ACE Factories
humAn CEntred Factories

Human-centred Factories

- The vision and development paths

Eija Kaasinen, VTT Technical Research Centre of Finland Ltd

Coordinator, Factory2Fit

Factories of the Future Community Day,

Brussels June 27th, 2018

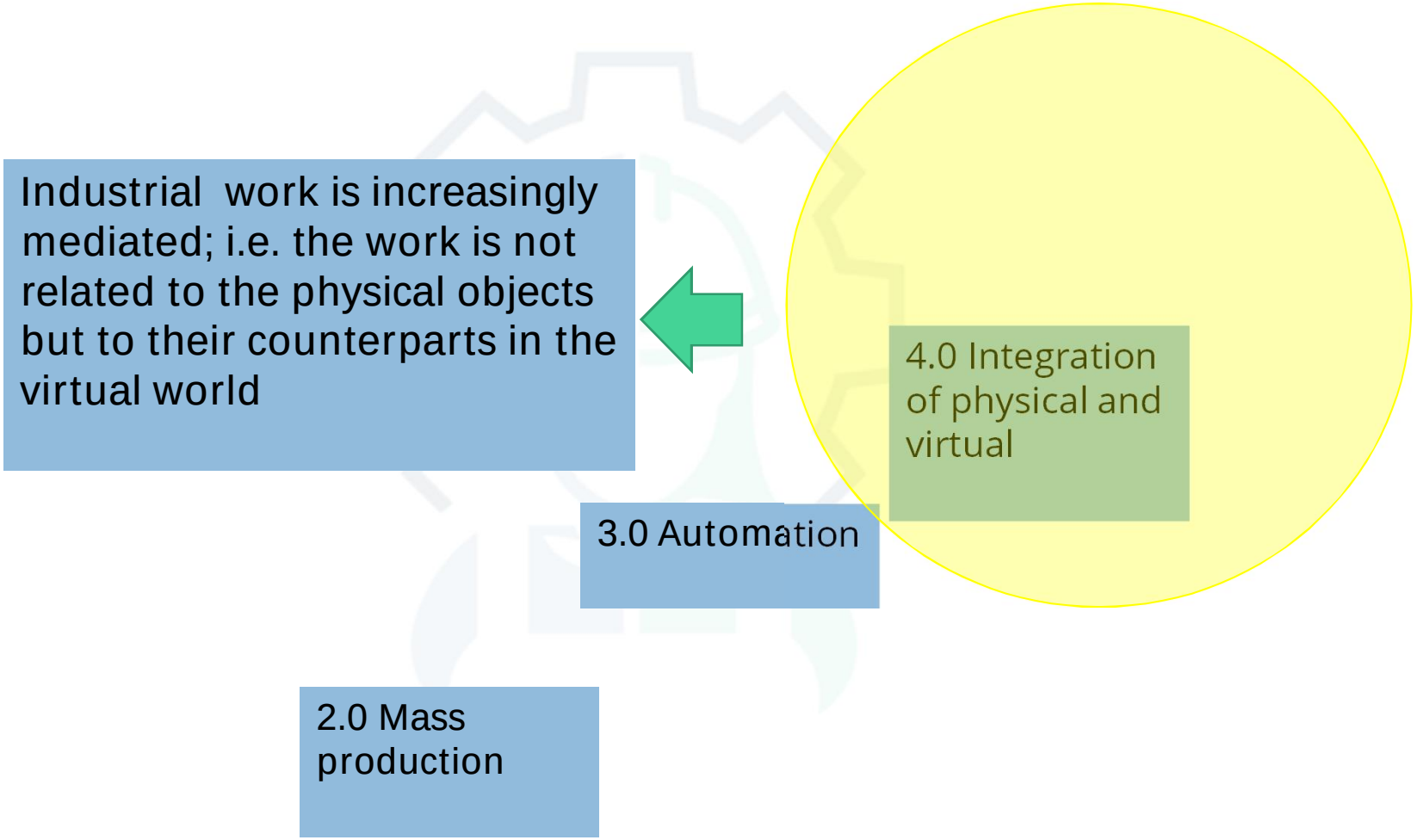
HumAn-CEntred Factories (ACE) cluster

- Networking cluster of all five FoF-4 projects
- Started 2017 with dissemination collaboration
- Focus extending towards research collaboration

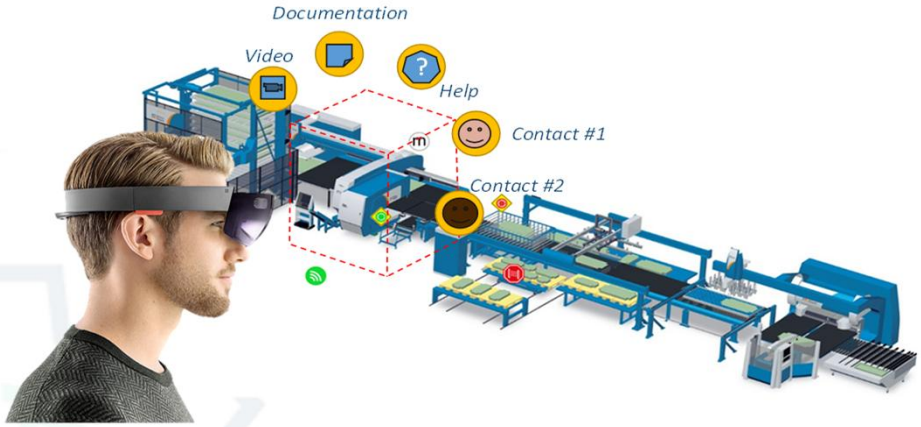
Outline of the presentation

- Industry 4.0 and Operator 4.0
- Vision of human-centred factories
- Five development paths towards human-centred factories
- Examples of industrial cases
- Foreseen impacts of human-centred factories

Industry 4.0


Industrial work is increasingly mediated; i.e. the work is not related to the physical objects but to their counterparts in the virtual world
4.0 Integration of physical and virtual
3.0 Automation
2.0 Mass production

Factory Operator 4.0



Opportunities

- More interesting and versatile jobs
- Work is physically less demanding
- Individual preferences can be taken better into account
- Remote work is increasingly available

Challenges

- How current operators can be supported in learning new skills
- How to tempt young talented people to choose factory work as the career
- Mentally demanding work tasks
- How to maintain the understanding of the physical world and work

Vision of a Human-Centred Factory

- Humans and automation take advantage of each others strengths
- Automated factory systems adapt to the individual skills, capabilities and preferences of the worker
- Workers get encouraging feedback of their well-being and competence development
- Workers take responsibility of their own competence development with adaptive on-the-job learning tools
- Human operators and the factory have a symbiotic relationship; operators take ownership of their work with engaging training, knowledge sharing and participatory design tools
- Parallel to new technical solutions, new procedures, working practices as well as safety requirements and conditions are quickly co-created and assimilated.
- Cooperation and easy access to shared knowledge supports workers to embrace changes

Development paths towards Human-Centred Factories

- Get insight of operator status
- Adapt the automation according to the operator status and the production situation
- Support continuous competence development on the operator's own pace
- Support knowledge sharing between workers
- Let the operators participate in designing and planning their own work

Get insight of operator status

Utilise knowledge on:

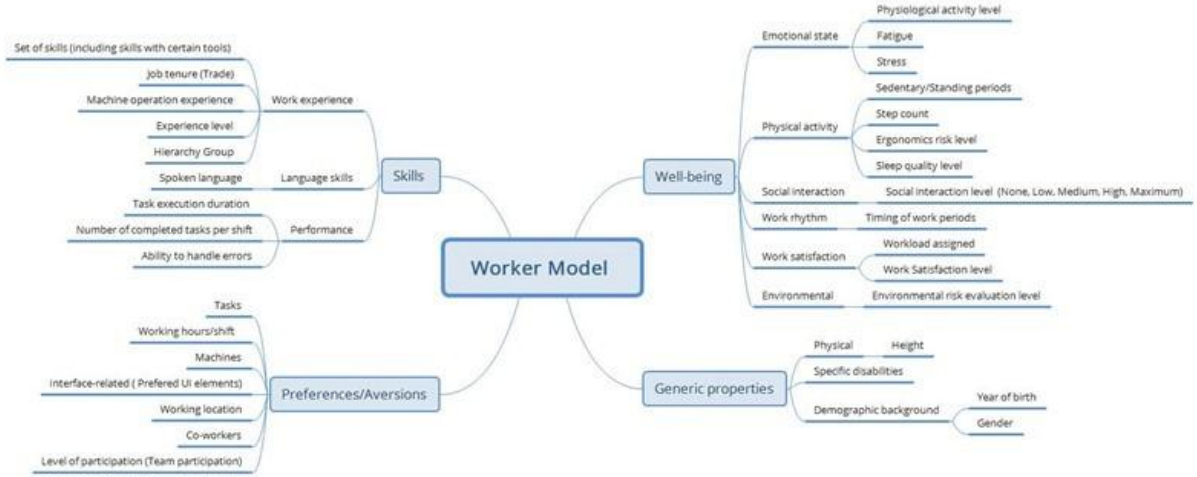
- Age and gender
- Work role
- Education level
- Capabilities
- Disabilities
- Skills

Ask:

- Work satisfaction
- Concentration level
- Preferences

Monitor:

- Cognitive load
- Physical load
- Well-being parameters
  - Resting heart rate
  - Pupil dilation
  - Steps
  - Sleep quality/tiredness
- Current work activity
- Environmental conditions



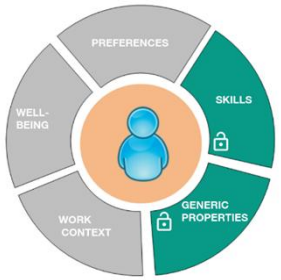
Get insight of operator status - but protect his/her privacy

FACTORY2FIT A4BLUE HuMan HUman MANufacturing INCLUSIVE MANUWORK

General Data Protection Regulation (GDPR) principles

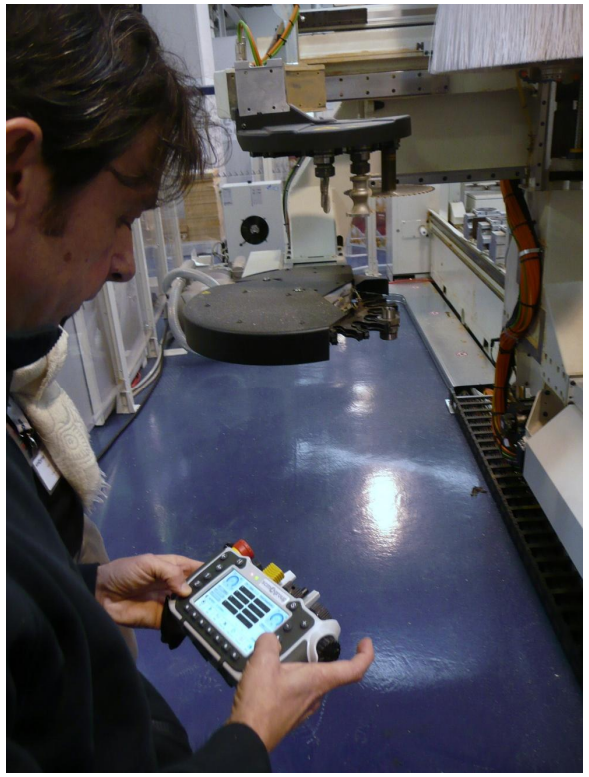
- Operators' information and data are treated and analysed anonymously
- Only such data is gathered that is needed in adaptation
- The operator can decide whether his/her data is gathered and can decide to which purposes it can be used
- The operator can decide who has access to his/her data

Ethics by design to contribute to ethically sound solutions that are accepted by users



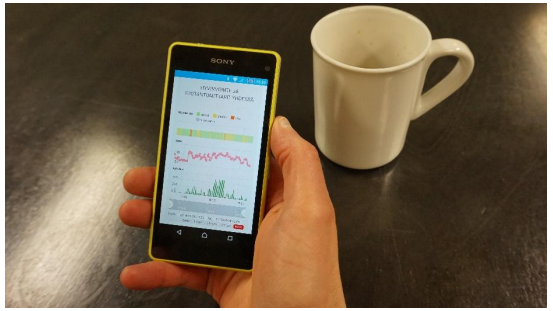
Adapt the automation according to the operator status and the production situation

- Optimal automation level
- Optimal information load
- Optimal human-machine interfaces
  - Multichannel interaction
- Physical and cognitive adaptation
- Intervention when the situation requires/allows
- Assistance tools



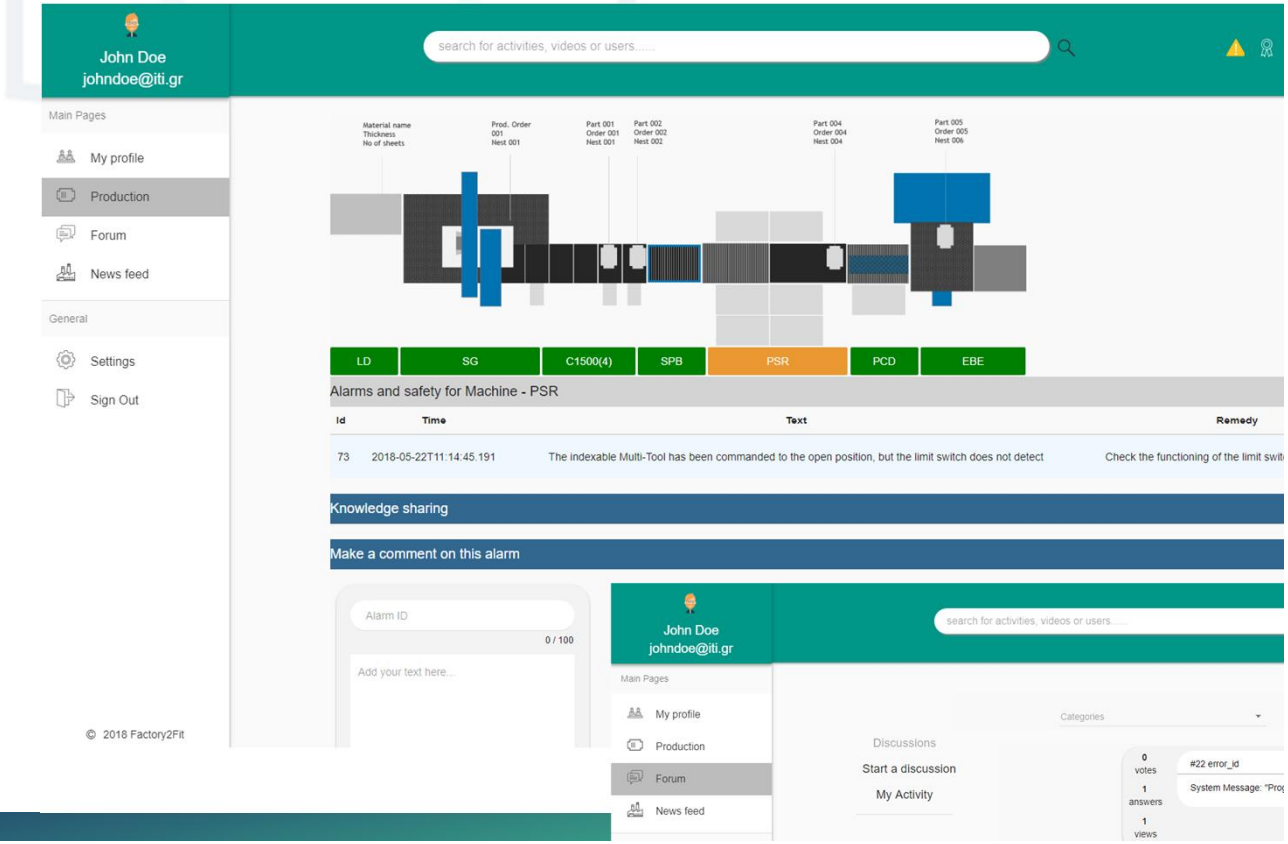
Support continuous competence development on the operator's own pace

- Encouraging feedback of work performance
- Virtual reality based hands-on training
- Augmented reality based on-the-job guidance and training



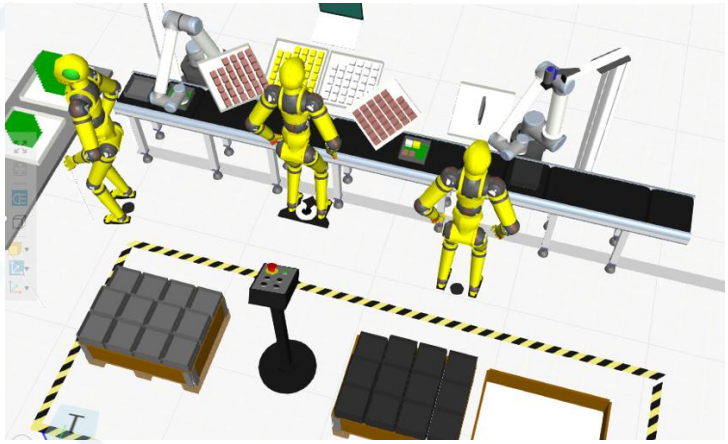
Support knowledge sharing between workers

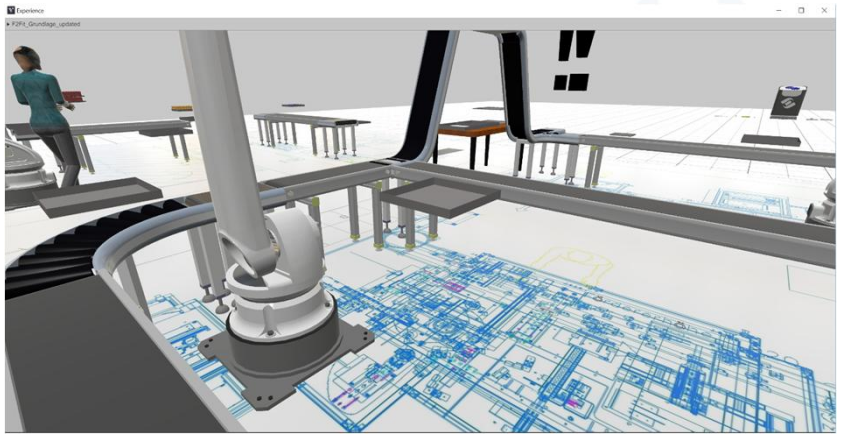
- Social media based knowledge sharing integrated to the production environment
- Industrial social network supporting training
- Collaborative knowledge management integrating knowledge from the field to the official information

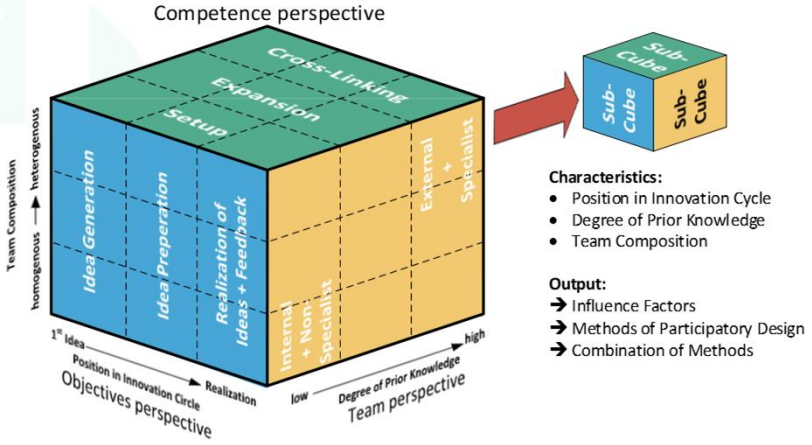


Let the workers participate in planning their own work

- Operator monitoring and assessment, complemented by operator reports, triggers needs to redesign the workplace to optimize the production
- Virtual reality based design environment to support co-designing the user experience and the functionality
- Method cube to support choosing suitable participatory design methods







Examples of industrial use cases

- Small artisans workshop: Human-machine interaction (HMI) supports the customization function of the woodworking machine for elderly or disabled customers' operators

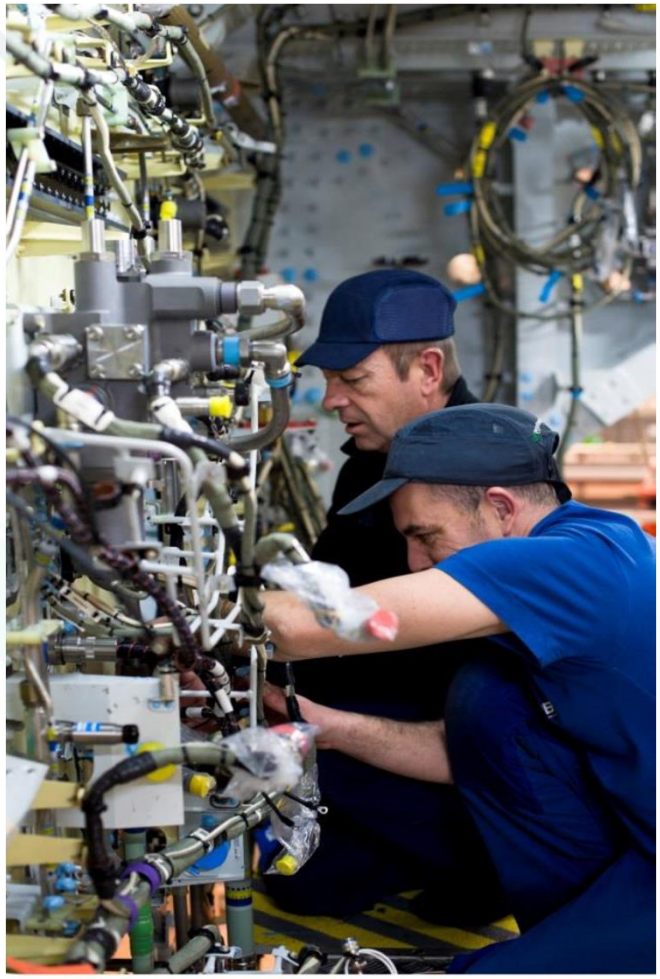
- Large manufacturing plants: HMI supports the management of complex machines in production lines, compensating variations in role, skills, cognitive capabilities, disabilities, education level and age of operators

- Companies introducing automation for the first time: HMI supports personnel without experience in managing the process of metal bending thanks to the on-line and off-line training and the social experts network

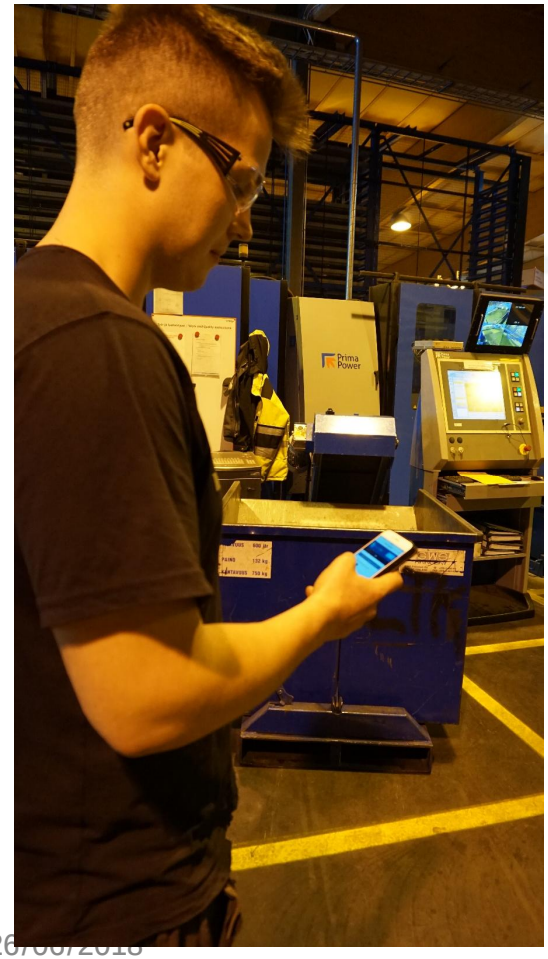
Examples of industrial use cases

- Aircraft manufacturer: Introduction of smart tools adapted to process and on-the-job guidance through AR in the assembly of complex hydraulic system.

- Aircraft components manufacturer: Deburring process improvement through introduction of safe automation in collaboration with humans and job guidance and training through AR in assembly of a retraction actuator.



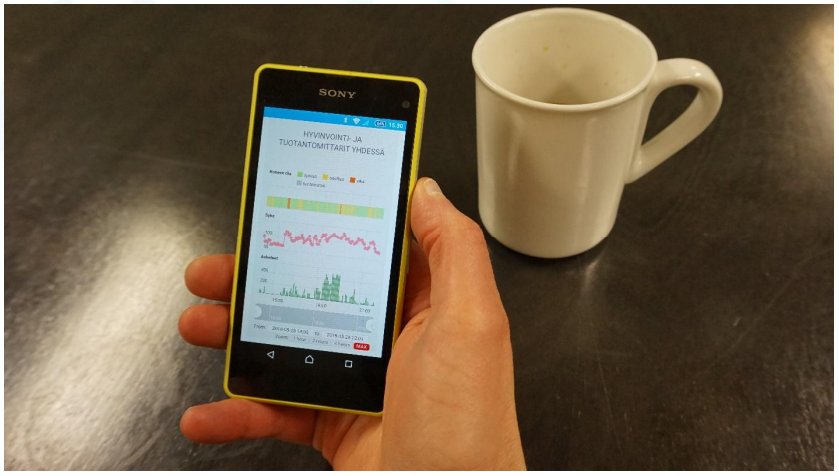
Examples of industrial use cases



Worker Feedback Dashboard application provides workers with positive feedback on their personal well-being at work and work performance. Only the worker him/herself has access to the data.

The operators of an automated Prima Power line at Stera Oy piloted the Worker Feedback Dashboard for 8 weeks at their daily work.

Self-monitoring of well-being at work and work performance supports individual on-the-job learning at a rate that suits the person in question



Foreseen impacts of Human-centred factories

- More flexible, inclusive and safe workplaces
- Empowered and engaged workers
- Increased automation and human performance
- Increased work well-being
- Better work conditions
- Ownership of processes, faster and better implementation of changes with worker involvement
- Increased productivity and improved quality
- Increased interest towards factory work as a career

www.ace-factories.eu

Thank you for your time!

eija.kaasinen@vtt.fi