

ErgoSkel

Dispositif d'Assistance Passive à la Manutention

Centre d'Expertise en Biomécanique du Mouvement - BMBI UMR 7338 CNRS



Khalil BEN MANSOUR

Khalil.ben-mansour@utc.fr



FM LOGISTIC

SATT
LUTECH

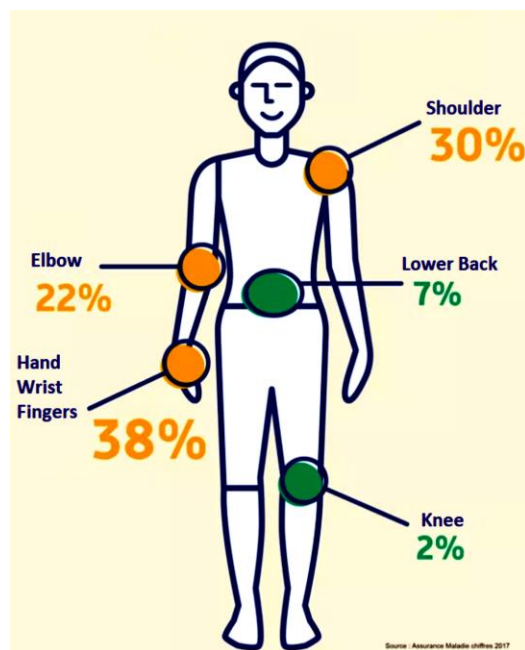
OCCO
Bureau d'études

HUBLEX

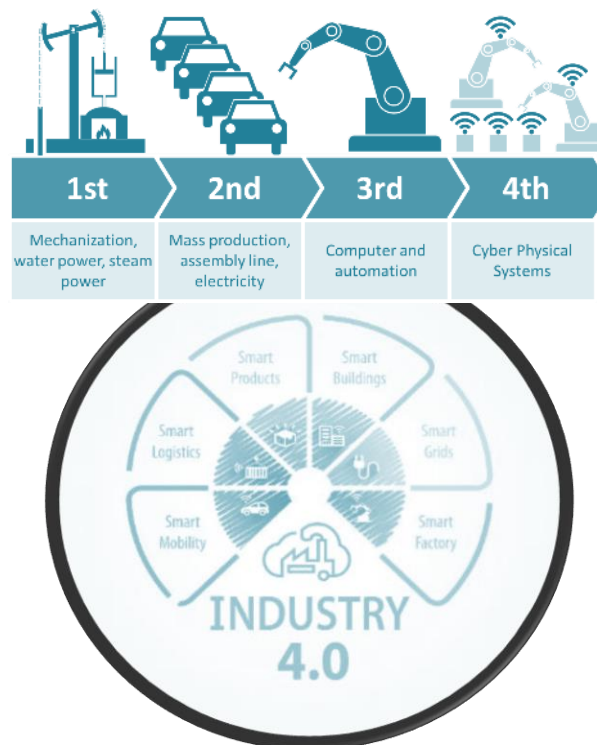
Contexte

Work-related Musculoskeletal Disorders (WMSDs) are the foremost cause of work disability and absenteeism.

WMSD is generating each year slightly more than 240 billion loss in Europe.

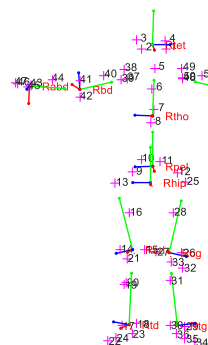
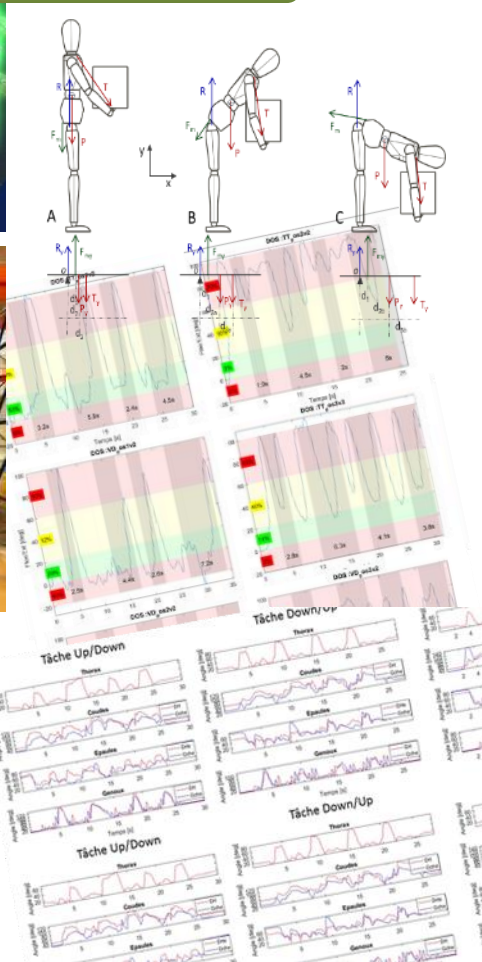
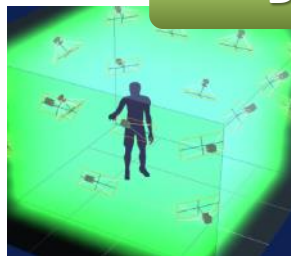
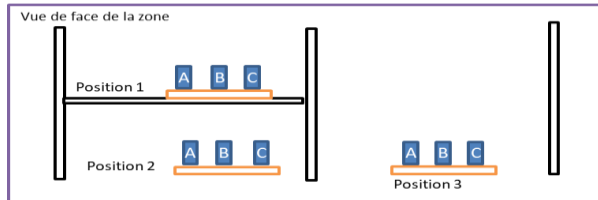


Body parts most affected by MSDs
(Assurance Maladie, 2024)



Diagnostic

Diagnostic



TRL1

Basic principles observed
Motion Analysis in situ
Tech and Biblio reviews

Review



Technical Choice

Technical choice

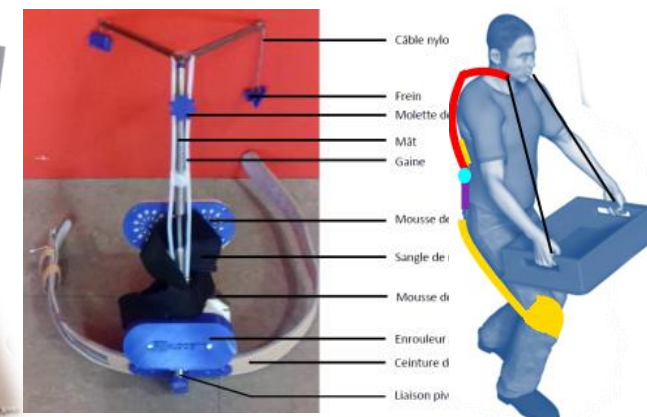
	Fonctions	Critères
F1	Porter une charge dont le poids est variable	Entre 2 et 30 kg
F2	Réduire les efforts articulaires : membre sup	Transfert des efforts à la ceinture pelvienne
F3	Ne pas limiter la liberté de mouvement	Liberté par bras, 3 pour la colonne
F4	S'adapter à la charge	Adaptabilité (H/F)
F5	Résister à l'usure	Usure, masse, bords coupants, cisaillement
F6	Résister à la déchirure	Résistance mécanique
F7	Être insensible à l'environnement	Exemples

TRL1

TRL2 & TRL3

Basic principles observed
Motion Analysis in situ
Tech and Biblio reviews

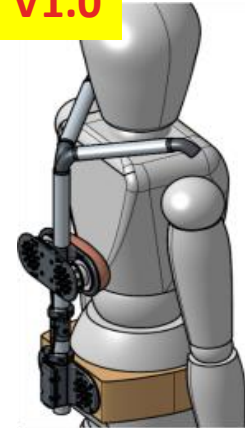
Tech. concept formulation
Experimental POC
development



POC

ErgoSkel Evolution

V1.0



V2.0



Câble nylon

Frein

Molette de réglage

Mât

Gaine

Mousse de confort

Sangle de maintien

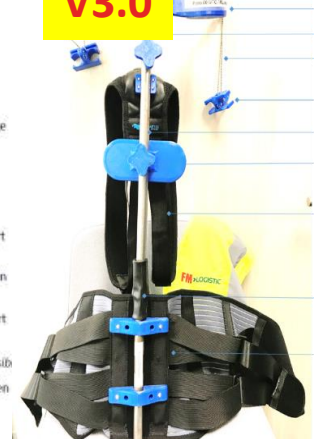
Mousse de confort

Enrouleur (non visib)

Ceinture de soutien

Liaison pivot

V3.0



Enrouleur

Ergo d'ajustement de la taille

Cordes

Freins

Mât

Ergo de confort

Ceinture scapulaire glissante et ajustable

Liaison pivot

Ceinture pelvienne renforcée



V4.0



V5.0



V6.0

TRL1

TRL2 & TRL3

Basic principles observed
Motion Analysis in situ
Tech and Biblio reviews

Tech. concept formulation
Experimental POC
development

Evaluation of the Exoskeleton

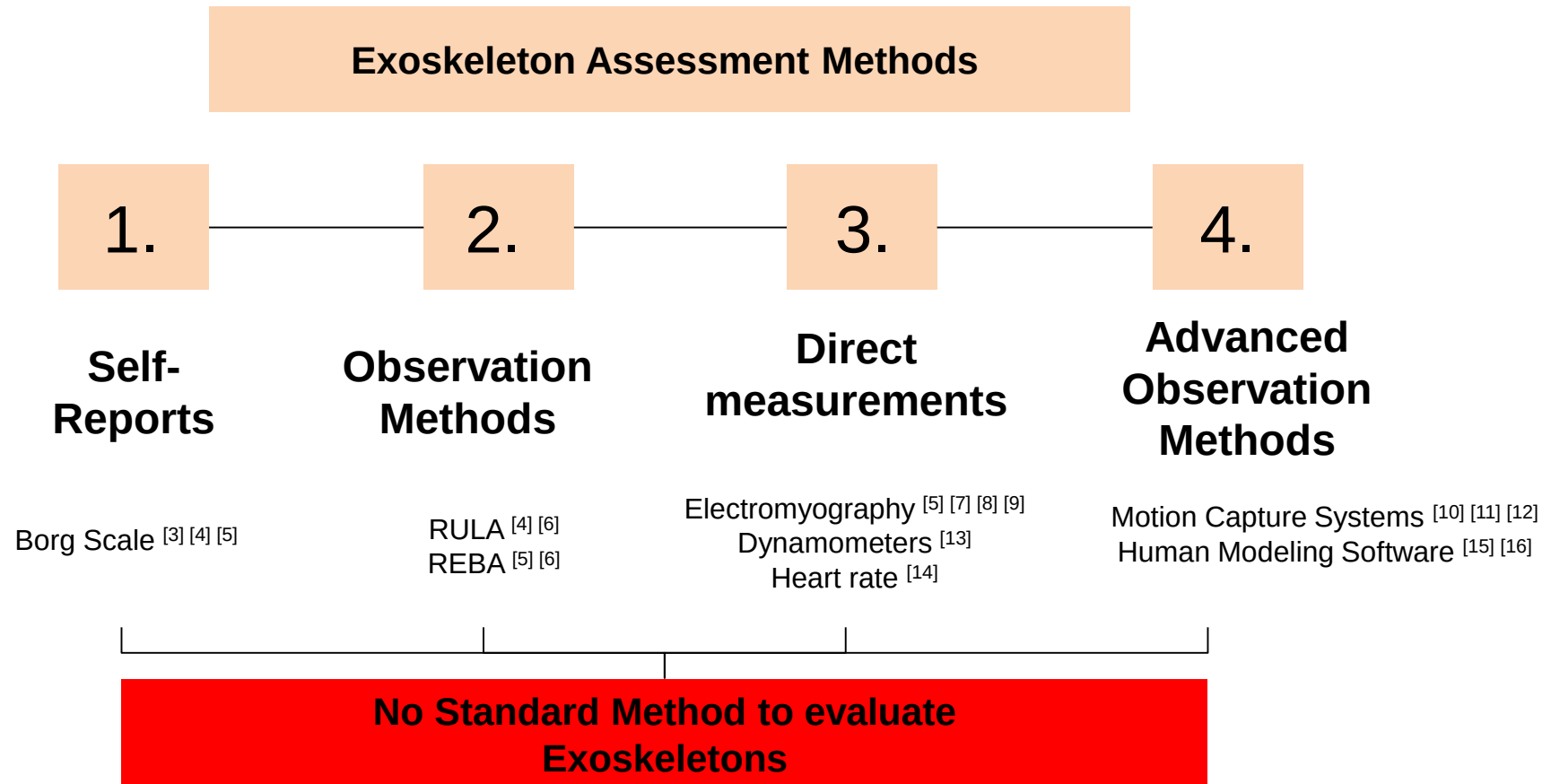


ErgoSkel

Weight : 1,8 Kg
Male and female
150cm – 200cm
Battery life :1 week



Evaluation of the Exoskeleton



Evaluation of the Exoskeleton



Towards Better Exoskeleton Evaluation Framework

Transparency Level

Evaluates the exoskeleton's ability to permit natural movement.

Assistance Level

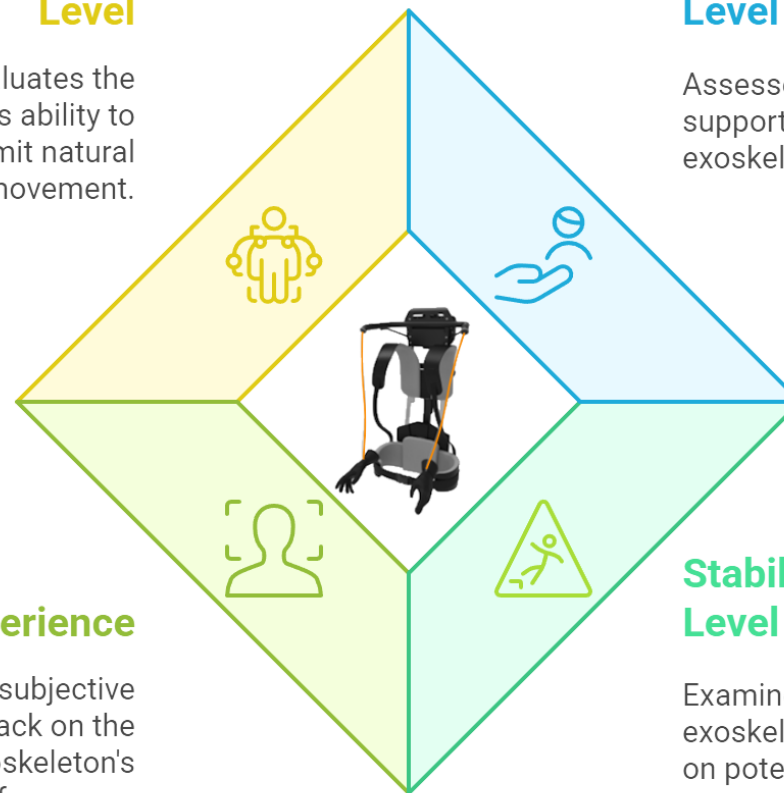
Assesses the level of support provided by the exoskeleton.

User Experience

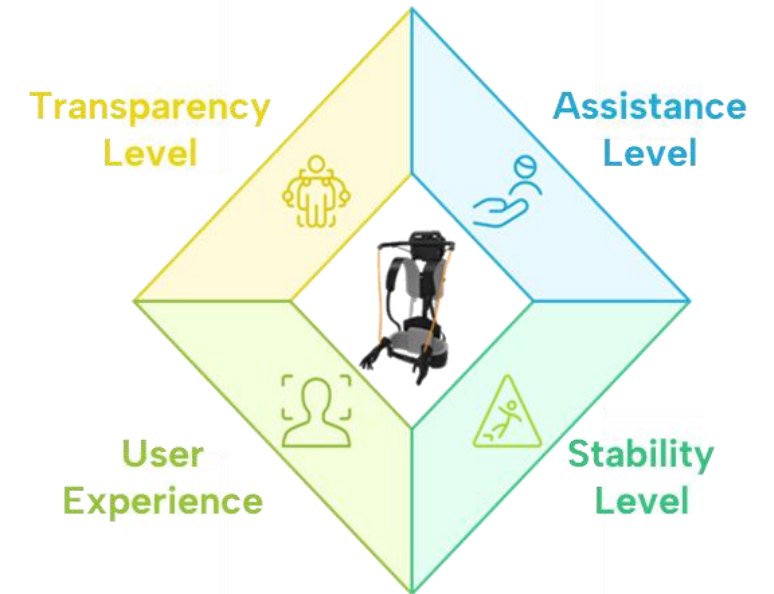
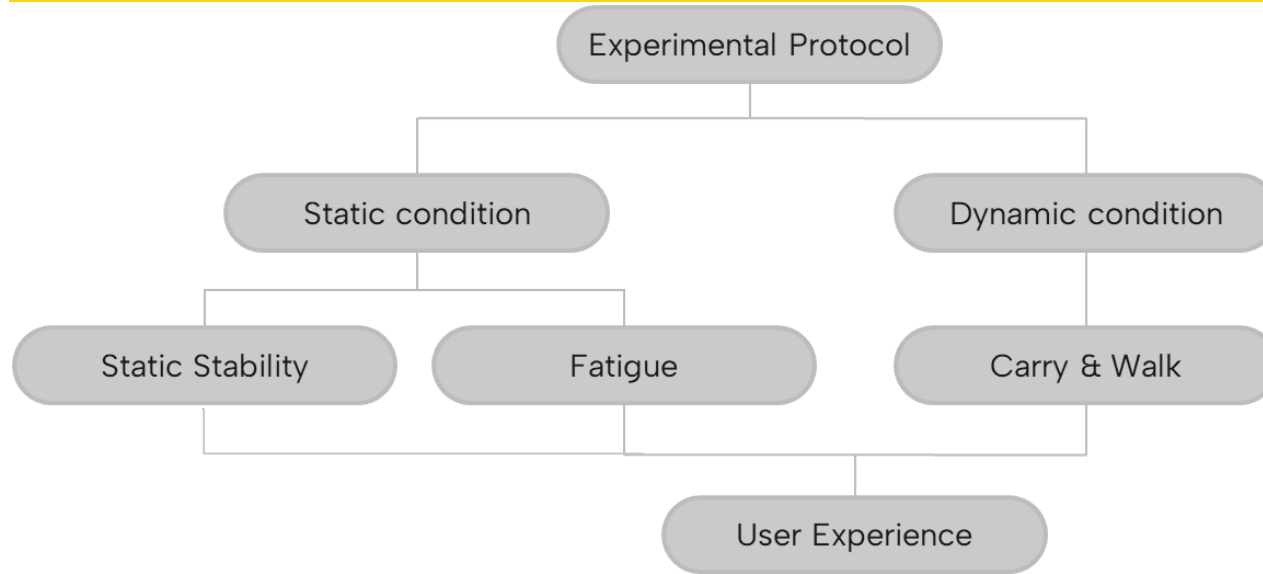
Captures subjective user feedback on the exoskeleton's performance.

Stability Level

Examines the exoskeleton's influence on potential fall risk.



Transparency Level



35 Subjects
17 Female
18 Male

6 subjects (3M, 3F) from FmLogistic

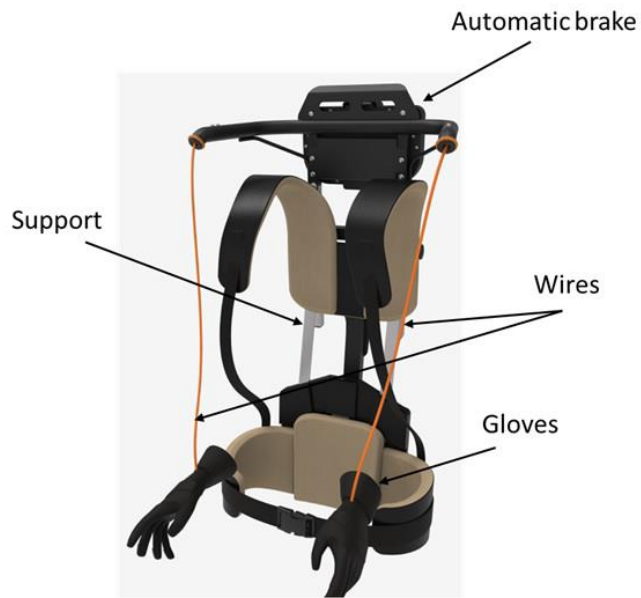
FM➤LOGISTIC

NE / WE : 0Kg , 5Kg , 10Kg, 15kg

1 Week familiarisation

Results

Patents : FR3095608A1 / EP3962700A1 / US20220212338A1 / JP2022530572A / WO2020225114A1



 Weight < 2Kg


 Robust


 Economic


 Design

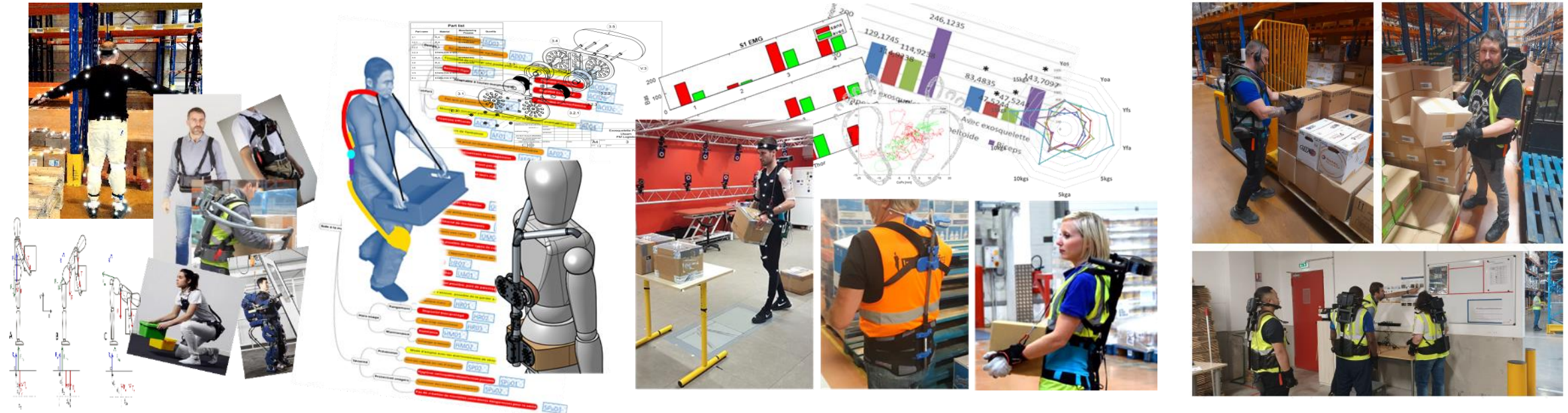
Transparent ~95%
User Movement Non-Constrained

Upper Limbs Join Forces ↘ 60%
Joint Force Reduction in Upper Limbs

Muscle Activities ↘ 60%
Reduction of Muscle Activity in the Upper Limbs

Fatigue 3 time less

Solution Proven in situ



TRL1

TRL2 & TRL3

TRL4

TRL5 and TRL6

TRL7, TRL8 & TRL9

Basic principles observed
Motion Analysis in situ
Tech and Biblio reviews

Tech. concept formulation
Experimental POC
development

User review
Tech. validated in lab

Tech. validated in situ
Tech. demo. in situ

50 ErgoSkel in situ
Sol° complete and qualified
Solution proven in situ

Perspectives

What is the effects of wearing it
after 6 to 12 months ? ?

We are working
on it !



PhD students

Yosra Tounekti
Julie Procopé

Internship students

Nour SGHAIR
Fabien ALDROBVANDI
Africa SANCHEZ VERA
Nicolas SHAN
Laurene DUBAIL
Jeanne MAILLARD
Audrey BERRAZ GHIATI
David SOLIS
Ariane ALEXANDRE

Merci!

