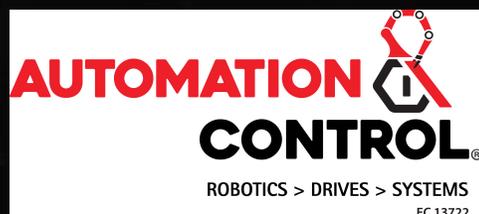


COMAU

MATEXT

FIT FOR WORKERS

WHERE DOES IT WORK? **WHERE YOU DO.**



MATE-XT Product Presentation

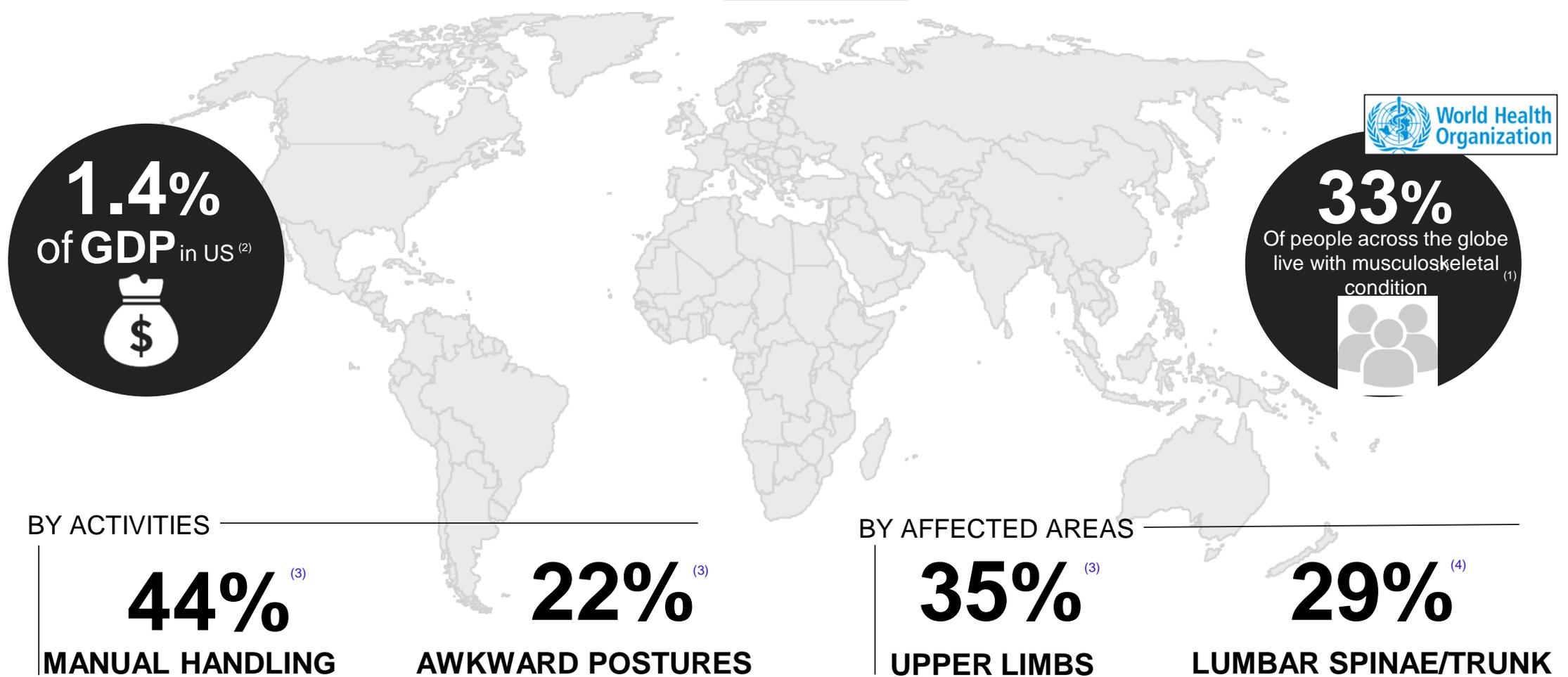
What are you about to learn?

1. ADDRESSING WORK-RELATED MUSCULOSKELETAL DISORDERS
2. MATE-XT, ALL YOU NEED TO KNOW
3. MEASURABLE ADVANTAGES & BENEFITS
4. REAL APPLICATIONS & INDUSTRIES

ADDRESSING WORK-RELATED MUSCULOSKELETAL DISORDERS

What was MATE-XT made for?

Work-related Musculoskeletal Disorders (WRMSDs)



(1) World Health Organization- Data on Musculoskeletal Conditions - <https://www.who.int/news-room/fact-sheets/detail/musculoskeletal-conditions>
(2) The Impact of Musculoskeletal Disorders on Americans — Opportunities for Action <http://www.boneandjointburden.org/docs/BMUSExecutiveSummary2016.pdf>
(3) Estimated value from <http://www.hse.gov.uk/statistics/causdis/msd.pdf>
(4) <http://www.hse.gov.uk/statistics/causdis/msd.pdf>

The cost of WRMSDs to Employers UK Case Study

WORK REORGANIZATION

- Labor turnover;
- Absenteism;

MSDs
Average costs
to Employers in
UK

= DIRECT COST + INDIRECT COST + INTANGIBLE COST =

£ 2,900
per year per
worker



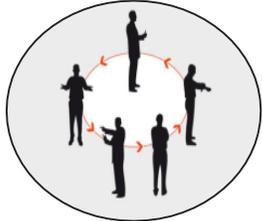
MEDICAL&LEGAL EXPENCES

- Sickness Payment
- Costs of Employers' Liability Compulsory Insurance (ELCI)
- Legal&Administration

HUMAN COSTS

- Decreased quality of life (pain or disability)
- Adverse impacts on labor relations.

Current Solutions- Tackling MSDs means taking actions in the workplace

	COST	EFFICIENCY	SCALABILITY
 <p>Workplace Design</p> <ul style="list-style-type: none">• Automation• Adjustable Workplace	●	●	●
 <p>Organizational Design</p> <ul style="list-style-type: none">• Job/Task Rotation• Rest periods	●	●	●
 <p>Tools&Equipment Design</p> <ul style="list-style-type: none">• Exoskeleton for work	●	●	●

Hypothesis driven product Design



MATE-X^T, ALL YOU NEED TO KNOW

MATE-XT. Where does it work? Where you do

MATEXT
FIT FOR WORKERS
WHERE DOES IT WORK? **WHERE YOU DO.**



CERTIFICATIONS

- CE (2006/42/EC)
- ISO 13482:2014 (Personal Care Robot)
- Ergonomics EAWS

MATE is the only exoskeleton able to fully reproduce the physiological movement of your shoulder



ADJUSTABLE ASSISTANCE



EXTERNAL RESISTANT



ERGONOMIC CERTIFICATE



INTUITIVE DESIGN



COMPACT & SAFE

Multi-Competence Collaborations

COMAU

World leader in the field of industrial automation



Lean Manufacturing
Human manufacturing approach
Engineering and Industrialization

Outdoor accessories and clothing manufacturer



CONTEMPORARY
OUTDOOR
SINCE 1870

*"WE DESIGN WITH EVERYONE'S
NEEDS IN MIND, FOR PROFESSIONAL
AND NON-PROFESSIONAL USERS"*



Soft Robotics
Neuro robotics

Sensor signal and information processing
Translational neural engineering

Surgical robotics

Artificial Hands

IUVO

Experts on Wearable and
exclusive IP licensing



Mission: improve people mobility

Founded in 1971 in Iceland

+ 3000 employees

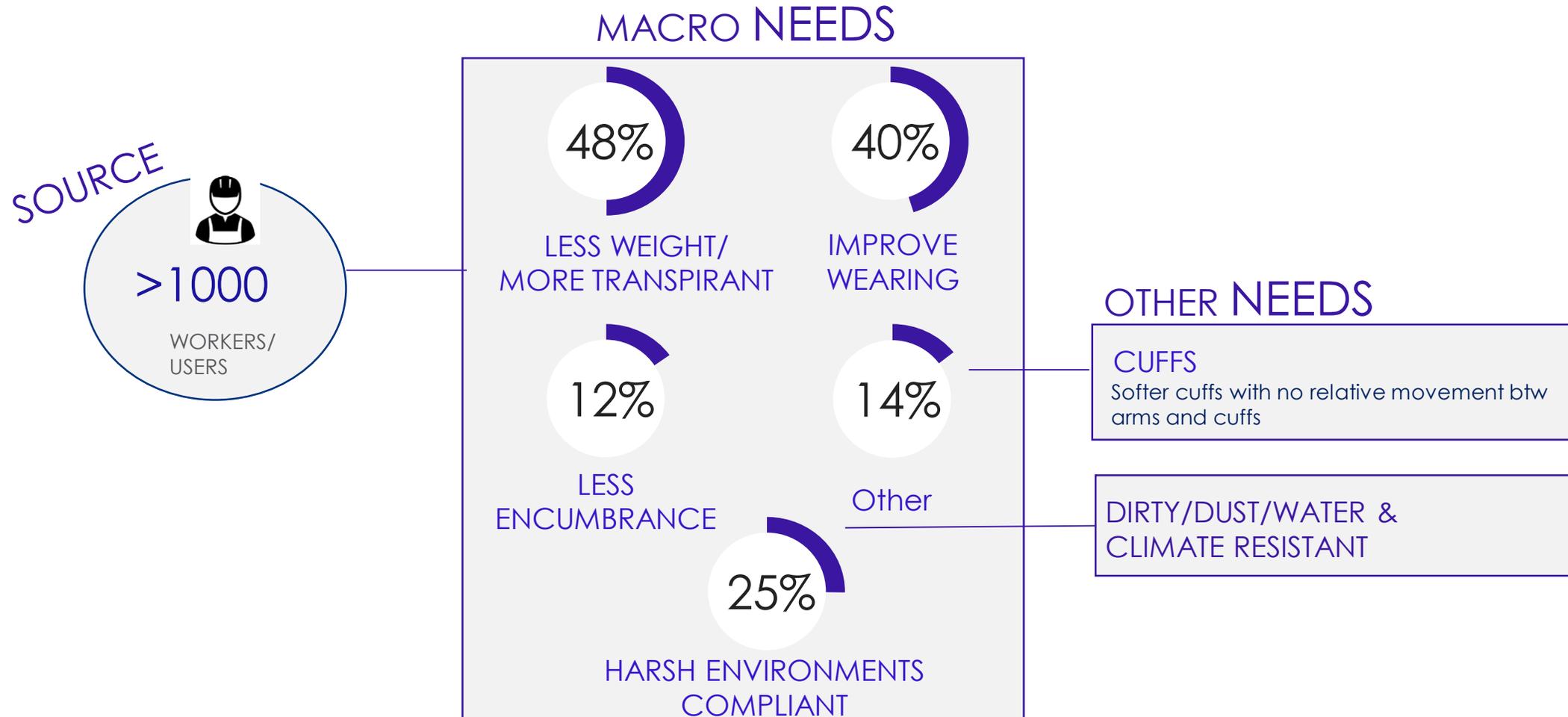


world market technology leader
of non-invasive orthopaedic
equipment



Development Process

A Client-Oriented Approach



What is MATE-XT?

MATE-XT is the new upper-limb exoskeleton totally passive (w/o motors).

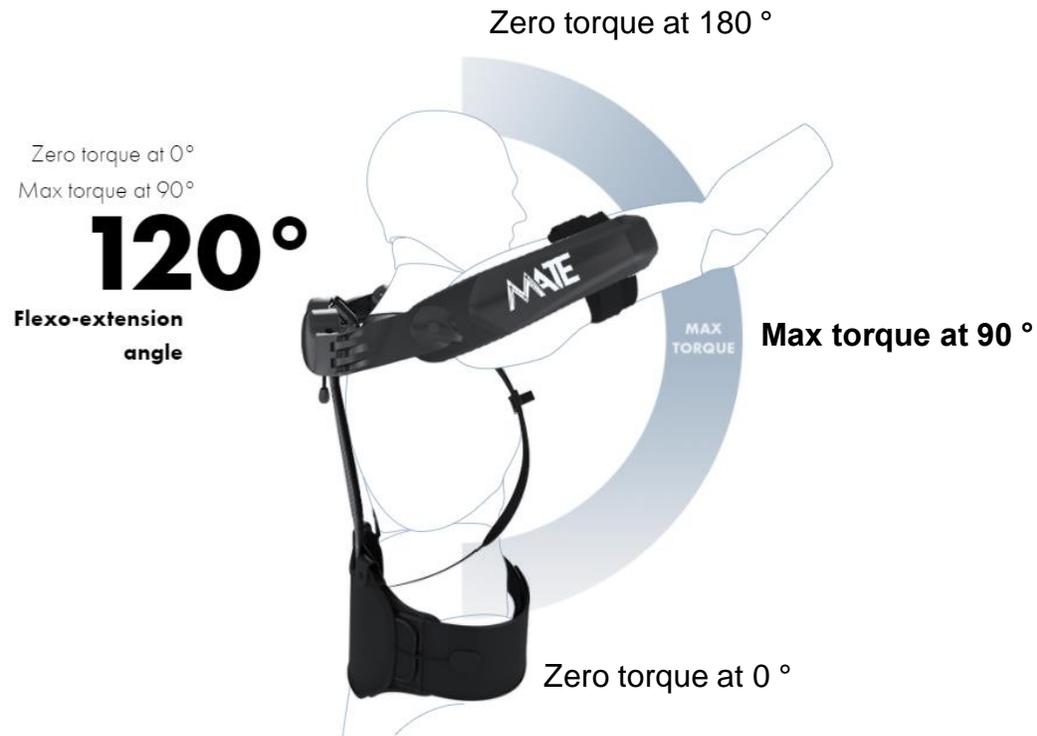
MATE-XT is designed to assist the user during flexo-extension movements of the shoulder.

- 1 Garment interface**
All parts in direct contact with the user's body
- 2 Mechanical shoulder chain**
Structure that facilitate the free movement of the user, such as sliding and rotating joints
- 3 Torque generator box**
Core mechanism that store and transform potential mechanical energy of order to create an adjustable assistive torque (**8 levels**)



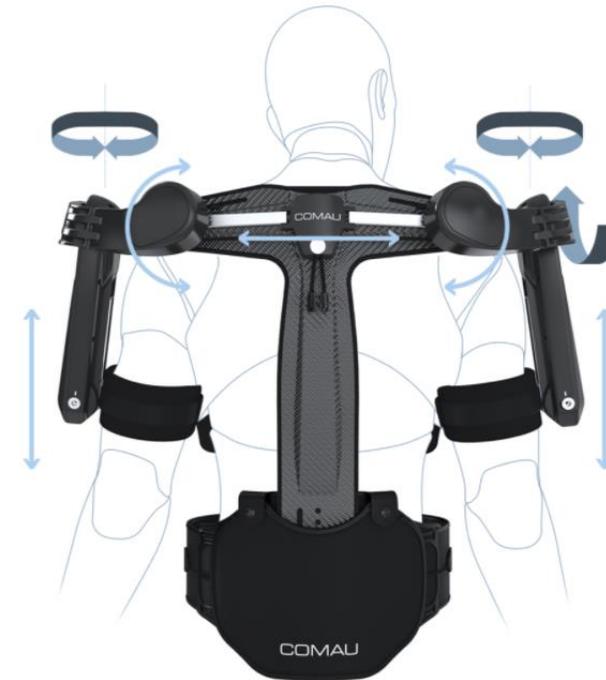
MATE-XT works just the way you do

MATE GIVES YOU THE EXACT LEVEL OF SUPPORT WHEN AND WHERE YOU NEED IT



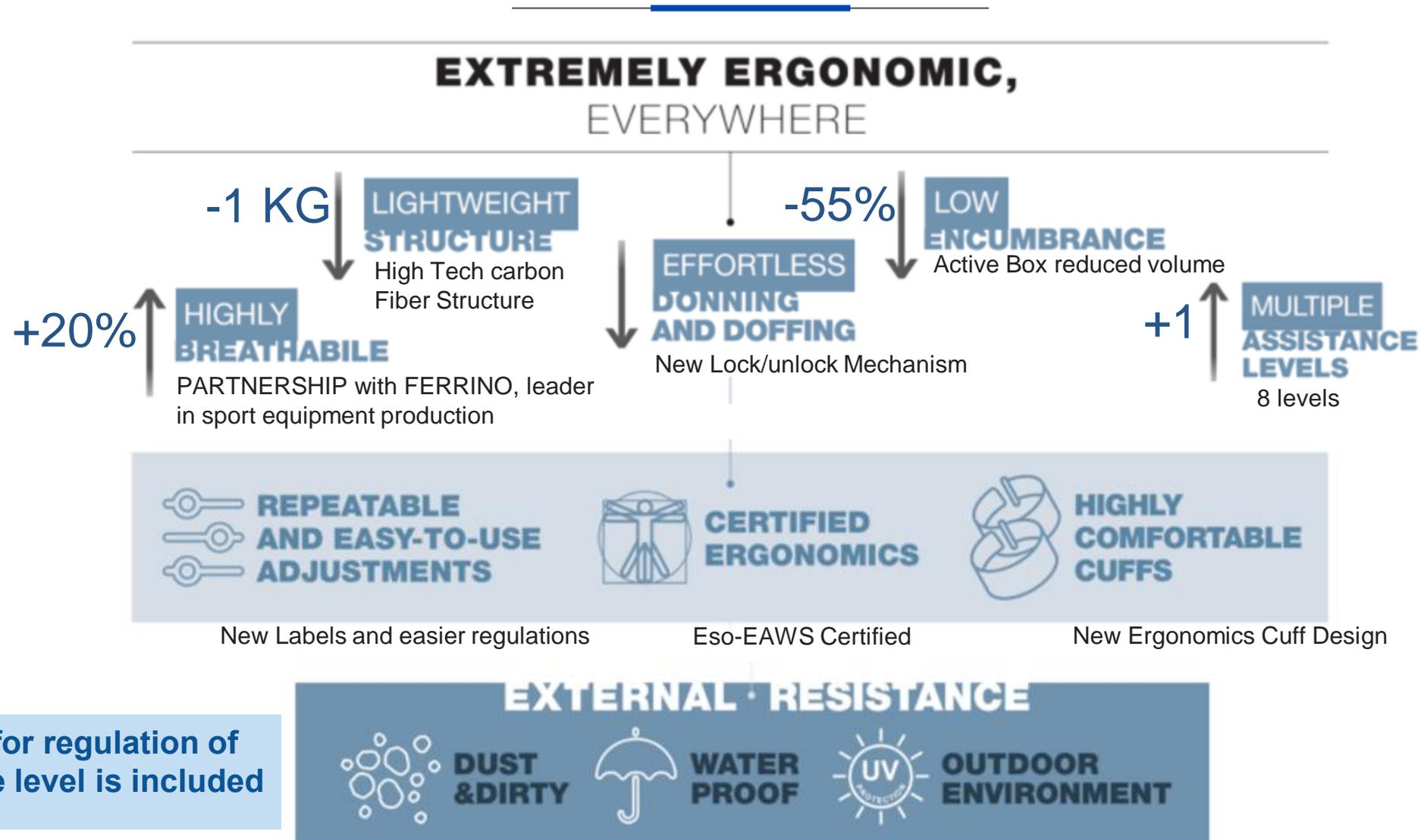
The assistance torque provided by the MATE exoskeleton suit follows your individual shoulder flexion/extension angle
(maximum torque is at 90° degree)

MATE MOVES IN HARMONY WITH YOUR SHOULDERS



Thanks to a chain of passive degrees of freedom, the flexion-extension rotation axis of the human shoulder is aligned with that of MATE.

What's new with MATE-XT*?



Allen key for regulation of assistance level is included

*MATE-XT new features, when compared with first MATE edition

What else makes MATE unique?

**LEARN ABOUT EACH
COMPETITIVE ADVANTAGE
OF MATE-XT on our website**

Physiological Movement	Ergonomic certificate
Fit for EXTREME and EXTERNAL Environment	Lightweight Technology
Safety Lock Mechanism	Compact and Safe Structure
Fast Donning and Doffing	Adjustable Assistance
Intuitive and easy to use design	

MEASURABLE ADVANTAGES & BENEFITS

How MATE-XT can help workers and companies

WORKERS

**REDUCED
MUSCULAR
EFFORT**

30% ↓ **AT
SHOULDER
LEVEL**

SCIENTIFIC STUDY

**PERCEIVED
EFFORT
REDUCTION**

25% ↓ **LESS MUSCLE
STRAIN
PERCEIVED**

PERFORMING ACTIVITIES

**BACK
SUPPORT
RELIEF**

50% ↑ **OF WORKERS
IMPROVED
THEIR POSTURE**

PERFORMING ACTIVITIES

COMPANIES

**POSITIVELY
IMPACT YOUR
ERGONOMICS**

**LESS
EXECUTION
TIME**



**AND
HIGHER
PRECISION**



**ADDRESS
WORK-RELATED
MUSCULOSKELETAL
DISORDERS**

Clinical Studies ⁽¹⁾



CONGREGAZIONE DELLE SUORE
INFERMIERE DELL'ADDOLORATA
OSPEDALE VALDUCE



Objectives

- To test upper limb muscle activation in the targeted tasks
- To test whether the device alters the shoulder kinematics



Methodology

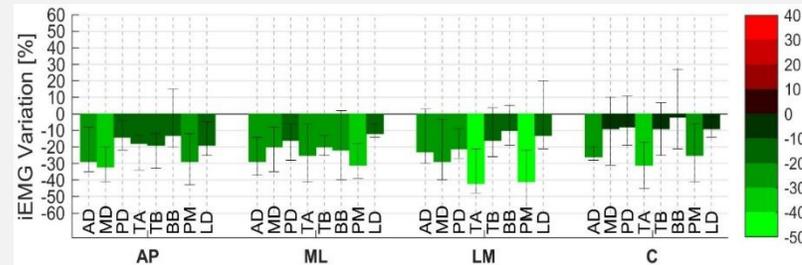
- EMG recording by means of BTS FREEMG 1000, 1000 Hz
- Motion tracking by means of BTS (SMART DX 7000) at 250 Hz, 8 cameras

Task

- Non-functional movements
- Functional movements



Main Results



Conclusion

- The **device reduces the physical workload** of agonist and antagonist muscles involved in shoulder flexion-extension and abdo-adduction
- The **shoulder joint kinematics is not significantly altered** by the exoskeleton
- The **pHMI is stable** and well-coupled with the body segments during the execution of the tasks

⁽¹⁾ «Experimental Evaluation of the proto-MATE, a novel ergonomic upper-limb exoskeleton for reducing the worker's physical strain», Pacifico et al., *IEEE Robotics and Automation Magazine*, 2019, Pacifico et al.

FCA Studies ⁽¹⁾



ErgoLab

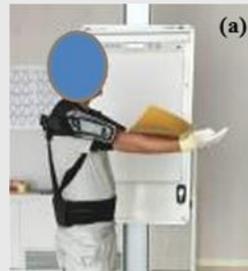


Objectives • Evaluate benefits in terms of performances (time of execution, precision, fatigue)



Methodology • Task Execution with and without the usage of the exoskeleton

Task



Static Fatigue

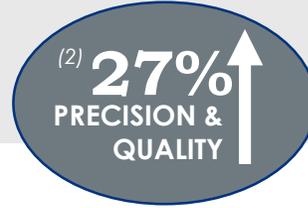


Repetitive Manual Handling



Precision

Results



⁽¹⁾ *Passive Upper Limb Exoskeletons: an Experimental Campaign with Workers*, Stefania Spada (FCA), Lidia Ghibaudo (FCA), Chiara Carnazzo (FCA), Laura Gastaldi Maria Pia Cavatorta.

⁽²⁾ *Estimated KPI from (1)*

Scientific Evidence on IEEE Robotics & Automation Magazine



An Experimental Evaluation of the Proto-MATE

-A Novel Ergonomic Upper-Limb Exoskeleton to Reduce Workers' Physical Strain-

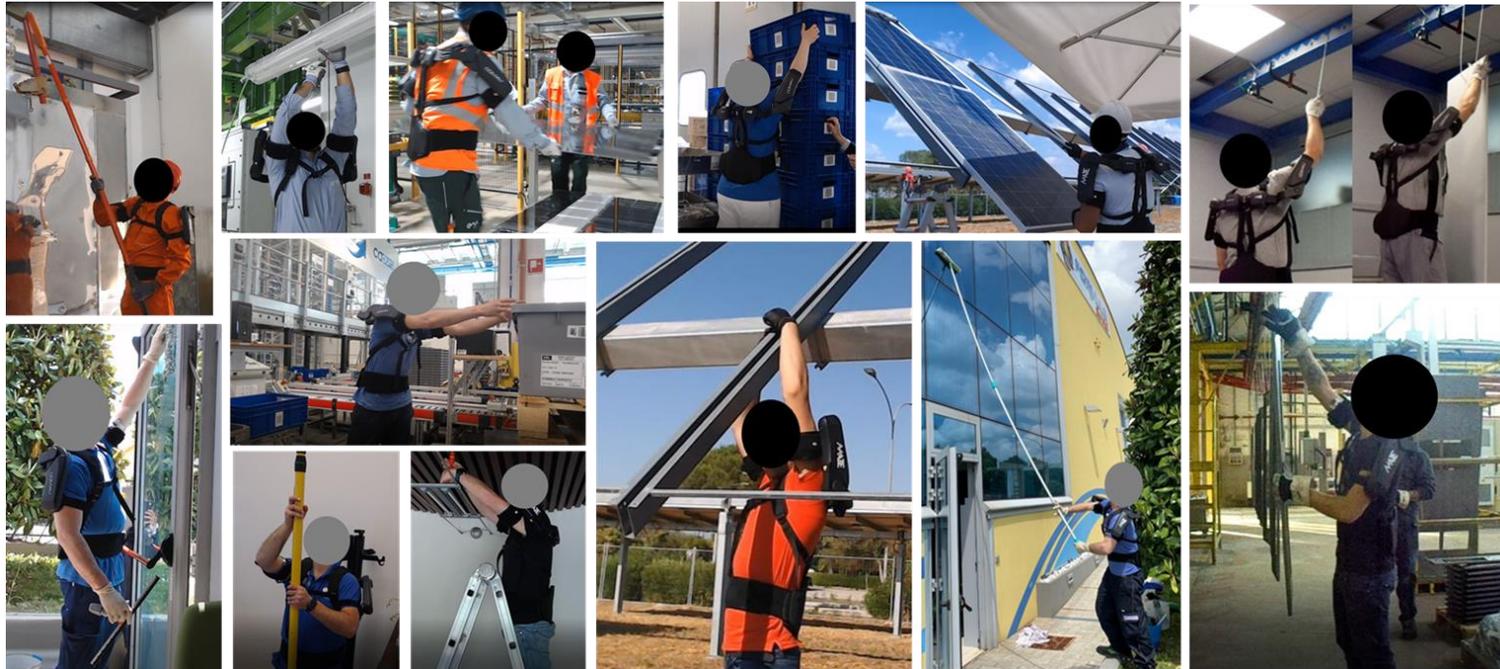
I. Pacifico, A. Scano, E. Guanziroli, M. Moisé, L. Morelli, A. Chiavenna, D. Romo, S. Spada, G. Colombina, F. Molteni, F. Giovacchini, N. Vitiello, S. Crea,, IEEE Robotics and Automation

(1) «Experimental Evaluation of the proto-MATE, a novel ergonomic upper-limb exoskeleton for reducing the worker's physical strain», Pacifico et al., *IEEE Robotics and Automation Magazine*, 2019, Pacifico et al.

Collection of scientific Evidences in Field Studies

100+ operators

9+ different applications



1 Reduction of muscular effort
EMG MEASURES



2 Reduction of perceived Effort
BORG SCALE



3 **USABILITY & ACCEPTANCE**
MEASURES ★★★★★

MATE-XT positively impacts your Ergonomics: it is the first exo in the world included into an ergonomic standard for industries

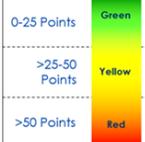
The ESO-EAWS version allows to calculate the reduction of the ergonomic evaluation score of manual work activities achievable thanks to the use of MATE

What is EAWS?

EAWS

THE ERGONOMIC ASSESSMENT WORK-SHEET

"EAWS is an **ergonomic tool for the assessment of the risk due to biomechanical overload**, developed to provide an overall risk evaluation that includes every biomechanical risk to which an operator may be exposed during a working task"

COMPREHENSIVE SYSTEM	PROVIDING A SINGLE SCORE	PLANT COMPATIBLE	USED IN MANY SECTORS	COMPLIANT WITH LABOR LEGISLATION
<ul style="list-style-type: none"> Body Postures Action Forces Manual Materials Handling Upper Limbs 		Link with MTM Industrial ergonomics	<ul style="list-style-type: none"> AUTOMOTIVE (OEM and suppliers) Large&Small DOMESTIC APPLIANCES AEROSPACE & DEFENCE AGRICULTURE & CAPITAL EQUIPEMENT MACHINES RAIL SUPPLY/TEXTILE/MACHINERY 	<ul style="list-style-type: none"> EU Machinery Directive (2006/42/EC, formerly 98/37/EU, 89/392/EEC) EU Framework Directive (89/391/EEC) <ul style="list-style-type: none"> ISO TR 12295 ISO TR 23076

A Comprehensive System

Risk Areas	Standards		Tools	
	CEN	ISO	Correlated single systems	Comprehensive systems
Body Postures with low external effort	1005 - 4	11226	OWAS	AAWS
Action Forces	1005 - 3	11228-2	RULA	
Manual Material Handling (Repositioning)	1005 - 2	11228-1	NIOSH	
Upper Limbs - high frequencies / low loads	1005 - 5	11228-3	OCRA, Strain Index, HAL-TV	EAWS

Click here to learn about EAWS --> <https://www.fondazionergo.it/advisory/exoskeleton--eaws-certification>

Click here to see the MATE EAWS Certificate --> https://www.fondazionergo.it/upload/EAWSform/20200520_SummaryReportFondazioneErgo_v01.pdf

ESO-EAWS project at a glance

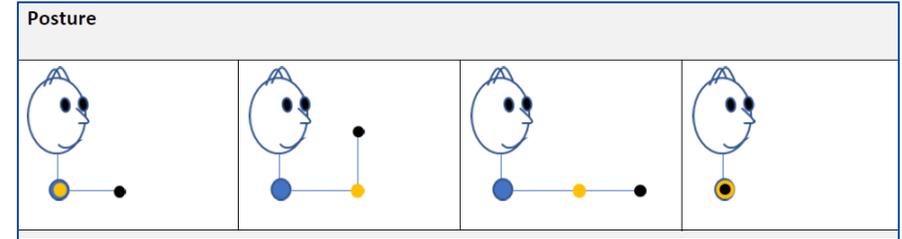
PARTNERS



METHOD

- **12 Volunteers**
- **12 simulated conditions** (8 static and 4 dynamic, with and without exoskeleton MATE)
- **EMG** of 6 main shoulder muscles

POSTURES



STARTING POINT

The ESO-EAWS Project starts from one of the most important open challenges that can be summarized in the question:

“How does standard ergonomics scale change with the use of exoskeletons?”

MAIN RESULTS

The results of the study confirm the **biomechanical load reduction effect**, measured by the EAWS system.

Postures and movements
Up to **30%**
EAWS SHOULDER SCORE REDUCTION

Upper Limbs
25%
EAWS SHOULDER SCORE REDUCTION

CERTIFICATION



MATE-XT

exoskeleton, used to conduct the first study ESO-EAWS,

is certified by the Fondazione Ergo as an effective tool to reduce the EAWS score

of Section 1 and Section 4, where awkward shoulder postures are involved.

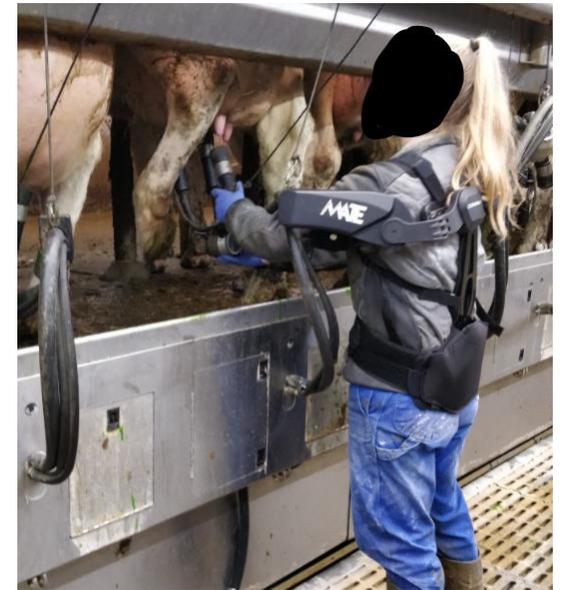
Click here to learn about EAWS --> <https://www.fondazioneergo.it/advisory/exoskeleton--eaws-certification>

Click here to see the MATE EAWS Certificate --> https://www.fondazioneergo.it/upload/EAWSform/20200520_SummaryReportFondazioneErgo_v01.pdf

REAL APPLICATIONS & INDUSTRIES

Agriculture / gardening / forestry

Pruning / fruit picking / handling /cutting / milking



Automotive / Aerospace / Railways

Screwing / drilling / riveting / Cabling / Sanding / maintenance



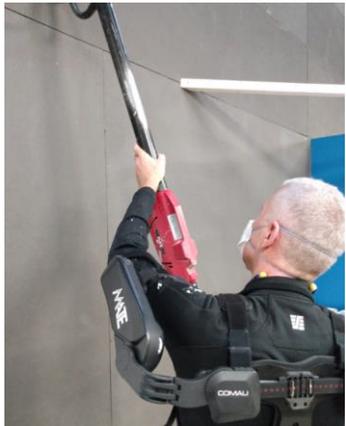
Automotive / Aerospace / Railways

Screwing / drilling / riveting / Cabling / Sanding / maintenance / painting / arc welding training



CONSTRUCTIONS

Drilling / sanding / painting / cabling / mounting drywalls/ maintenance



Electrical

Drilling / cabling / maintenance / mounting & cleaning of solar panels



FURNITURES / WOOD

Painting / Sanding / handling / nailing / riveting / sculpting



Food & Beverage

Handling / packaging / meat processing-cutting-trimming



Industrial machinery / Oil & Gas

Load-unload paint lines / Maintenance-inspections / handling



Service / Cleaning

Industrial laundry / hanging / windows clean / waste processing



[Video link](#)

Pharma

Vials inspections / analysis with lifted arms / maintenance / packaging



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website and find
everything you need!



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