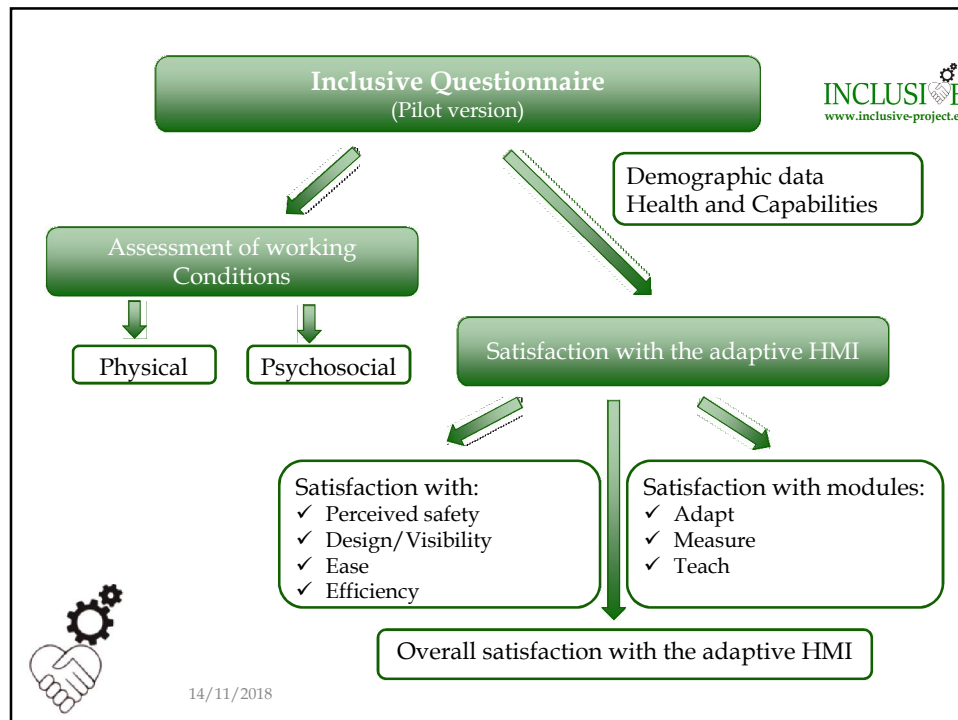
- The Subjective Workload Assessment Technique (SWAT)
- The Computer User Satisfaction (CUS),
- The User Information Satisfaction (UIS),
- The Questionnaire for User Interaction Satisfaction (QUIS),
- The System Usability Scale (SUS)
- The Cognitive Walkthrough (CW)
- The Heuristic Walkthrough (HW)
- The Collaborative critique (CC)
- The USE Questionnaire
- The Questionnaire for User Interaction Satisfaction (QUIS)
- IBM Questionnaires:
  - ✓ The After -Scenario Questionnaire (ASQ)
  - ✓ The Printer Scenario Questionnaire (PSQ)
  - ✓ The Post-Study System Usability Questionnaire (PSSUQ)
  - ✓ The Computer System Usability Questionnaire (CSUQ)



Questionnaire items have been collected from the literature and brain storming

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## Physical working conditions

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Environmental physical conditions (noise, dust, etc.)  
Physical workload (body position, repetitive movements, etc.)

Response 4-point scale:  
☐ Most of the time   ☐ Sometimes   ☐ Rarely   ☐ Never

**I. Working Conditions**

**PHYSICAL WORKING CONDITIONS**

1. During work are you frequently exposed to difficult conditions such as:

a) Excessive Noise	<input type="checkbox"/> Most of the time <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
b) Extreme Temperatures	<input type="checkbox"/> Most of the time <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
c) Dust	<input type="checkbox"/> Most of the time <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
d) Too bright/too dark light	<input type="checkbox"/> Most of the time <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never

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## Psychosocial working conditions

- Items chosen from the Copenhagen Psychosocial Questionnaire II (COPSOQ II; Pejtersen et al., 2010) scales:
  - ☐ Quantitative demands (e.g. Do you have enough time for your work tasks?)
  - ☐ Cognitive demands (e.g. Do you have to keep your eyes on a lots of things while you work?)
  - ☐ Tempo, work pace (e.g. Is it necessary to keep working at a high pace?)
  - ☐ Influence at work (e.g. Can you influence the amount of work assigned to you?)
  - ☐ Support from colleagues (How often do you get help and support from your colleagues if you need it?)
  - ☐ Support from supervisors (How often can you get help and support from your nearest superior if you need it?)
  - ☐ Community at work (e.g. Do you feel part of a community at your place of work?)
  - ☐ Possibilities for development (e.g. Can you use your skills or expertise in your work?)
  - ☐ Meaning of work (e.g. Do you feel motivated and involved in your work?)
  - ☐ Rewards, recognition (e.g. Is your work recognized and appreciated by the management?)
  - ☐ Job insecurity (e.g. Are you worried about new technology making you redundant?)
  - ☐ Justice and respect (e.g. Is the work distributed fairly?)
  - ☐ Inclusiveness (e.g. Is there space for employees with various illnesses or disabilities?)
  - ☐ Job satisfaction (How pleased are you with your job as a whole, everything taken into consideration?)
- 28 items;
- 5-point response scale



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## Satisfaction with the adaptive HMI in general

- Included total 41 items
  - ☐ Safety – 9 items
  - ☐ Design/Visibility – 17 items (e.g. „Characters are easy to read”)
  - ☐ Ease – 9 items (e.g. „The system is easy to learn”)
  - ☐ Efficiency – 6 items (e.g. „The HMI helps me to more efficiently cooperate with the machine/robot”)
- 5-point response scale: 0- to a very small extent, 4 – to a very large extent;
- Additional response „Not applicable” in the pilot version.

**SAFETY**

0 – To a very small extent  
1 – To a small extent  
2 – Somewhat  
3 – To a large extent  
4 – To a very large extent  
5 – Not applicable

To a very small extent  
To a small extent  
Somewhat  
To a large extent  
To a very large extent  
Not applicable

According to your opinion:  
1. Safety functions (Emergency stop, guard locking functions, indications and alarms) are:

a) Clearly identifiable	0	1	2	3	4	5
b) Clearly visible	0	1	2	3	4	5
c) Readily accessible	0	1	2	3	4	5



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Type of meeting

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## Satisfaction with the modules of adaptive HMI

- Included total 31 items:
  - ☐ Adapt module – 9 items (e.g. „I can get started easily on the system’s newly added functions”)
  - ☐ Measure module – 4 items (e.g. „I feel it can challenge my physical comfort”)
  - ☐ Teach module – 18 items (e.g. „The way the on-line training system presented the information was adapted to my current work task”)
- 5-point response scale: 0- to a very small extent, 4 – to a very large extent;



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## Overall Satisfaction with the adaptive HMI

Regarding the adaptive HMI in general. How pleased are you with it as a whole, everything taken into consideration?

☐ Very satisfied   ☐ Satisfied   ☐ Neither satisfied, nor unsatisfied   ☐ Unsatisfied   ☐ Very unsatisfied

If you are satisfied, what do you like the most in the adaptive HMI?

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What should be improved in the adaptive HMI?

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The questionnaire with the detailed description can be found in the Deliverable 6.1 „Report on methods and tools to measure worker satisfaction“:

<http://www.inclusive-project.eu/deliverables>



**THANK YOU FOR YOUR ATTENTION**



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