Digitalization in an old, and not always «fashy» industry: Sociotechnical Change in Textile

28 September 2016, AAL Forum 2016, St. Gallen

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Agenda


Introduction
Sociopolitical relevance
Project SozioTex
Summary

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- Introduction
- Sociopolitical relevance
- Project SozioTex
- Summary & Outlook

RWTH Aachen University: facts & figures

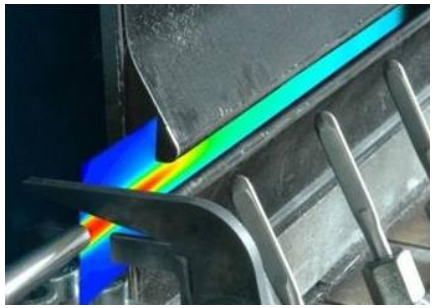
- 43,000+ students
  in 115 different course programmes
- 260 institutes
- 8,700 staff (65% scientists)
- 900 Mio. EUR budget
- 350 Mio. EUR external funds

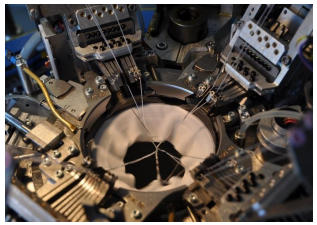
Institut für Textiltechnik at RWTH Aachen University (ITA)

Staff

- 110 researchers
- 65 non-scientific employees
- 200 student assistants
- 50 students graduate from ITA per year

ITA: textile research and know-how for...





- Mobility
- Building and Housing
- Healthcare
- Energy and Environment
- Information and Communication

- Production
- Materials
- Qualification

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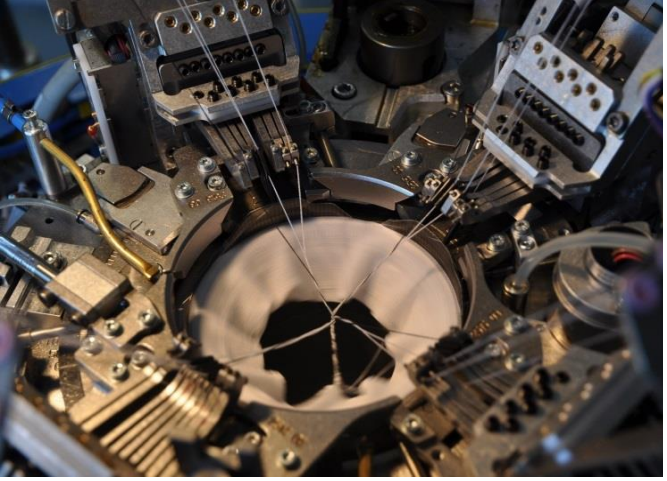

ITA: research on textile machinery

- Mechanical engineering
- Process and product development
- Quality management/ metrology
- Self optimizing machines
- Human-Machine-Interface
- Industry 4.0/ Industrie 4.0

CPPS & Digital Working Environments

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Social megatrends/challenges

Important challenge: workforce ageing

Change towards workforce diversity, esp. due to population ageing

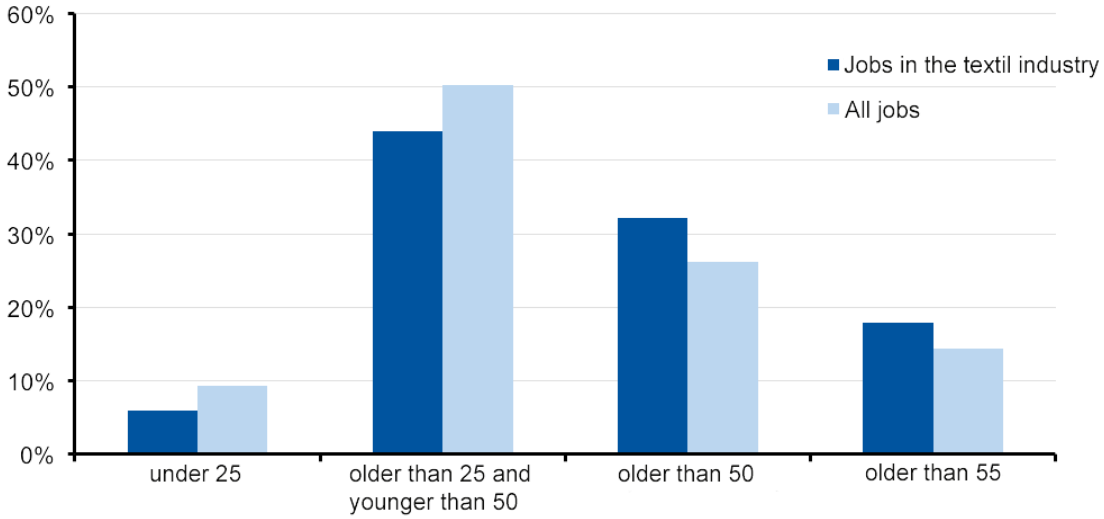

Chart based on statistics from the Bundesagentur für Arbeit (as of Dec 2014)

- 50% of employees in textile production are **50 years or older**
- **cognitive and physical deficits** = barriers in the production process
- Layoffs / conversions of older workers in restructuring: = **loss of knowledge (skills and experience)!**

Source: Löhrer et al. Soziotechnische Assistenzsysteme für die Produktionsarbeit in der Textilbranche

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Important challenge: digitalization

Digitalization adds to complexity concerning workforce ageing

Digital Natives

+

experienced employees

- grown up with smart electronics
- lack of knowledge/ experience

vs.

vs.

- often skeptical towards new technologies
- valuable know-how and experience

assistance needed!

assistance + knowledge transfer needed!

stock picture source: Diginomica.com, work-in-germany.de

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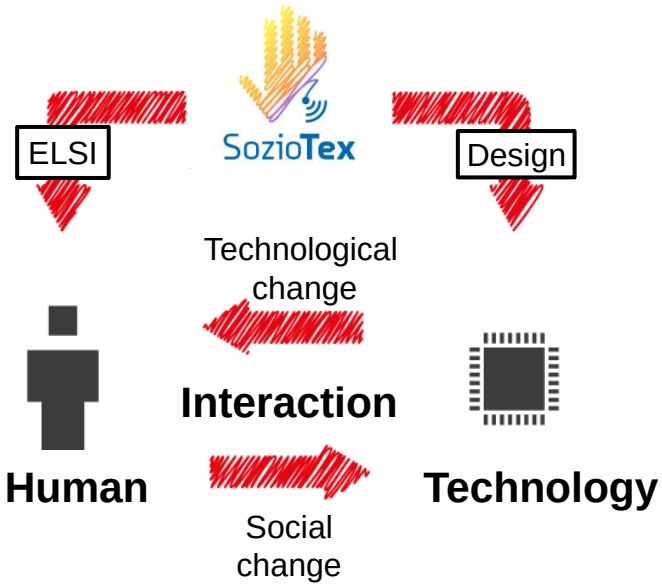
Project „SozioTex“

…an interdisciplinary research group:

- German BMBF*, Funding Priority „Interdisciplinary Development of Expertise Concerning Human-Machine Interaction with regard to Demographic Change“
- 2 mechanical engineers, 2 sociologists, 1 educational researcher
- Funding 11/2014-10/2019 (2,55 Mio. EUR)

Development and implementation of new production technologies as a combination of technical & social innovation



www.soziotex.de

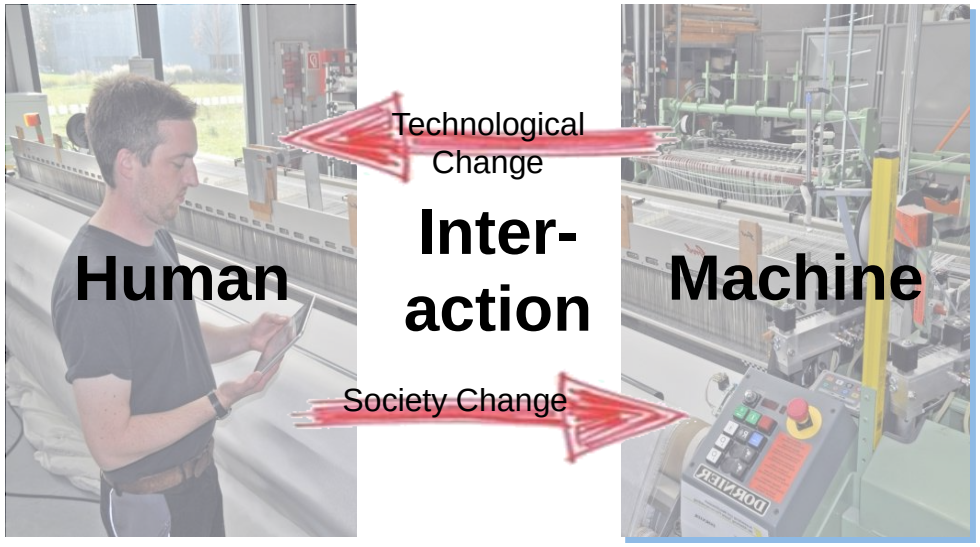
ELSI = Ethical, Legal and Social Implications

*BMBF means Federal Ministry of Education and Research

Project „SozioTex“

Research subject

- Productive use of the **growing diversity within the workforce:** older/younger employees, language barriers etc..
- To support employees with **cognitive and physical deficits.**
- **Archiving**, process and share **knowledge and experience**.



Source: SozioTex, own representation

Development and introduction of new socio-technical systems (**assistance systems**) for **competence conducive, supportive MTI**.

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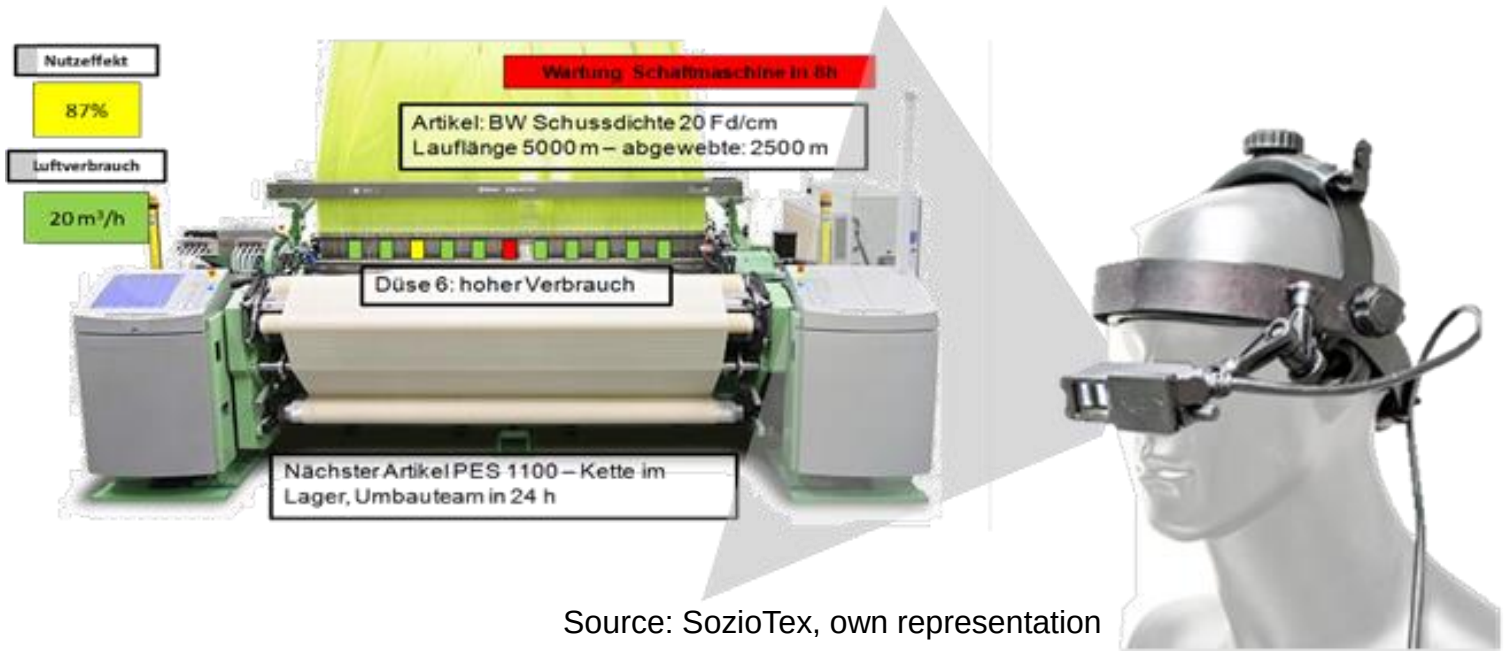
Project „SozioTex“

Research thesis:

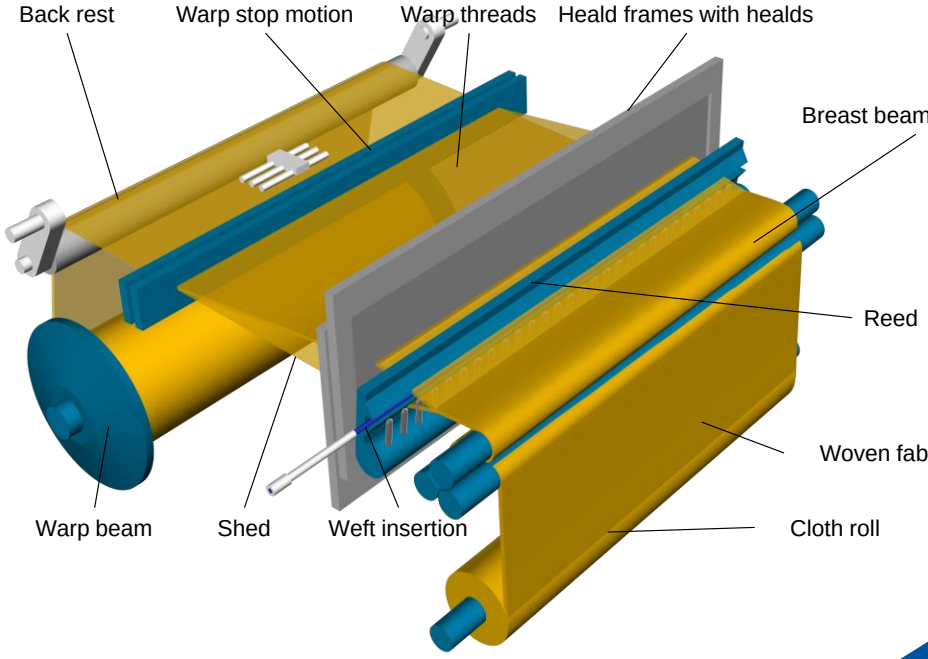
- **Individual needs** of an ever **more heterogeneous workforce** (for example age/ language barriers/ different education levels) must be supported **by assistance systems** in complex (e.g. digitalization) working situations.



Source: SozioTex, own representation

SozioTex Use Case: Weaving machines

Complexity of weaving machines in textile mills



variety of critical machine components and parameters

handling of different machine generations:

much knowledge required,
but not enough skilled workers!

assistance system!

Sources: Picanol N.V.; Velener Textil GmbH

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SozioTex approach: „Assistance Systems 4.0“

Assistence Systems „4.0“* should...

Dimensions

- serve as **intelligent** technical **tools** that **assist** in certain **situations/with certain actions** and help to **develop expertise** in the textile chain**
- **analyse** current and possibly **predict** future (machine) conditions
- support the **natural course of action of heterogeneous user groups** and achieve **physio-cognitive relief**

factual

temporal

social

... when **dealing with textile machines** that display increasing levels of automation in terms of Industry4.0

sociotechnical system***

• derived from VDE|DGBMT „Intelligente Assistenzsysteme“
** The current focus of SozioTex: production, weaving mills/weaving machines
*** gemäß Plattform I4.0, http://www.plattform-i40.de/glossar/soziotechnisches-system

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SozioTex approach: „Assistance Systems 4.0“

Exemplary applications for Intelligent assistance systems in everyday life:

Sources: aerzteblatt.de, medizin-und-technik.de, pflege.de; kfztech.de
experto.de

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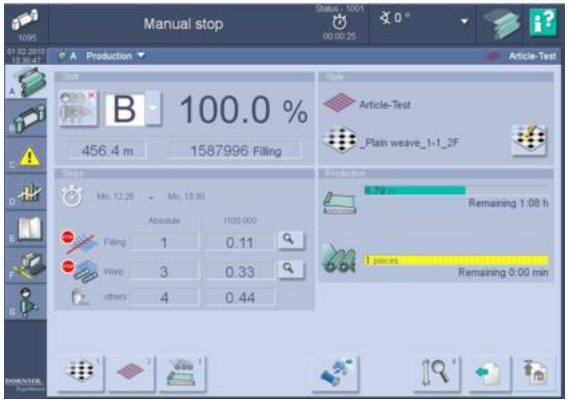
Assistance Systems in Textile

Exemplary human machine interfaces at *current* textile machinery:

Control panel for fabric take up © crealet AG

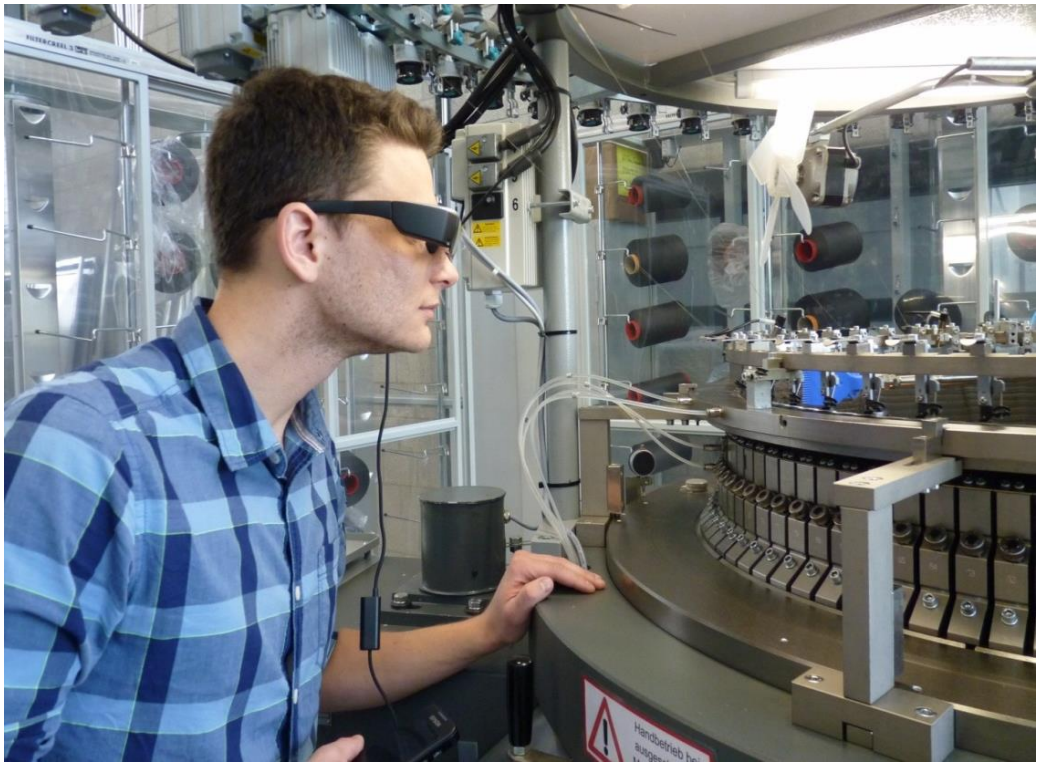
Warp beam lift; Source: genkinger.de



Production data system at a weaving machine © caderadesign

Assistance Systems in Textile

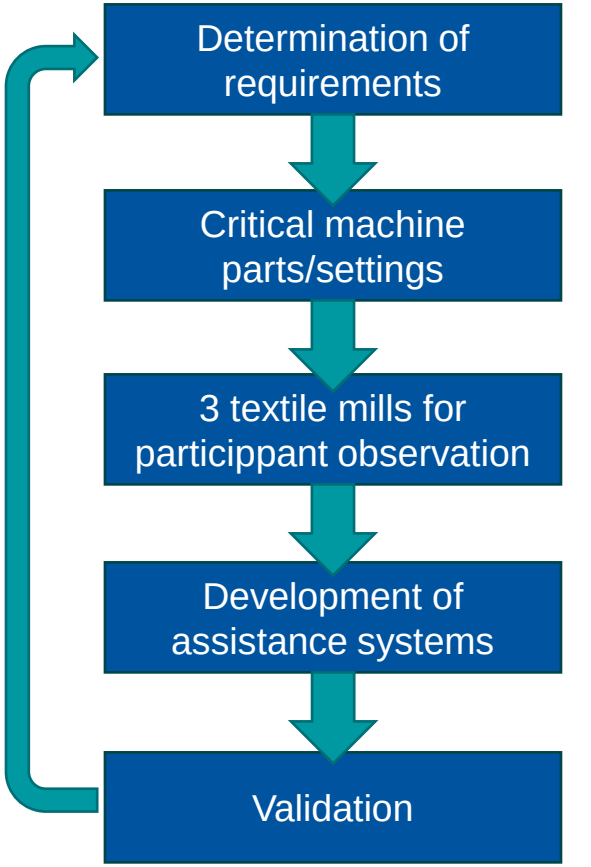
Exemplary human machine interfaces in the *future* textile industry:



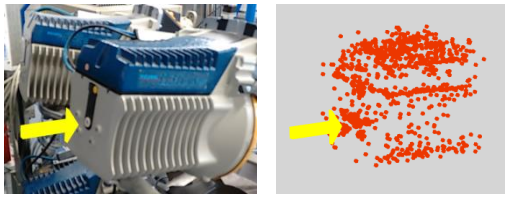
Textile machine‘s regulation by the use of a Smart Personal Device; Source: ITA

SozioTex Assistance Systems: procedure/methodology

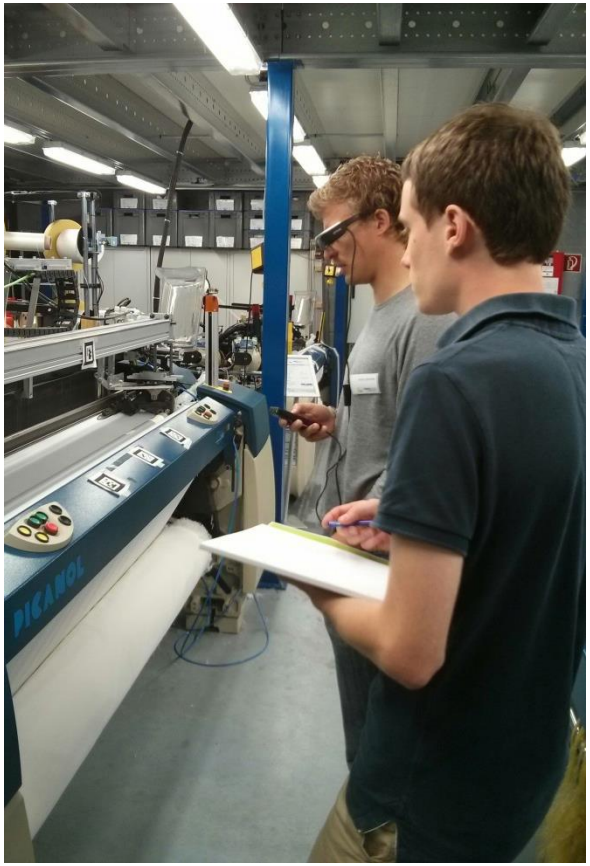
Iterative procedure within project course



Requirements catalog, requirements specification, functional specification



Implementation of AR*



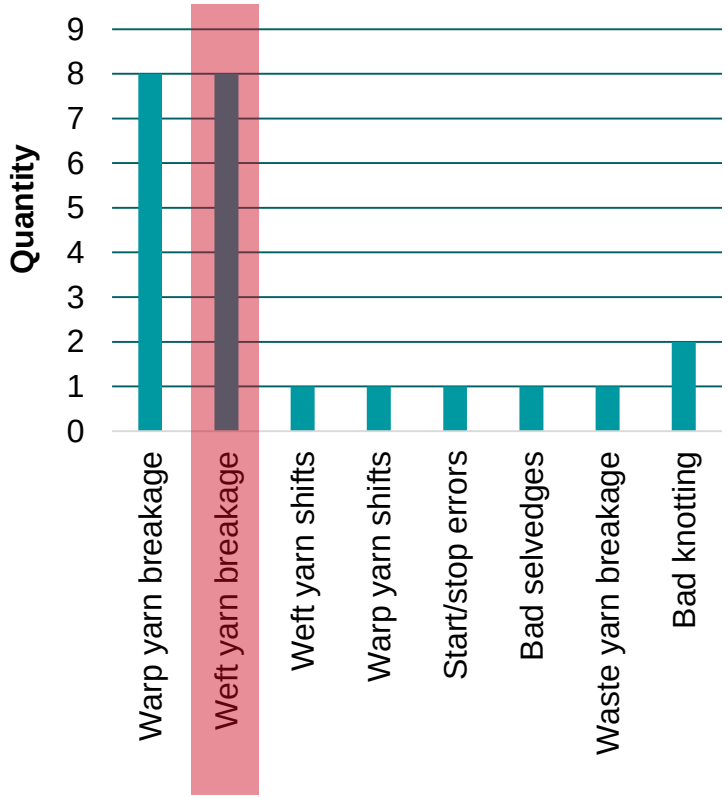
User test with AR app/smartglasses

*AR = Augmented Reality

SozioTex Assistance Systems: AR-based Prototype

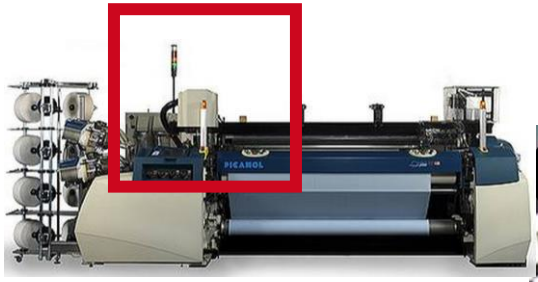
Empirical Survey: Questionnaire to 18 Weaving Mills [Extract]

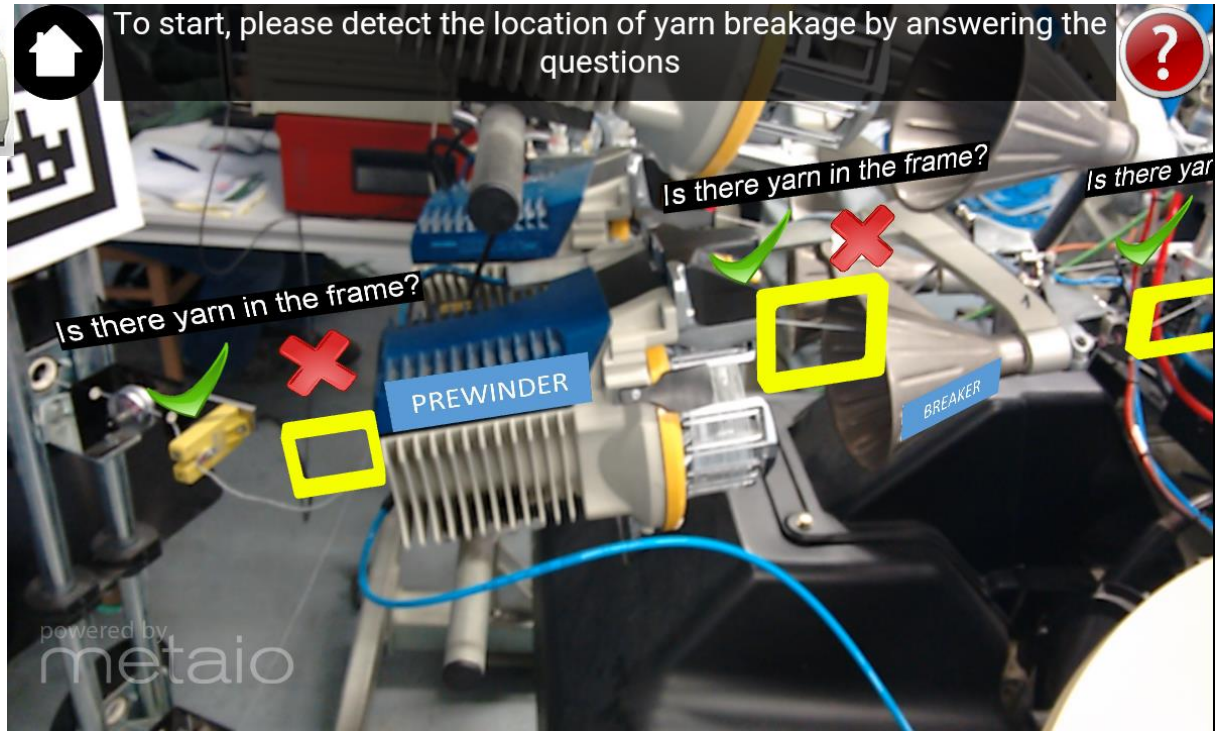
- What are the most critical machine components?



SozioTex Assistance Systems: AR-based Prototype

Prototype: Assistance based on Augmented Reality (Test-Case)

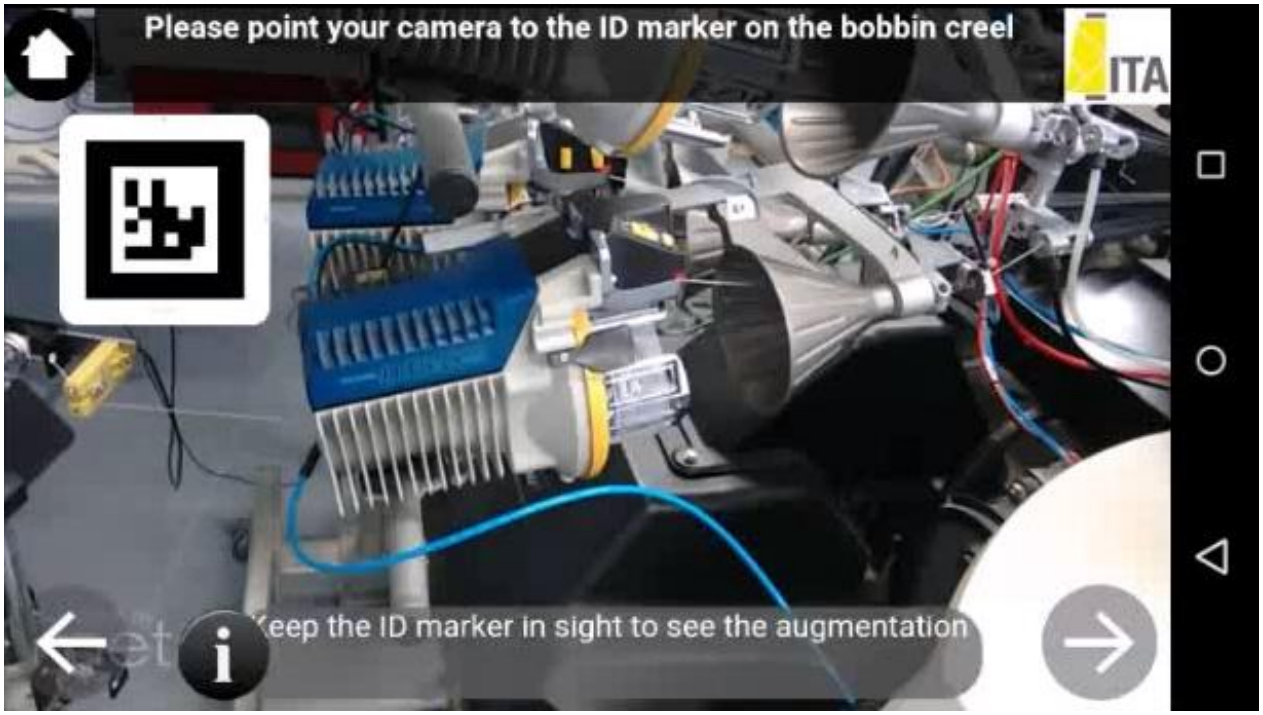




Screenshot of an assistance app for tablets and smartglasses

SozioTex Assistance Systems: AR-based Prototype

Prototype: Assistance based on Augmented Reality (Test-Case)



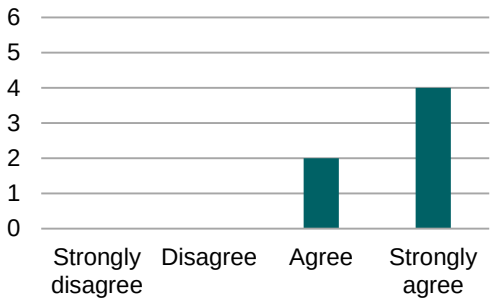
SozioTex Assistance Systems: user feedback (Prototype)

Validition with user tests

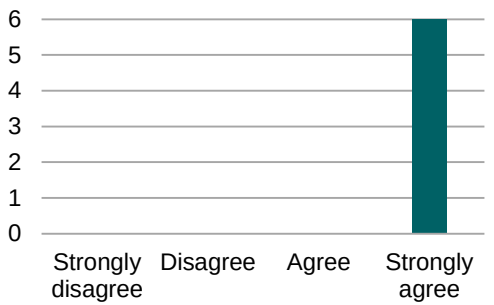
Tests with heterogenous user groups
(@lab- and production-scale)

Examples of questions and results

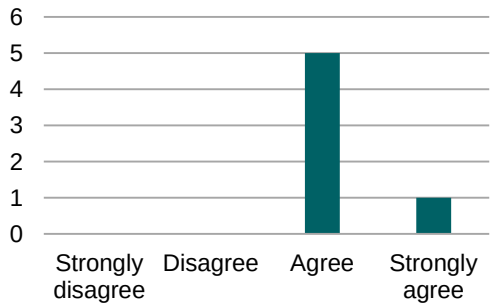
Is the built-in tutorial clear?



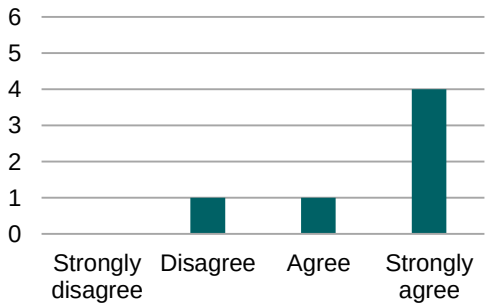
Is the augmentation useful to understand the instructions?



Do you think the application is easy to use for the first time?



Did you enjoy using the application?



Work in progress: *transfer* to process of warp-beam exchange

Extract from a video showing a warp-beam exchange

06 Kettwächter und Schäfte aushängen und Kettbaum webringen.wmv

SozioTex

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Physical/cognitive *stress* in 3 mills

Workplace and work process analysis (warp-beam exchange)

- 3 mills, Employees on the shop floor level were asked about their pysical/cognitive stress and their wishes about support during the warp-beam exchange.

- Main stress:
  - Noise
  - Dirt
  - poor posture
  - Ergonomics/work unit is not at the correct height
  - High concentration needed

Belastung	Beurteilung SozioTex	Häufigkeit W1 (%)	Häufigkeit W2 (%)	Häufigkeit W3 (%)
Lärm	Hoch	100	100	100
	Mittel	0	0	0
	Niedrig	0	0	0
Beleuchtung/Lichtverhältnisse	Hoch	0	14	0
	Mittel	100	72	0
	Niedrig	0	14	100
Staub/Dreck	Hoch	100	28	100
	Mittel	0	37	0
	Niedrig	0	35	0
Schlechte Körperhaltungen/Bewegungen	Hoch	49.3	65	0
	Mittel	36.2	28	34.62
	Niedrig	14.5	7	65.38
Ergonomie/Arbeitsgerät nicht auf der richtigen Höhe	Hoch	89.9	60	0
	Mittel	0	30	34.62
	Niedrig	10.1	10	65.38
Hoher Kraftaufwand (Gefahr des Abrutschens)	Hoch	5.8	30	0
	Mittel	11.6	39	0
	Niedrig	82.6	31	100
Hohe Konzentration notwendig	Hoch	60.9	58	7.69
	Mittel	23.2	35	11.54
	Niedrig	15.9	7	80.77
Temperatur/Luftfeuchtigkeit/Zugluft	Hoch	0	0	100
	Mittel	100	4	0
	Niedrig	0	96	0

Physical/cognitive *stress* in 3 mills

Workplace and work process analysis (warp-beam exchange)

Physical/cognitive *support* in 3 mills

Workplace and work process analysis (warp-beam exchange)

- Support the employees find useful:
  - Height adjustment of the loom
  - Tablet-App

- Functions of the App:
  - The Operation will be simplified
  - The communication will be improved
  - The organization of work is digitized and unified

Mögliche Assistenz	Beurteilung SozioTex	Häufigkeit W1 (%)	Häufigkeit W2 (%)	Häufigkeit W3 (%)
Hebehilfe	Sinnvoll	2.9	26	0
	Nicht sinnvoll	97.1	74	100
Beistelltisch (Ablage für Werkzeug usw.)	Sinnvoll	37.7	42	100
	Nicht sinnvoll	62.3	58	0
Tablet-App	Sinnvoll	89.9	56	100
	Nicht sinnvoll	10.1	44	0
In-Ear-Device	Sinnvoll	89.9	33	100
	Nicht sinnvoll	10.1	67	0
Chairless Chair	Sinnvoll	14.5	25	0
	Nicht sinnvoll	85.5	75	100
Automatisierungen	Sinnvoll	30.4	60	100
	Nicht sinnvoll	69.6	40	0
ProGlove	Sinnvoll	0	60	0
	Nicht sinnvoll	100	40	100
Handgelenksstütze	Sinnvoll	63.8	68	0
	Nicht sinnvoll	36.2	32	100
Verstellbare Höhe des Geräts	Sinnvoll	91.3	89	100
	Nicht sinnvoll	8.7	11	0
Schutzkleidung	Sinnvoll	4.3	88	100
	Nicht sinnvoll	95.7	12	0
Hocker (Erhöhung der Position)	Sinnvoll	2.9	47	0
	Nicht sinnvoll	97.1	53	100
Sicherheit (Einweisung)	Sinnvoll	1.4	84	100
	Nicht sinnvoll	98.6	16	0
Zusatzmaterial (Werkzeug)	Sinnvoll	56.5	12	85
	Nicht sinnvoll	43.5	88	15
Zusätzlicher Mitarbeiter	Sinnvoll	91.3	18	0
	Nicht sinnvoll	8.7	82	100
Datenbrille	Sinnvoll	81.2	30	0
	Nicht sinnvoll	18.8	70	100

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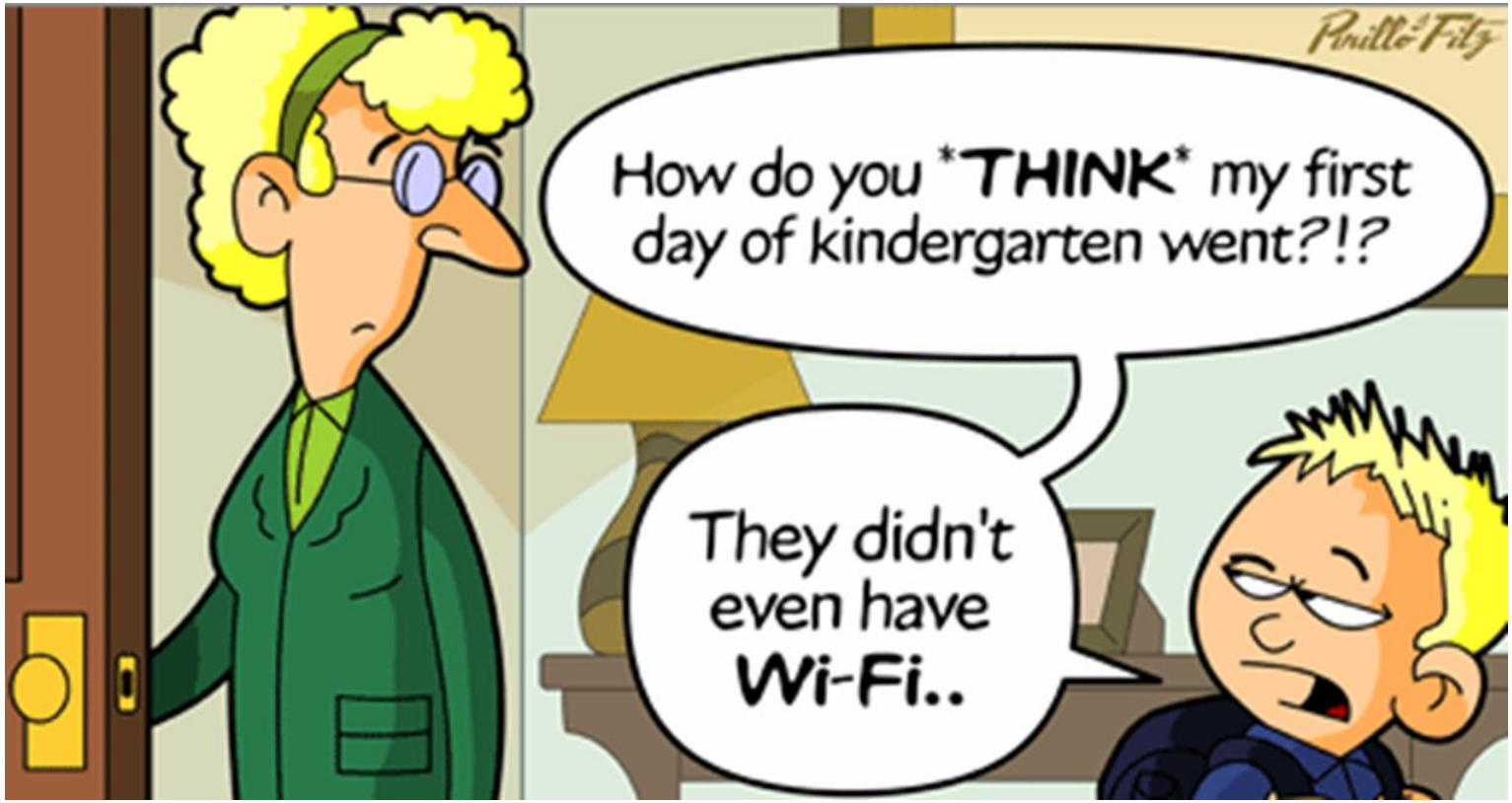
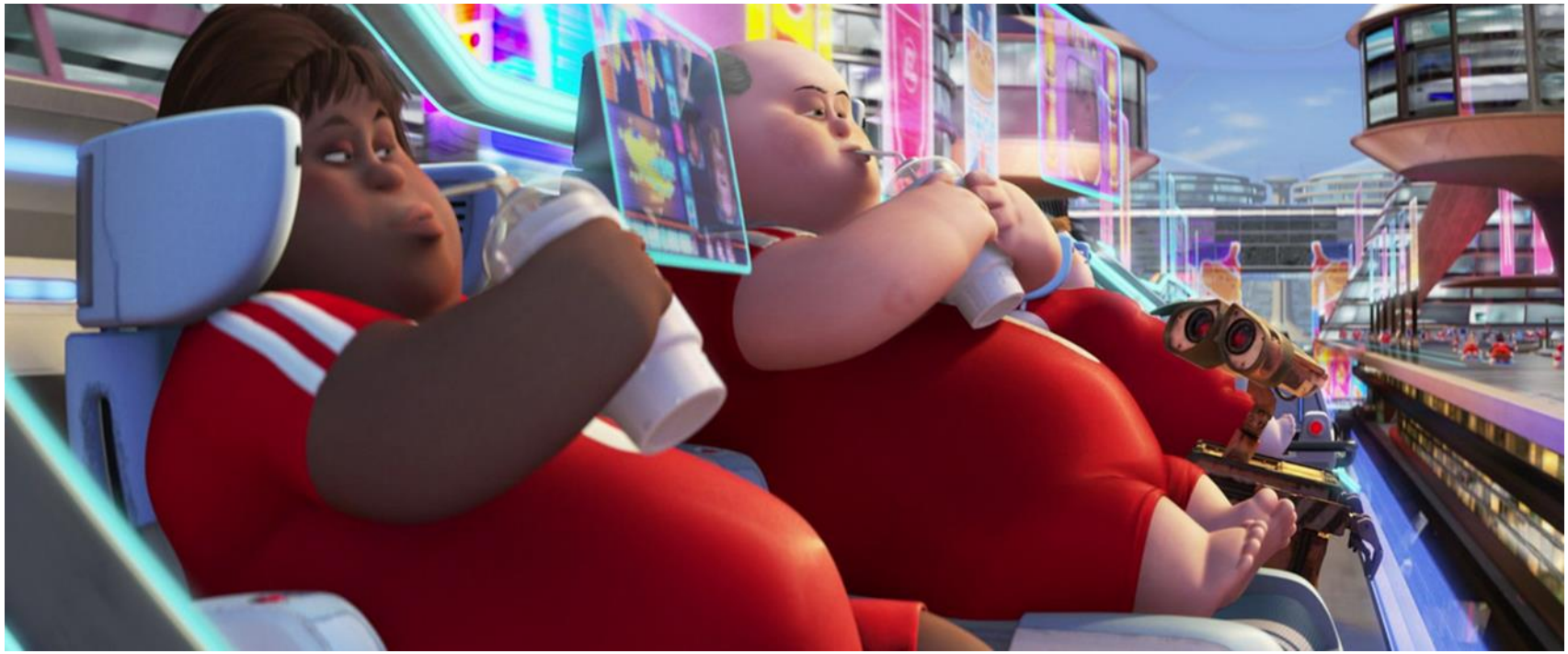
Facing the challenges of workforce ageing & digitalization = different needs of digital immigrants and digital natives…



Take-Home Message:

Support yes - lack of independence: No!



Source: Disney Pixar „WALL·E – Der Letzte räumt die Erde auf

Thank you very much for your kind attention!

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Acknowledgment

We would like to thank the German Federal Ministry of Education and Research (BMBF) for funding the young scholars' research group "SozioTex – Neue soziotechnische Systeme in der Textilbranche" (FKZ: 16SV7113) as well as VDI/VDE Innovation + Technik GmbH, Berlin, for advice in applying and managing the project.