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An Industrial Social Network for Sharing Knowledge among Operators

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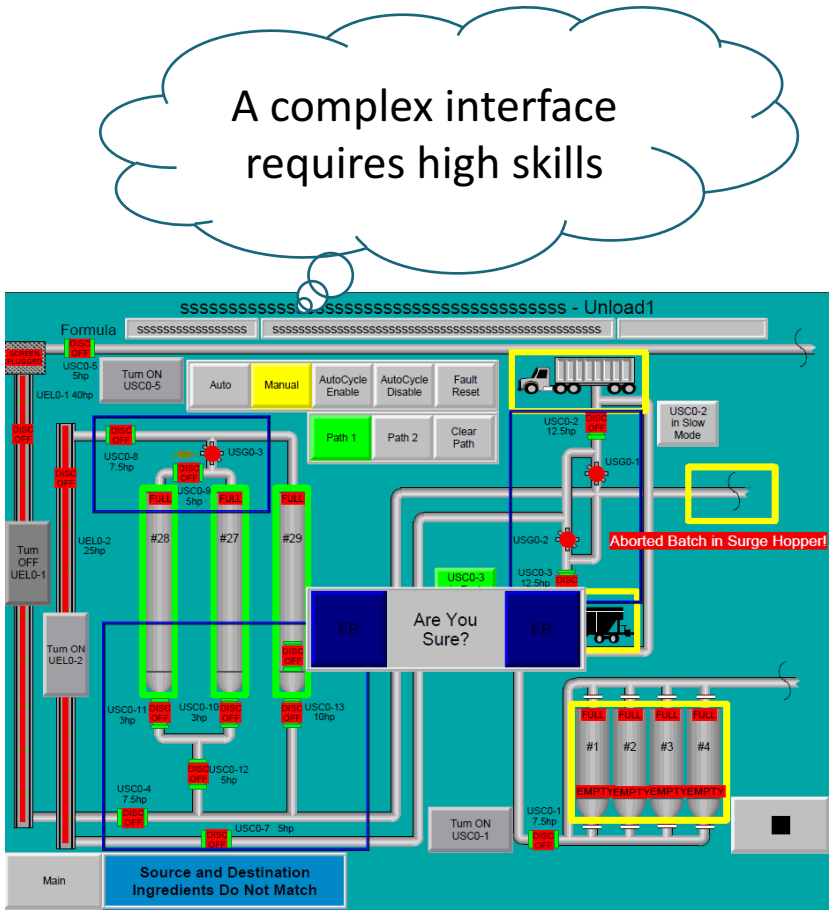
University of Modena and Reggio Emilia

Reggio Emilia, Italy

INCOM 2018

Background

- Machine interfaces are **critical** in machine performances
- **Poor** interfaces lead to poor processes
- Today machine interfaces have **static** presentation
- Different persons with different skills, cultural backgrounds, and cognitive capabilities might take great **advantage** by personalized interfaces

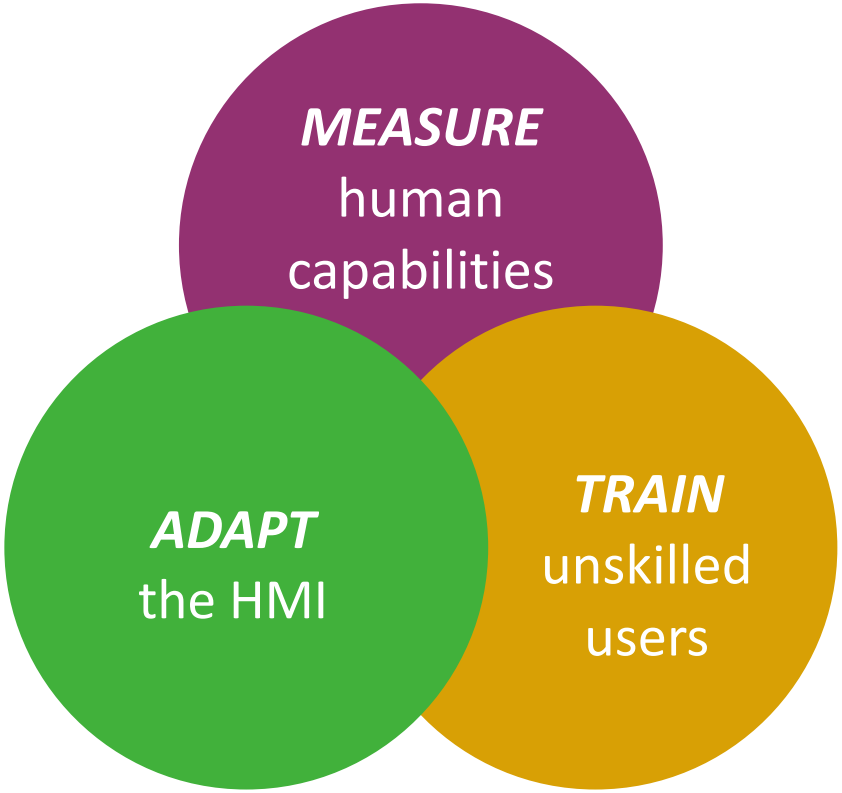


MATE approach

Measure, Adapt, and TEach

Devising complex automatic or robotic solutions that

- ***measure*** the current operator's status and capability,
- ***adapt*** the interaction accordingly, while
- providing him or her with the necessary ***training*** and support



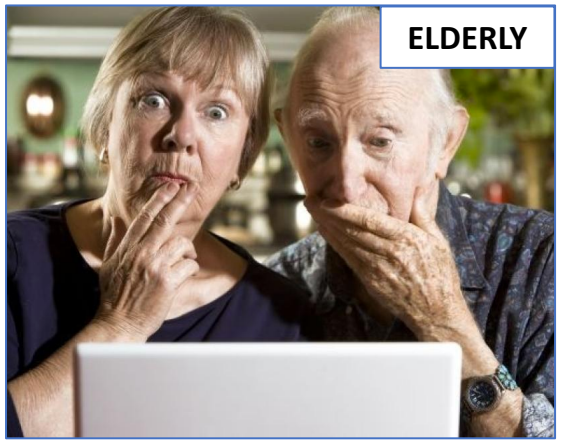
The INCLUSIVE project

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 723373.

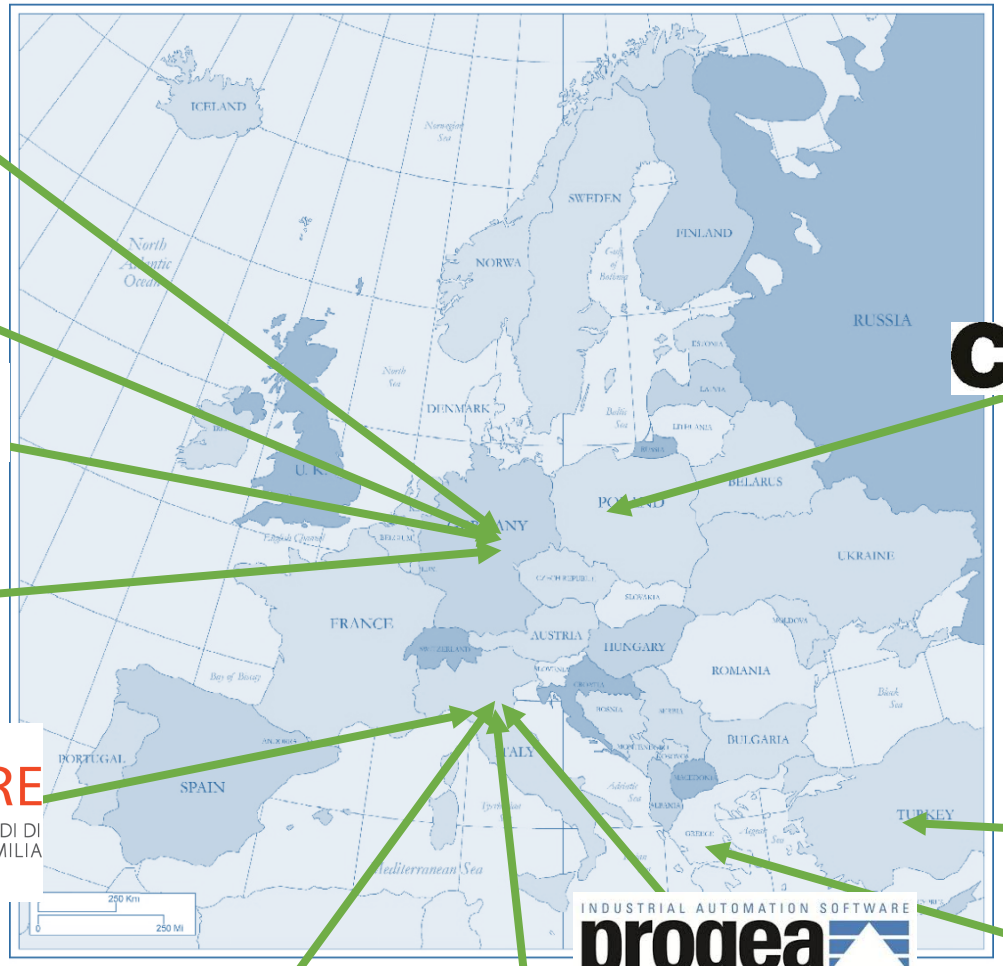
- The INCLUSIVE project drives a new concept of interaction in which

INCLUSIVE aims at developing an ecosystem of innovations driven by human factor analysis applied to industrial use cases

The goal is to create a **human-machine interaction system for complex robotic or automatic solutions**, which can be used also by **vulnerable users**



Consortium



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CIOP PIB

SILVERLINE

INDUSTRIAL AUTOMATION SOFTWARE progea

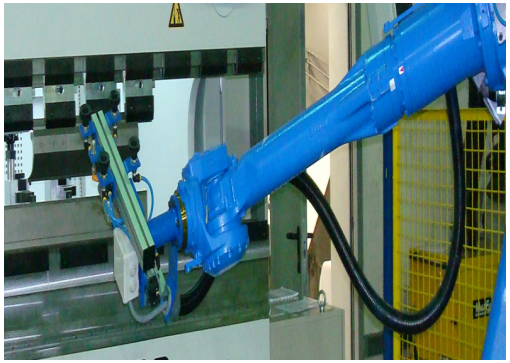
GIZELIS ROBOTICS

scmgroup
The specialists in the wood industry

ASTER

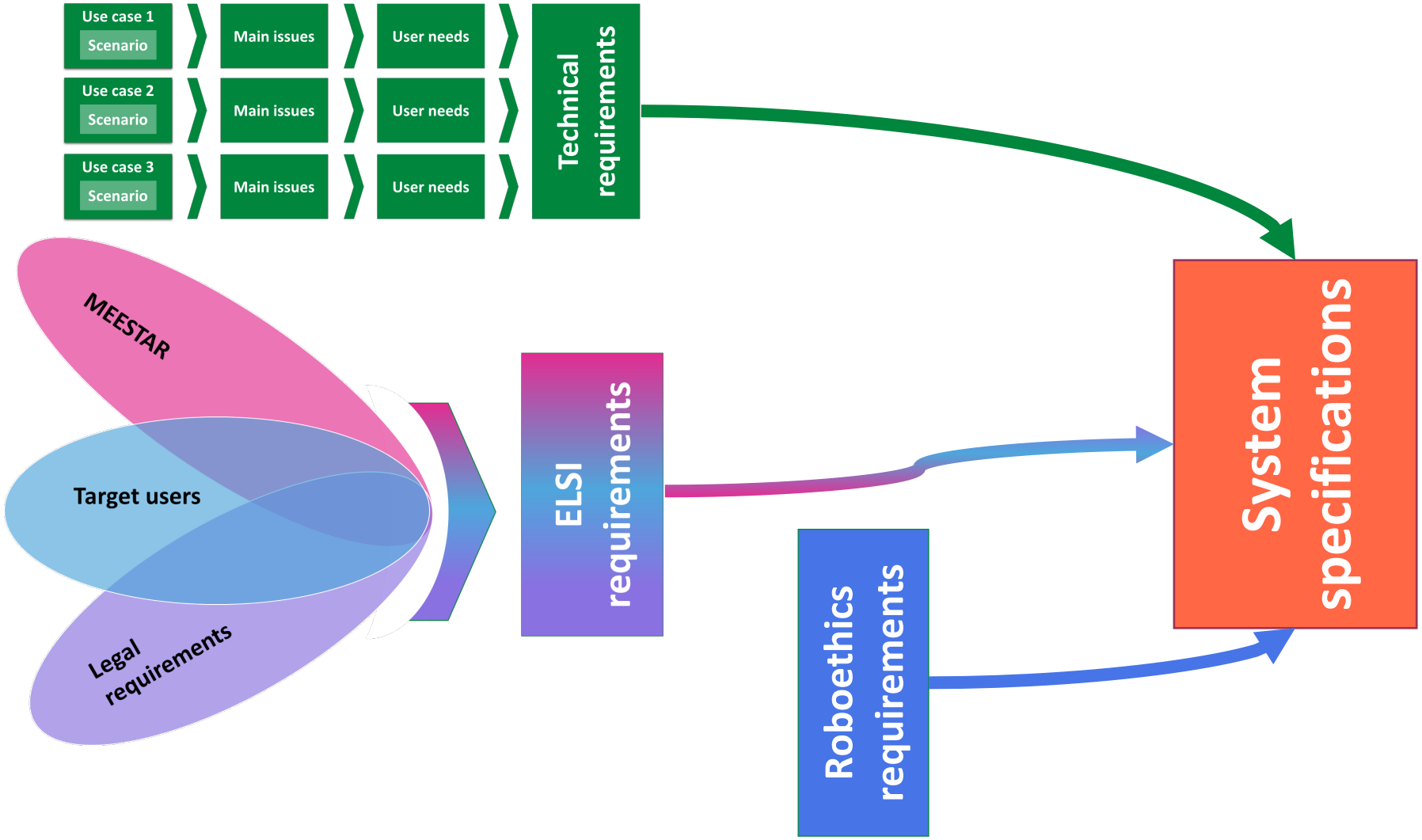
Analysis of the use cases

- To derive methodological considerations that have general validity we started from real use cases that depict the scenario of human-machine systems currently utilized in industrial environments
- We focused on three specific industrial case studies, which are representative of a wide area of interest for industry in Europe



1. **machinery for woodworking**, typically used in small companies run by elderly artisans
2. **robotic solutions to automatize the assembly of appliances**, currently done manually
3. **bottling automatic machines** used in industrial plants

Anthropocentric analysis of requirements

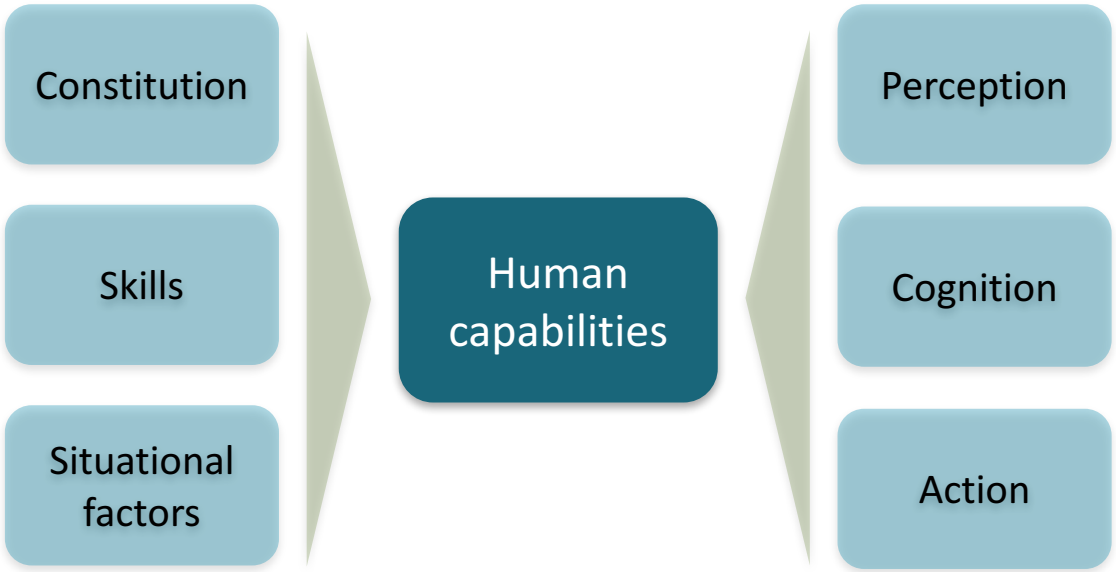


Design requirements for a MATE system

Design Requirements		
Technical Requirements	**ELSI Requirements**	**ROBETH Requirements**
T-R1: The interface adapts to the skill level of the operator.	ELSI-R5: The system should meet all relevant safety criteria.	ROBETH-R1: The operator should be protected from harm caused by the system.
T-R2: The system can be used by low-educated operators.	ELSI-R7: The system should not cause injuries by means of inductive-measuring technology.	ROBETH-R2: The operator has the right to refuse to be cared for by the system.
T-R3: The system can be used by physically and cognitively impaired operators.	ELSI-R3: The system does not use collected data to any employee's disadvantage.	ROBETH-R3: When using the system, the operator's liberty should be protected.
T-R4: The system can be used by people with fewer computer skills.	ELSI-R4: The system depicts relevant user requirements and prevents discrimination.	ROBETH-R4: The operator should be protected from any privacy breaches committed by the system.
T-R5: The system enforces the correct procedures.	ELSI-R2: The system considers anonymized personal data.	ROBETH-R5: The operator personal data processed by robots should be protected
T-R6: The operator feels satisfied with the interaction experience.	ELSI-R6: The system should not distract the operator.	ROBETH-R6: The operator should be protected from the risk of manipulation by the system.
T-R7: Interaction with the system generates a low level of stress for the operators.	ELSI-R1: The system does not cause strain to the operator.	ROBETH-R7: The dissolution of social ties should be avoided.
		ROBETH-R8: All operators should have equal access to advances in robotics and automation.
		ROBETH-R9: Human access to enhancement technologies should be restricted.

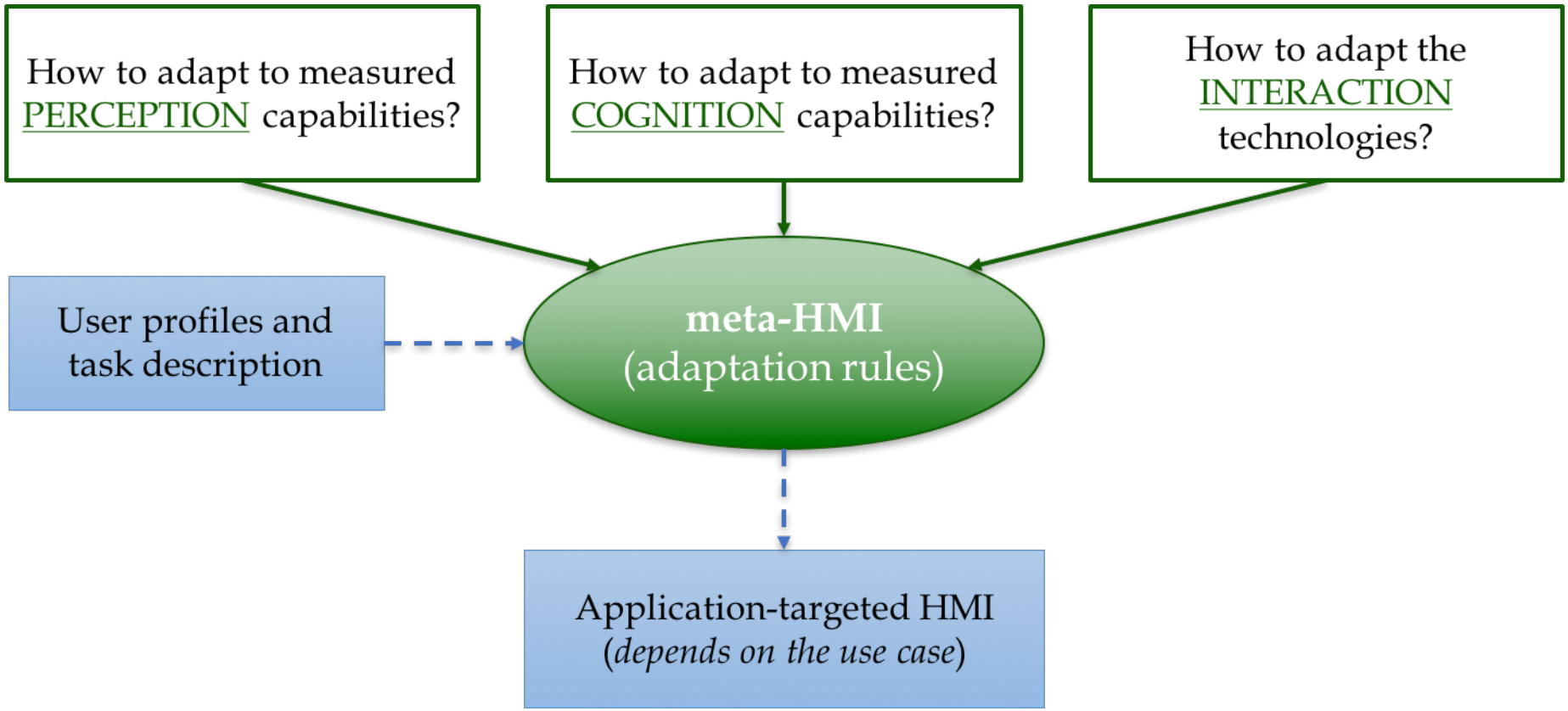
Villani, V., Sabattini, L., Czerniak, J. N., Mertens, A., & Fantuzzi, C. (2018). MATE Robots Simplifying My Work: The Benefits and Socioethical Implications. *IEEE Robotics & Automation Magazine*, 25(1), 37-45.

Methodology: *Measure* module

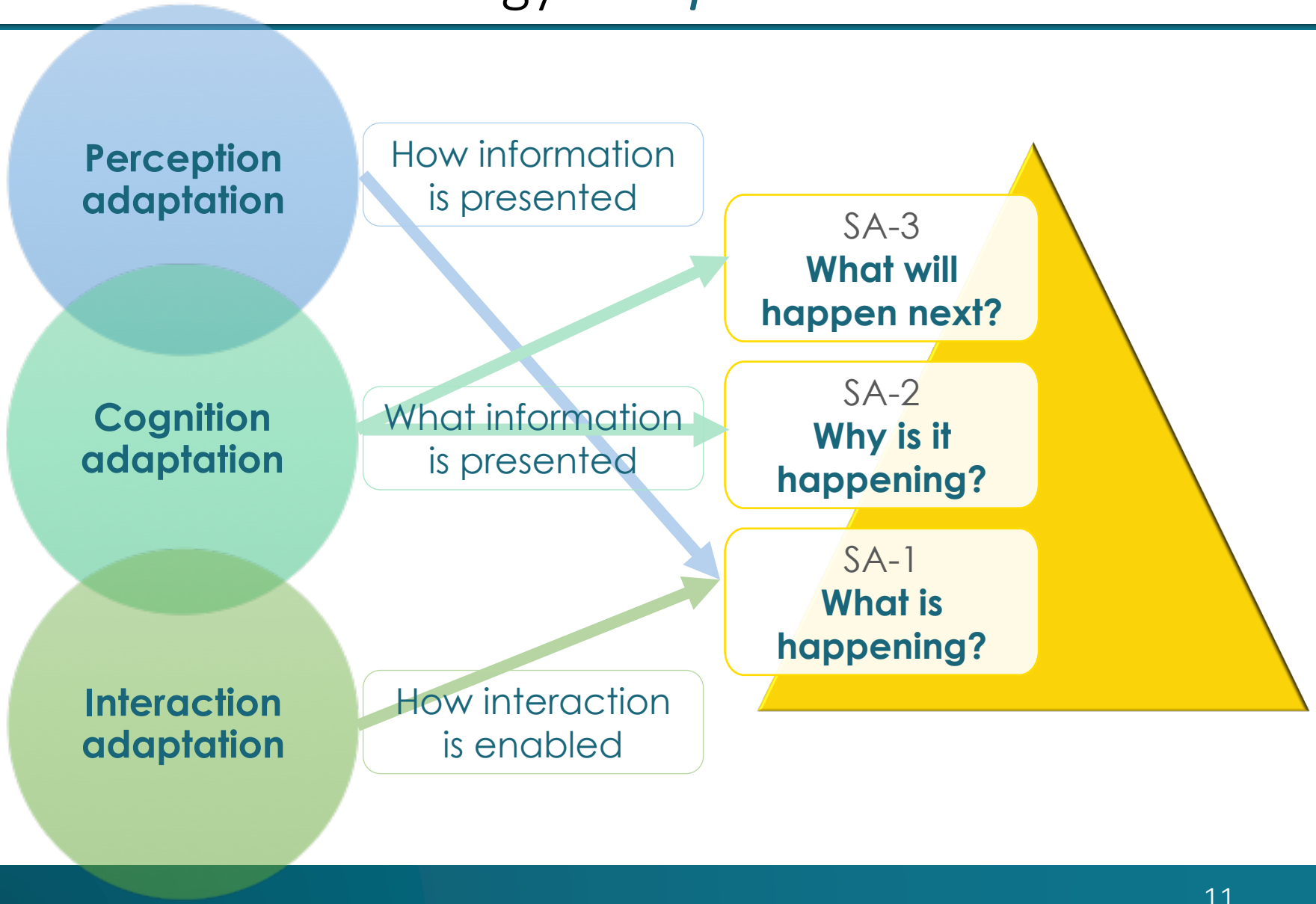


- A priori measurement: offline assessment in terms of questionnaires and tests for demographic questions, perceptive, cognitive and motoric capabilities
- Real-time measurement: physiological indicators for mental strain (e.g., pupil diameter, blinking rate, skin conductance, cerebral activity, body temperature, hormonal balance and heart rate)
- Longitudinal measurement: performance indicators, e.g. time for decisions, executions steps for the task, mistakes, and redundancies

Methodology: *Adapt* module

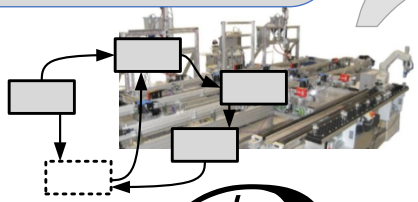


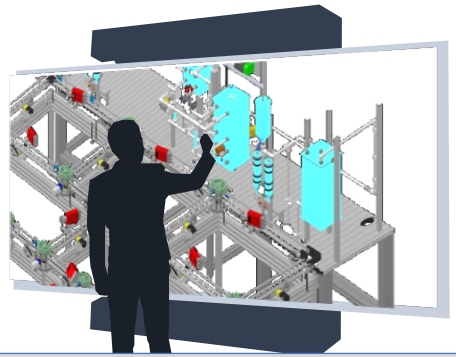
Methodology: *Adapt* module



Methodology: *Teach* module

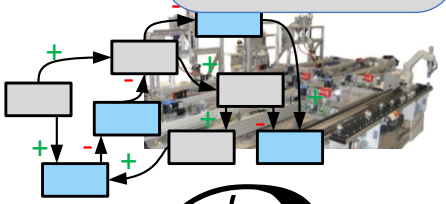
Basic mental model of operator (dependent on education, skills, experience,…)

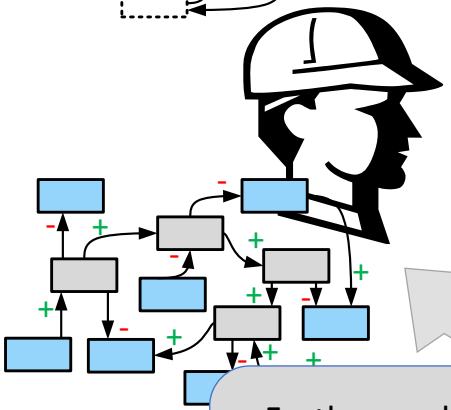




Off-line training in virtual environment (training scenarios adapted to abilities of the operator)

Evolved mental model after off-line training

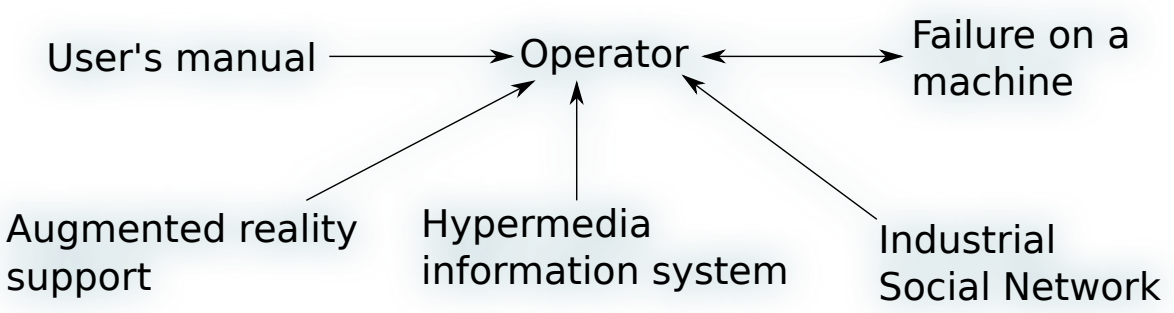




Further evolving mental model enables operator to conduct more complex tasks

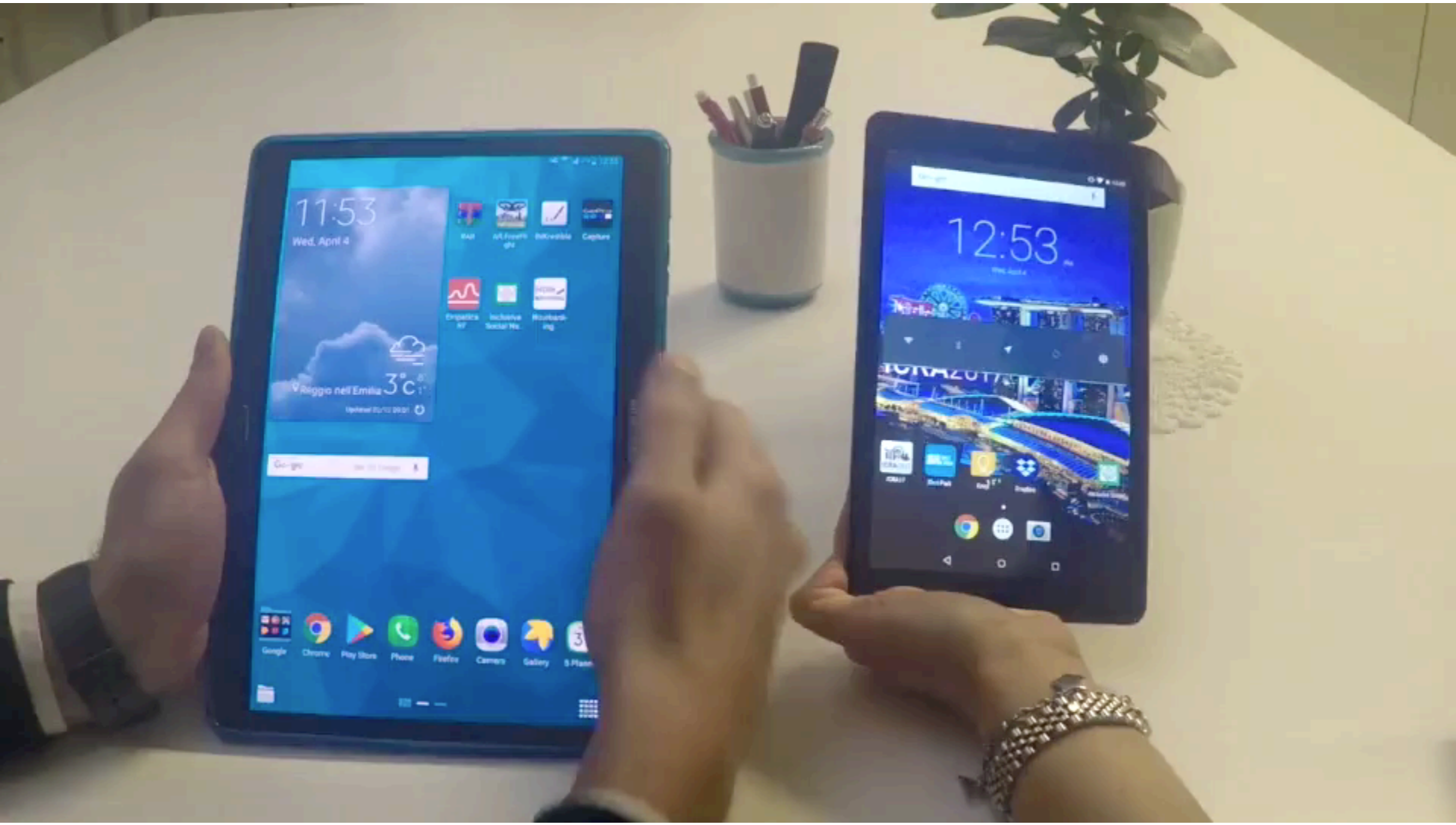
On-line support through training sessions and contextual help (industrial social network), based on classified errors (skill, rule, or knowledge based)

Industrial Social Network



- It allows to ask for assistance on specific errors and issues that are not covered by AR and VR teaching support
- A message can be sent to colleagues and other workmen
- Messages are delivered selectively based on the skills required to solve the current problem
- Multimedia (videos, images, audio recs) can be attached to a message
- Private messages can be sent to another member of the social network (*in the case the user knows who can be help her/him with the current issue*)

Industrial Social Network Demonstrative Video



Future works

- (…*A better video*…)
- Implementation in real use cases
- Integration in the *Teach* module
- Tests with end users

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