Occupational Ergonomics for SME: Anticipated Trends and Future Outlook

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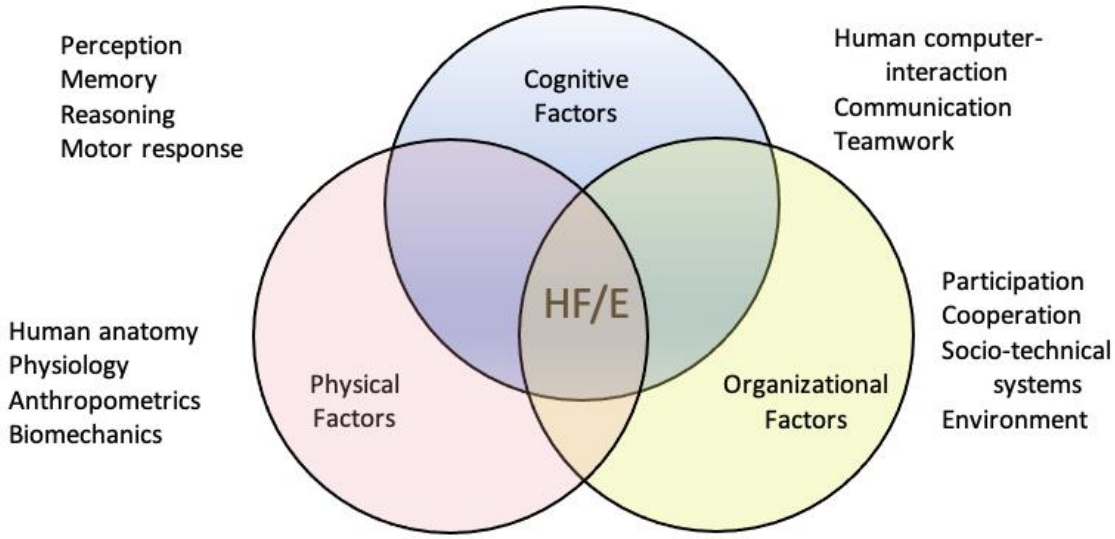
KEY CONCEPTS

(CONCEPTOS CLAVE)

ergonomics (or human factors)

key concepts

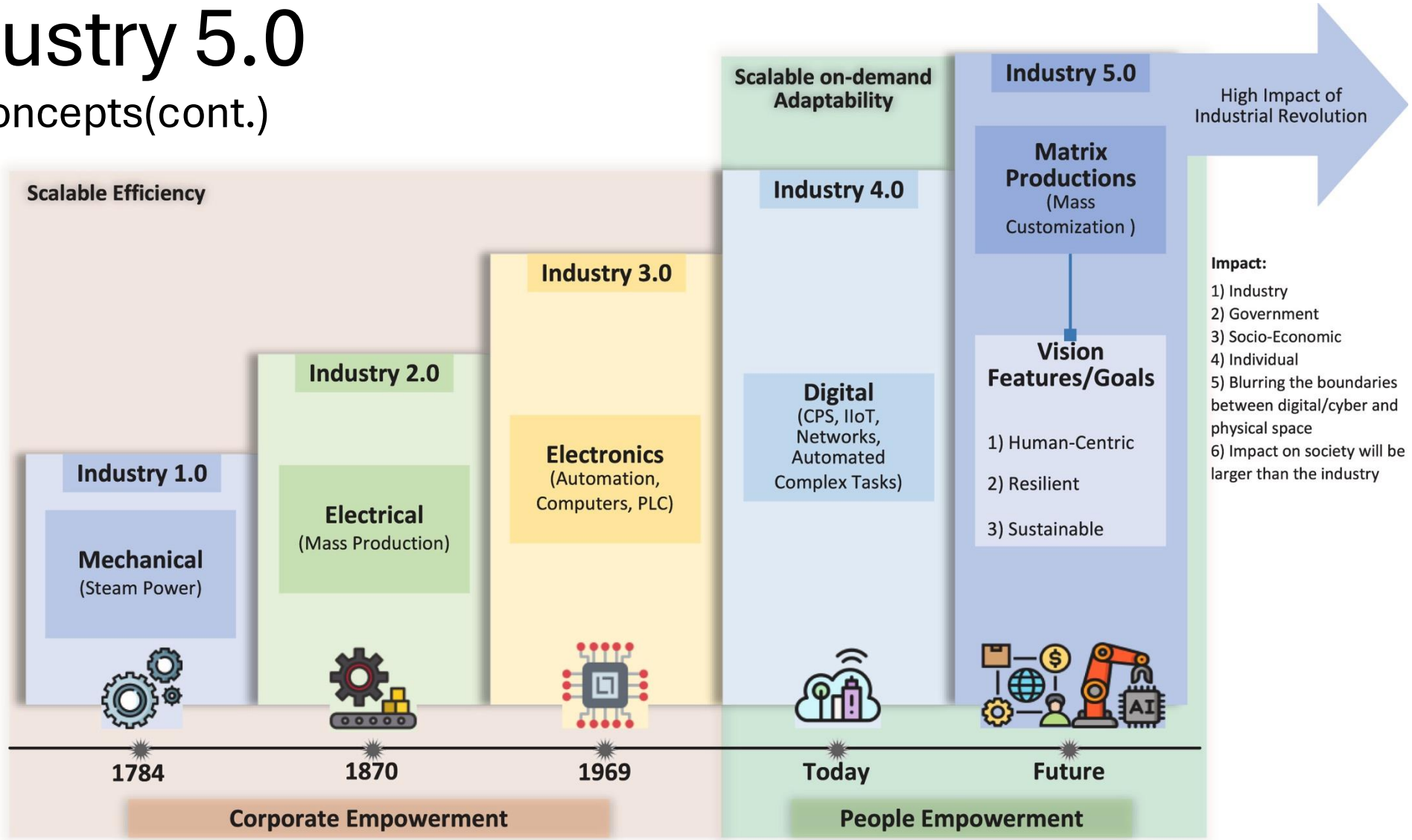
- **understanding of interactions** among humans and other elements of a system,
- applies theory, principles, data, and methods to design to **optimize human well-being,**
- and **overall system performance.**



adopted by the IEA in 2000
https://iea.cc/about/what-is-ergonomics/

Industry 5.0

key concepts(cont.)

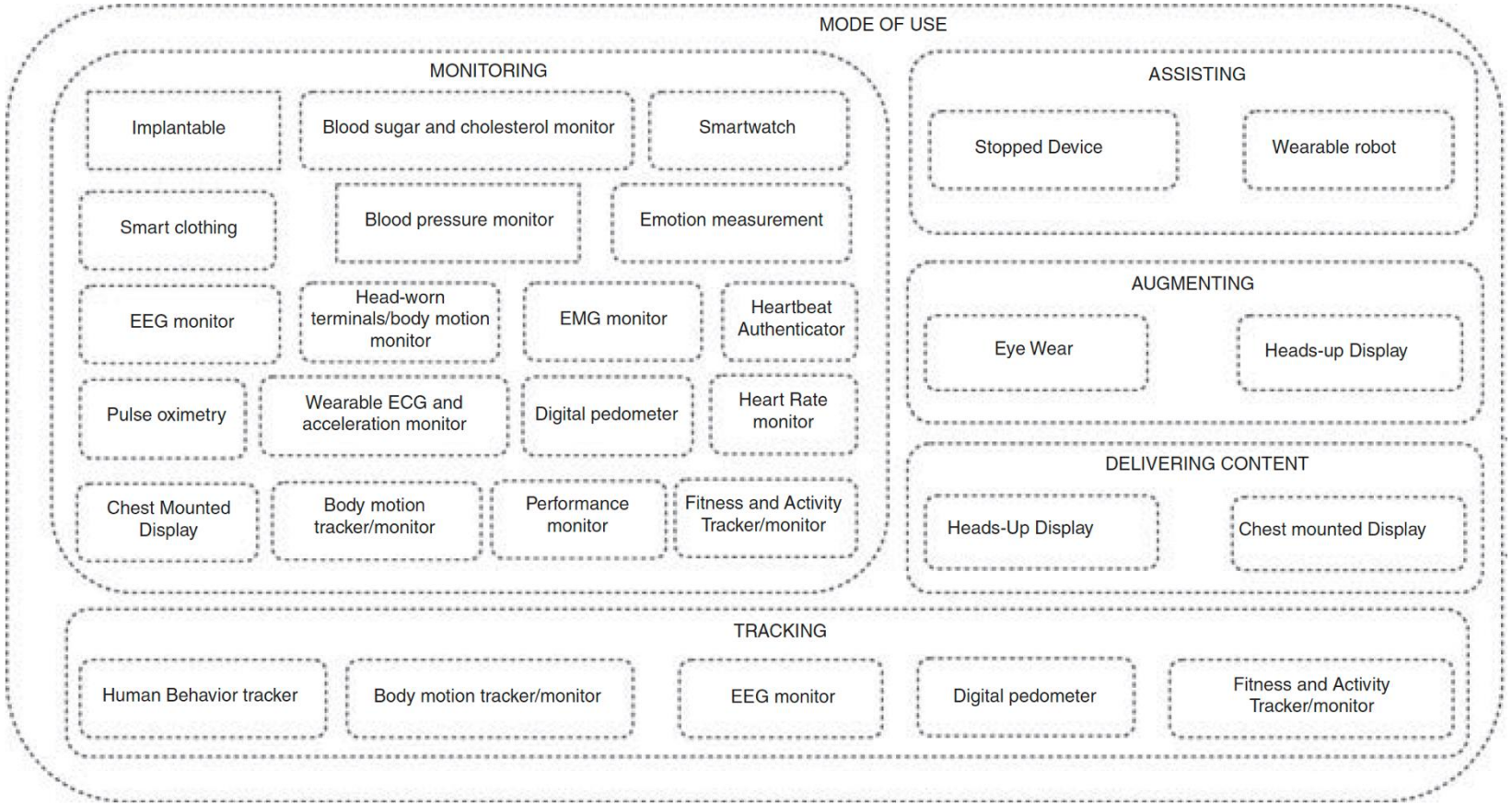


Zeb, S. et al, 2024
https://doi.org/10.1016/j.jnca.2023.103796

SYSTEMATICS OF TECHNOLOGIES

(SISTEMÁTICA DE TECNOLOGÍAS)

Wearable technologies for use in occupational contexts



Mode of use

- Monitoring
- Assisting
- Augmenting
- Delivering content
- Tracking

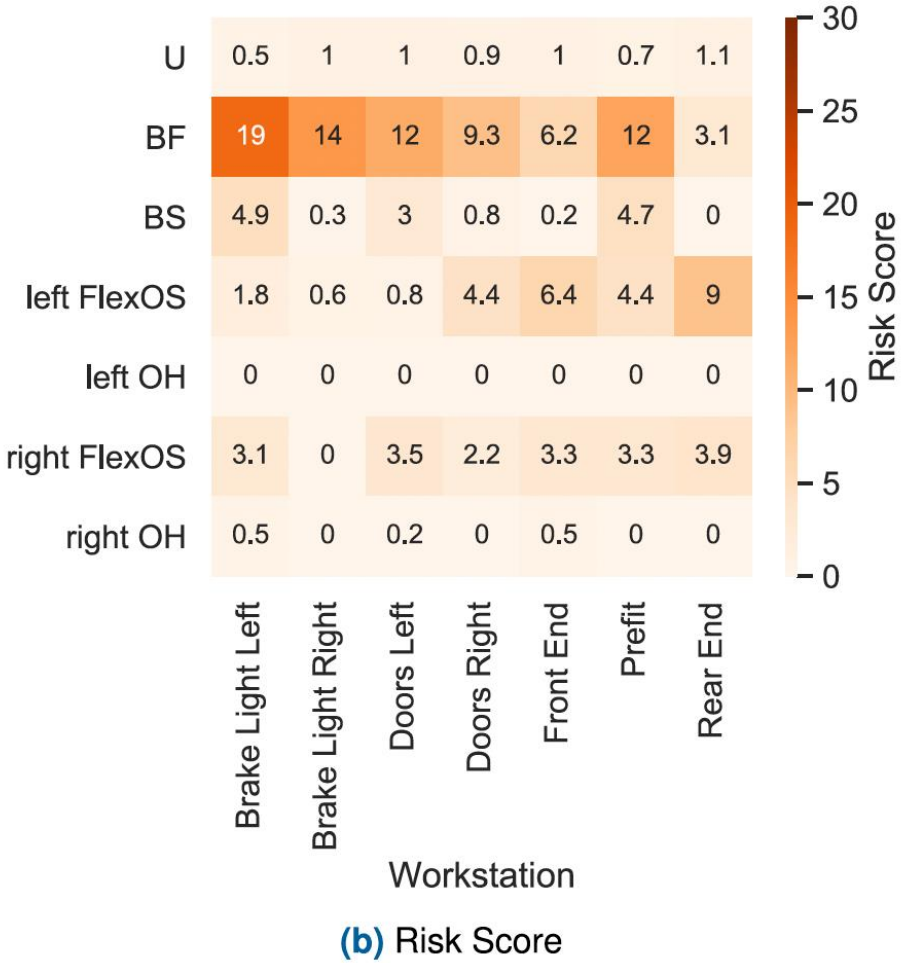
Khakurel, J. et al, 2017
https://doi.org/10.1108/ITP-03-2017-0076

APPLICATION STUDIES

(ESTUDIOS DE APLICACIÓN)

assembly line

Application studies



(b) Risk Score

- On-body sensor network of inertial sensors, and a motion tracking Framework was used;
- Within laboratory settings, the motion tracking estimates consistency and agreement are good;
- Within automotive assembly line acquisitions, the magnetic field disturbances, and sensor displacement occurrences lowered the outcomes.

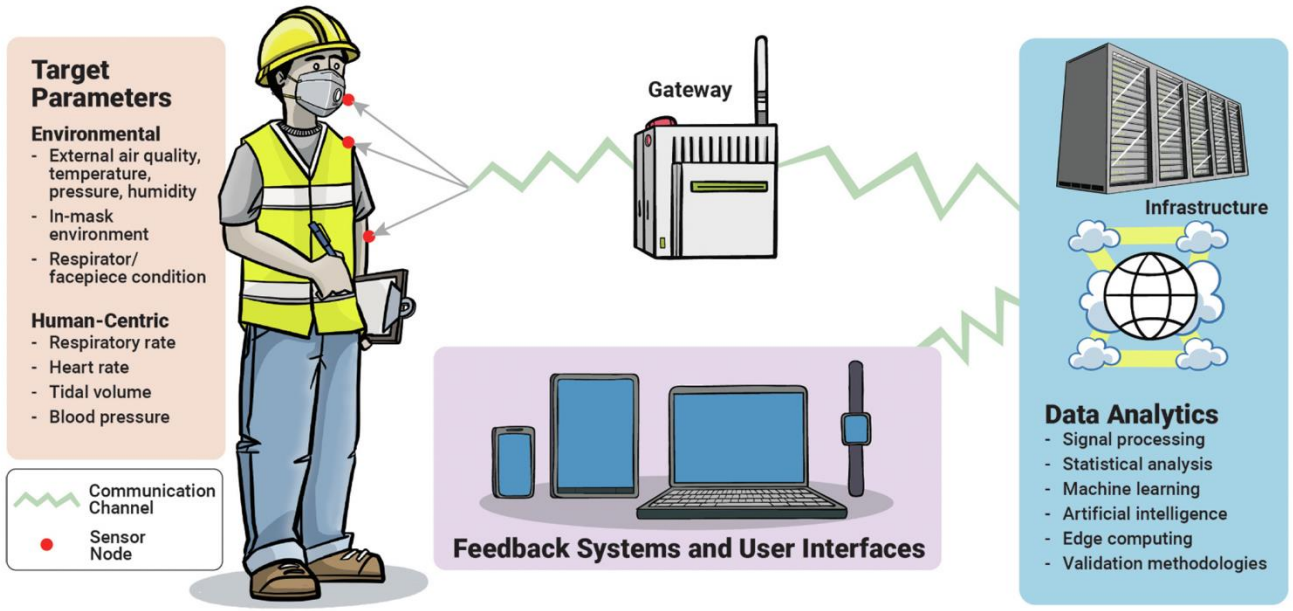
Nunes, M. L. et al, 2022
https://doi.org/10.1109/ACCESS.2022.3196473

UNIVERSIDAD DE MÁLAGA | uma.es

Ergonomics & Human Factors

respiratory health of workers across industries

Application studies



- overview of the current state of wearable respiratory sensors
- real-time monitoring of respiratory status, exposure, and device integrity;
- high-risk sectors (mining, firefighting, healthcare, construction, and oil and gas).

Devkota, J. & Sharma, H. N., 2026
https://doi.org/10.1016/j.jsr.2026.02.006

occupational heat stress

Application studies

Table 3
Frequency counts of devices (N = 14) studied.

Devices	Frequency Count of Device Usage	% of All Included Studies
Bodytrak® In-Ear Sensor	0	0
Cosinuss° One	2	8
Empatica® E4	4	17
Equivital® eq02+	5	21
HOBO® Temperature / RH Data Logger	1	4
HOBO® Pendant	2	8
Kenzen™	1	4
Kestrel® D3	3	13
MākuSafe®	0	0
Moni-Patch	1	4
Polar®	8	33
SlateSafety® V2	2	8
SlateSafety® Beacon	0	0
Zephyr™	5	21

- Heat-related illnesses persist as an occupational health management challenge;
- global commercially available real-time devices (relevant literature and validation studies;
- high-risk sectors (construction, agriculture, firefighting, hazardous waste operations, and factory workers).

Cannady,R. et al., 2024
https://doi.org/10.1016/j.ssci.2024.106600

construction safety

Application studies

- A: Smart Wristband
- B: Basic Peak Wristband with PPG-based HR Sensor
- C: Wearable EEG
- D: Smart Glasses
- E: Apple Smart Watch
- F: Smart Safety Boot
- G: ECG-based HR Sensor (Chest Strap: Polar H7)
- H: Smart Safety Helmet
- I: GPS Tracker
- J: Smart Vest

- Systematic review of +90 studies (2010-2024);
- Four operational limitations:
  - Battery Life and Power Management,
  - Durability and Reliability,
  - Interference and Connectivity,
  - Integration with Existing Systems.
- Six adoption barriers (Technological, Cost, Human, External, Organization, Ethical).

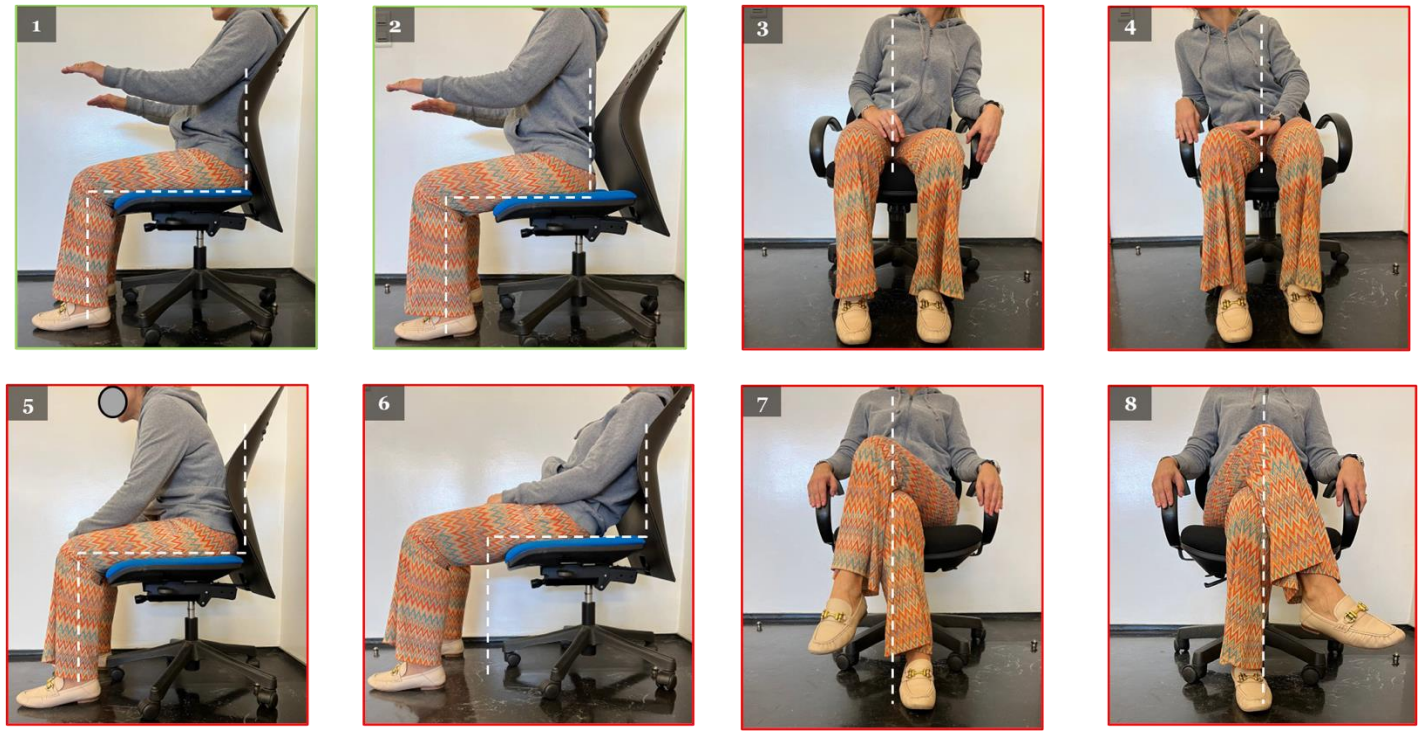
Fasoyinu, A. A. et al., 2025
https://doi.org/10.1016/j.autcon.2025.106424

UMINHO PROJECTS

(PROYECTOS UMINHO)

WORKER HP: A Noninvasive Smart Chair System for Monitoring Postures in Sedentary Workers

UMinho Projects (application studies)

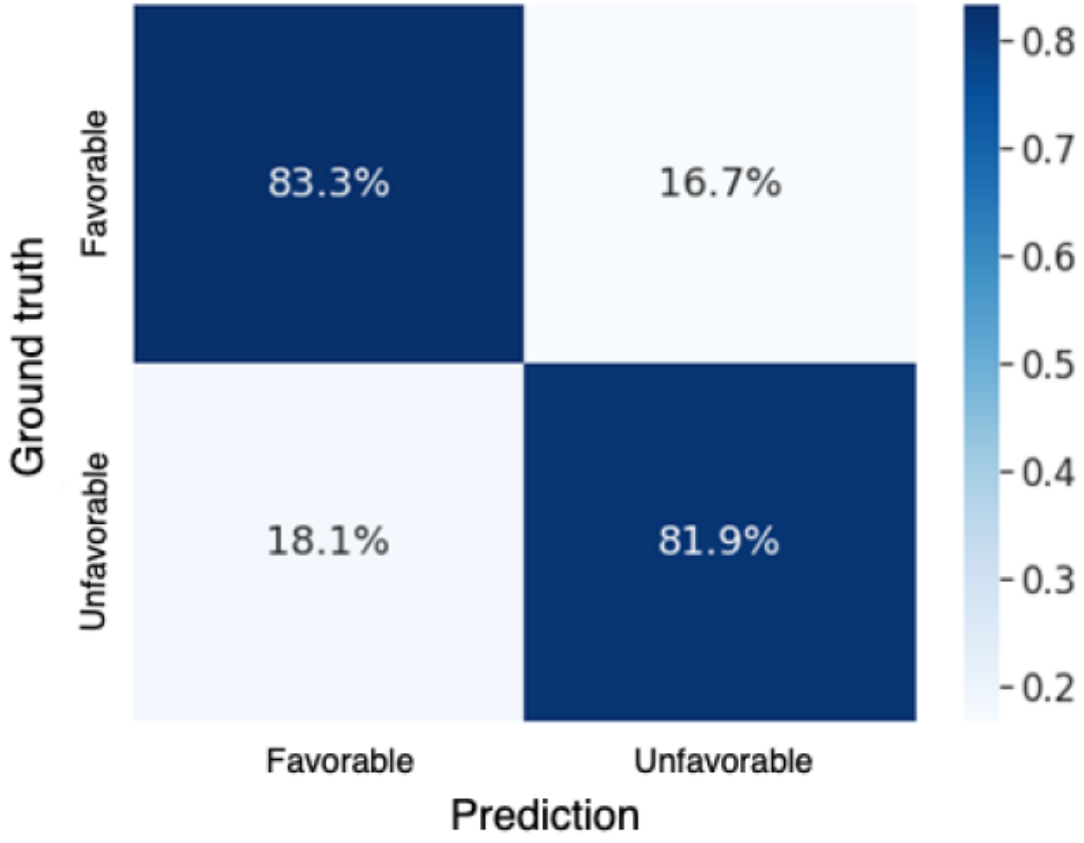


- most frequently observed postures in office environments where considered;
- positions P1 and P2 were considered low risk;
- 30 healthy participants were recruited;

Sigcha, L. et al, 2023
https://doi.org/10.1109/ISIE51358.2023.10228048

WORKER HP: A Noninvasive Smart Chair System for Monitoring Postures in Sedentary Workers

UMinho Projects (application studies)



- best results obtained for automatic classification were obtained using a Gradient Boost algorithm;
- high predictive capacity of the algorithm using the pressure sensor signals with minimal preprocessing;
- confusion matrix shows balanced results in the prediction of both classes (favorable and unfavorable).

Sigcha, L. et al, 2023
https://doi.org/10.1109/ISIE51358.2023.10228048

Assessing the Short-Term Effects of Dual Back-Support Exoskeleton within Logistics Operations

UMinho Projects (application studies)

Cardoso, A. et al, 2024
https://doi.org/10.3390/safety10030056

Assessing the Short-Term Effects of Dual Back-Support Exoskeleton within Logistics Operations

UMinho Projects (application studies)

		Without Exoskeleton				Exoskeleton Auxivo				Exoskeleton Htrius			
		A	B	REBA Score	Risk Level	A	B	REBA Score	Risk Level	A	B	REBA Score	Risk Level
PBS	T1	2.0	3.0	3.0	Low	2.0	3.0	3.0	Low	2.0	3.0	3.0	Low
	T2	1.0	3.0	2.0	Low	1.0	3.0	2.0	Low	3.0	4.0	**4.0**	Medium
	T3	2.0	3.0	3.0	Low	2.0	1.0	2.0	Low	2.0	1.0	2.0	Low
	T4	5.0	4.0	**6.0**	Medium	3.0	4.0	4.0	Medium	2.0	4.0	4.0	Medium
	T5	6.0	4.0	**8.0**	High	5.0	4.0	6.0	Medium	4.0	4.0	5.0	Medium
	T6	6.0	3.0	**7.0**	Medium	6.0	3.0	6.5	Medium	5.0	3.0	5.0	Medium
	T7	6.5	4.0	**8.5**	High	5.5	4.0	7.0	Medium	4.5	4.0	5.5	Medium
	T8	5.5	4.5	**7.5**	High	4.0	4.5	5.5	Medium	4.0	4.5	5.5	Medium
	T9	3.5	4.0	5.0	Medium	3.0	2.5	4.0	Medium	4.5	4.0	5.5	Medium
PBL	T1	2.0	2.0	**2.5**	Low	1.0	2.0	1.5	Low	1.5	1.0	1.5	Low
	T2	1.5	2.0	2.0	Low	1.5	3.0	2.5	Low	2.5	3.0	**3.0**	Low
	T3	7.0	4.0	**9.0**	High	5.5	4.0	7.0	Medium	4.0	4.0	5.0	Medium
	T4	6.0	4.0	**8.0**	High	4.0	4.0	5.0	Medium	3.0	4.0	4.5	Medium
	T5	6.0	4.0	**8.0**	High	5.0	4.0	6.0	Medium	5.0	4.5	6.5	Medium
	T6	5.0	4.0	**6.0**	Medium	4.5	4.0	5.5	Medium	4.0	4.0	5.0	Medium
	T7	4.5	4.0	**5.5**	Medium	4.0	4.0	5.0	Medium	3.5	4.0	4.5	Medium

REBA Group A (A); Reba Group B (B); bold denotes the higher REBA scores.

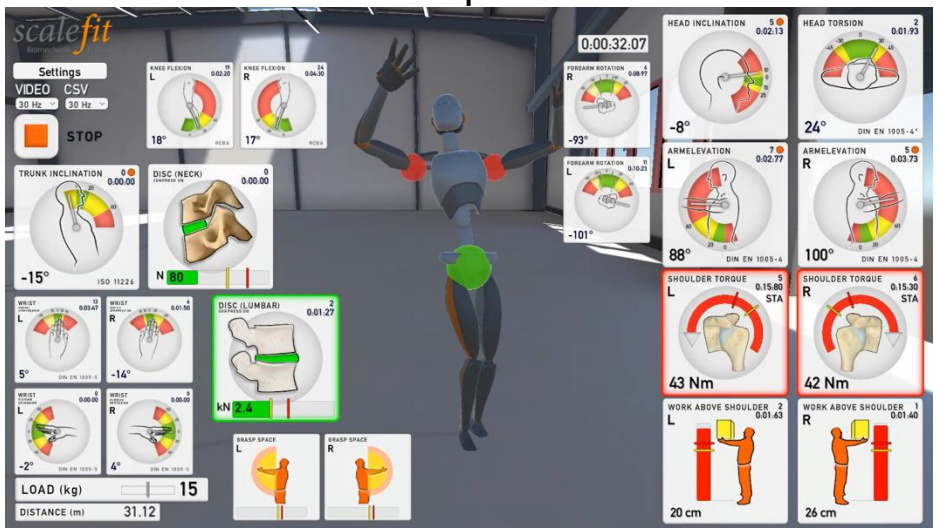
- two picking methods, pick by store (PBS) and pick by line (PBL);
- free to choose the movements to palletize boxes.

Cardoso, A. et al, 2024
https://doi.org/10.3390/safety10030056

Agenda PT Smart Retail (Mobilising Agendas for Business Innovation in the Recovery and Resilience Plan [PRR])

UMinho Projects (application studies)

Assessment of the removal of the product from the fruit and vegetable pit



Just ended, 2026

https://doi.org/#

SUCCESS FACTORS

(FACTORES DE ÉXITO)

key success factors

that can ensure sustainability - discussion

- **Real records** of exposure to risk (not samples or estimates);

Image from: https://www.industrialacousticdesign.co.uk/

key success factors

that can ensure sustainability - discussion

- **Early warnings** help to reconfigure the workplace and reduce risks;

Image from: https://fsesafe.com/

key success factors

that can ensure sustainability - discussion

- **Information** available for workers (and accompanying doctors);

Image from: https://www.wellable.co/

key success factors

that can ensure sustainability - discussion

- **Ageing workforce** (increased demand and need for surveillance);

Image from: https://amtrustfinancial.com/

key success factors

that can ensure sustainability - discussion

- Development of **smaller devices** (more energy efficient);

Image from : https://tinycircuits.com/

key success factors

that can ensure sustainability - discussion

- Increased **computing power** and communication speed.

Image from: https://www.aau.at/

OPPORTUNITIES

(OPORTUNIDADES)

Opportunities for OSH

open discussion

- **New risks** by human-machine interfaces;

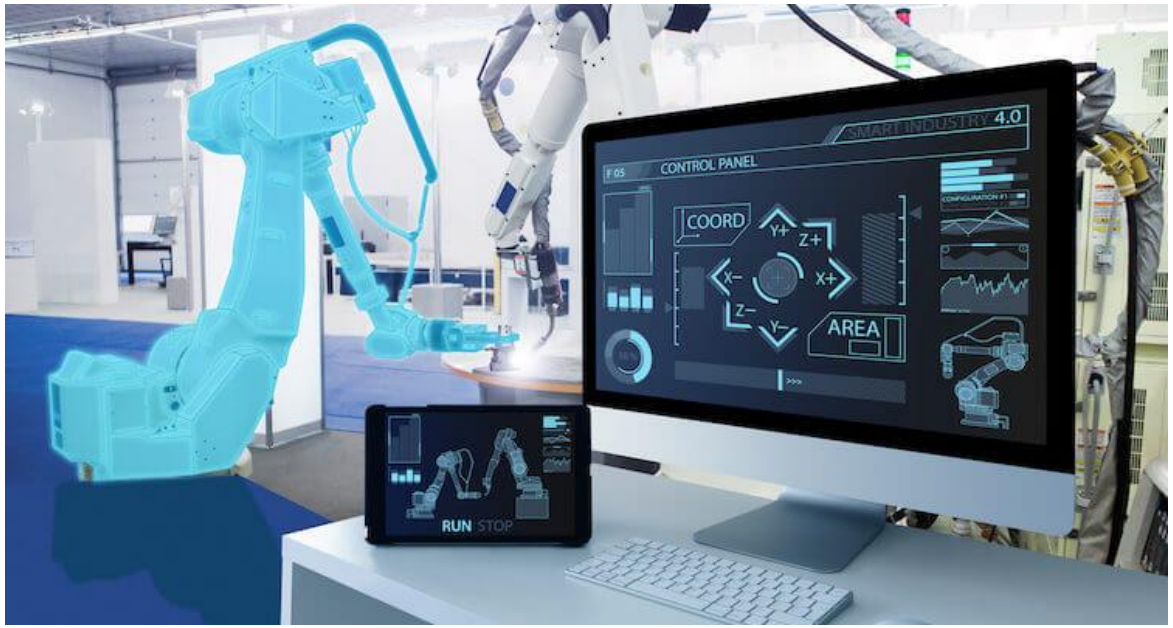


Image from: https://www.automationreadypanels.com/

Opportunities for OSH

open discussion

- **Psychosocial** and **organisational factors** (pace of work, where it is done, management and oversight);

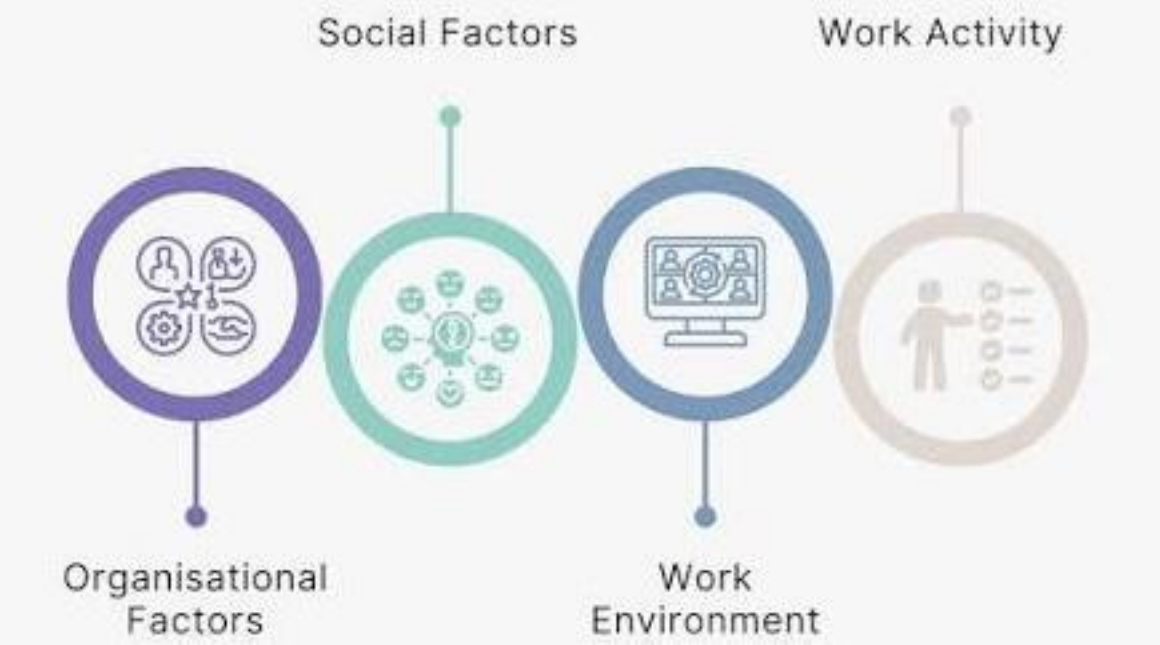


Image from: https://healthandsafetyindex.com.au/

Opportunities for OSH

open discussion

- **Work-relates stress** from increased worker monitoring;

Image from: https://teeptrak.com/

Opportunities for OSH

open discussion

- **Non-office** environments;

Image from: https://www.modsnational.com/

Opportunities for OSH

open discussion

- **Data protection** and **ethical issues**.

Image from: https://www.digit.fyi/

Q&A

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