Robo.Mate

***Intelligent Exoskeleton** based on human-robot interaction for manipulation of heavy goods in Europe's factories of the Future.*

Project Facts

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement N°608979.

PROJECT OUTLINE

FP7 theme:	New hybrid production systems in advanced factory environments based on new human-robot interactive cooperation.
Duration:	September 2013 – August 2016 (36 months)
Total costs:	5,879,430 euro
EC contribution:	4,449,973 euro

PARTNERS

zh aw School of Engineering

accelopment

GÜDEL

indra AUTOMOBILE RECYCLING

Fraunhofer

MRK-SYSTEME GMBH

CRF CENTRO RICERCHE FIAT

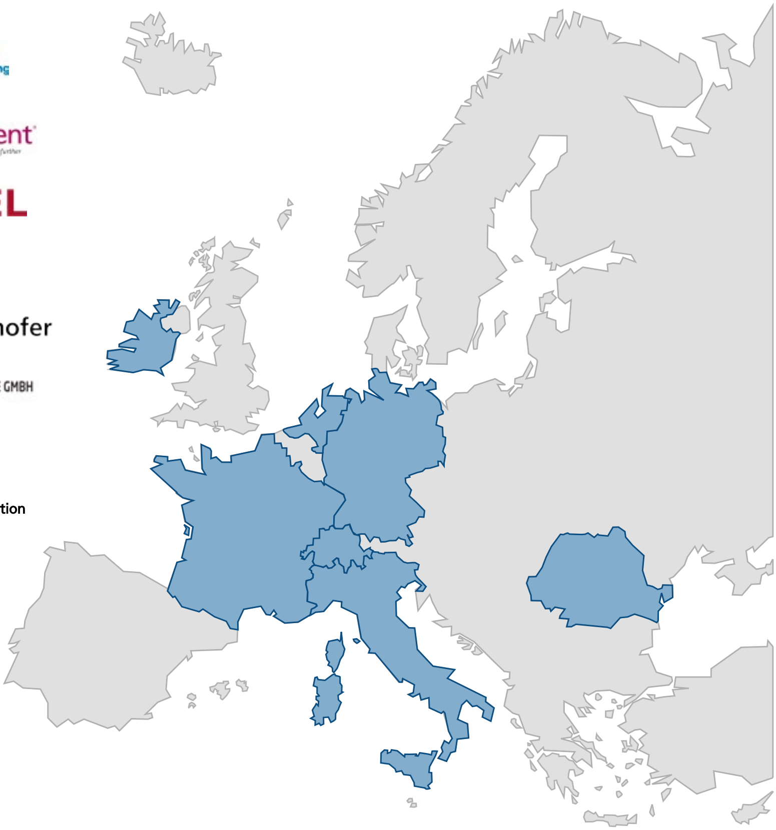
TNO innovation for life

ROPARDO

iit

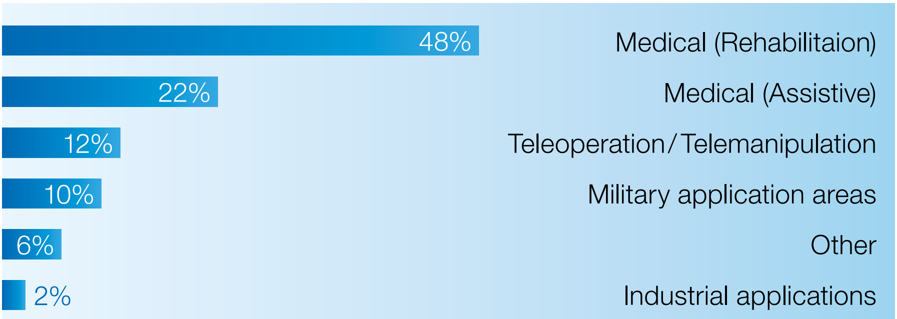
compa

University of Limerick



EXOSKELETONS IN USE

Based on the literature, exoskeleton research focuses on the medical and the military application areas.



Stadler, Konrad (2013). Exoskeletons - Von der akademischen Vision zur industriellen Anwendung. In: Internationales Forum Mechatronik. Winterthur: ZHAW, Institut für Mechatronische Systeme.

Exoskeletons for industrial applications have not reached sufficient attention so far.

Causes may be:

- Missing standards for exoskeletons in industry.
- Benefit unclear and risk of acceptance is high.
- Complexity of movements is very high.
- Power source for long shifts unclear.

Potential benefits:

- Increased production efficiency and flexibility.
- Reduced work-related musculoskeletal disorders.

INDUSTRIAL CHALLENGES

Compared to other application areas, industrial use of exoskeletons faces several challenges:

- Exoskeleton is operated in a not clean and non-smooth environment.
- Typical movements are lowering, lifting and carrying over short distances (<10m), hence many movements need to be actively supported. Hindering or slowing down the usual (or natural) movements will reduce user acceptance.
- User and company benefit needs to be obvious.
- Shift of 8 hours, hence special attention on comfortableness and user friendliness needed.
- Adaptations to workflows may be needed for optimal exoskeleton usage.

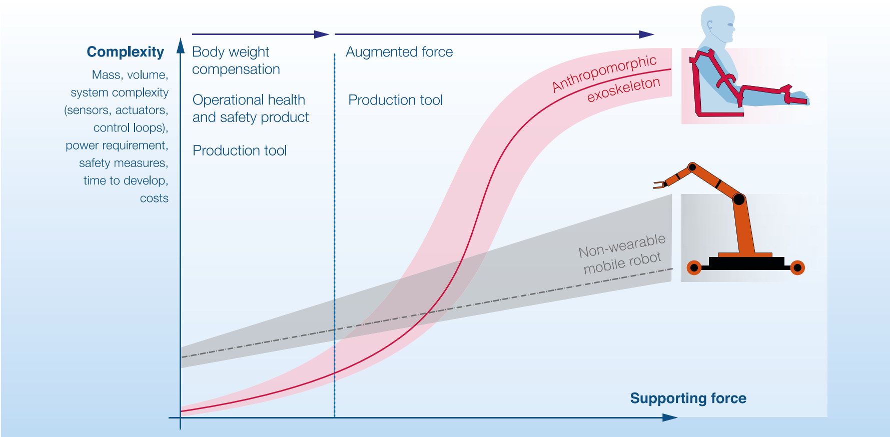
DEFINITION OF USE CASES

An initial analysis of our end-users' production lines showed the following results:

I. Two handed manipulation of goods between 5 and 15 kg for lifting, carrying and lowering.
II. One handed positioning of an object up to 7.5 kg for postural support.

DEVICE COMPLEXITY

Non-wearable mobile robots have the same functionalities included independent from the supporting force.

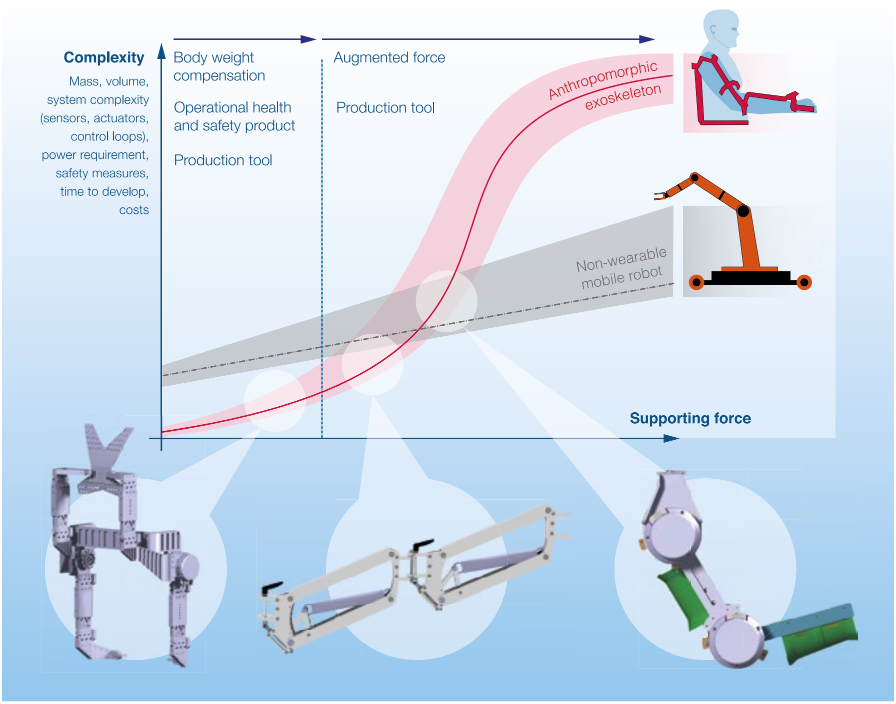


Wearable exoskeletons on the other hand can be separated into low complex devices, which compensate only the user's bodyweight. Passive elements (like springs or dampers) can provide efficiently supporting forces to reduce lower back compression forces or counteract gravitation. On the other hand, increasing the supporting force means that sensors, actuators and batteries and many other elements are needed, which increases the complexity of the device. As the exoskeleton is coupled tightly to the user's body, special measures for safety, separation between body and load weight and other functionalities require many more elements than for the non-wearable mobile robot. Resulting in more expensive devices.

To design an exoskeleton to support heavy loads is therefore not economically reasonable. Especially, as manipulating heavy loads is often already supported by appropriate devices. Providing relative low supporting forces with a light weight device, which reduces the risk for work-related musculoskeletal disorders, is however economically interesting.

MODULAR DESIGN CONCEPT

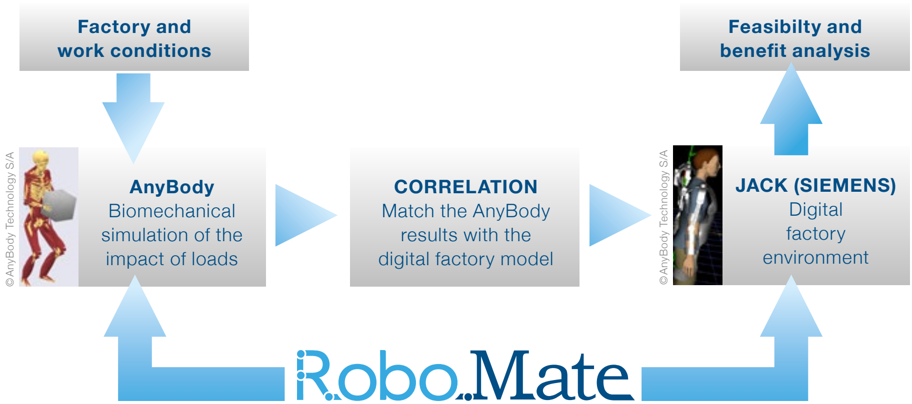
To cover all tasks with one single device will most likely impossible. For this reason, industry can select from a range of Robo-Mate modules to support a specific task or several tasks in an optimal manner.



- Trunk module to reduce lower back compression forces. Provides base for arm modules and external communication.
- Passive arm modules based on springs to provide gravity compensation and facilitate positioning of loads.
- Active arm to compensate higher weights during lifting, carrying and lowering.
- Human-machine-interface, which includes work flow advice and exoskeleton state indication and configuration.

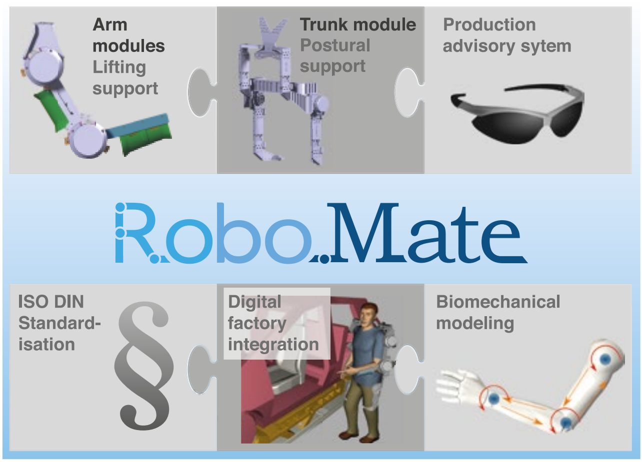
ROBO-MATE AND DIGITAL FACTORY SIMULATIONS

In the Digital Engineering Lab (DELAB) at Fraunhofer IAO it is possible to experience products and their production before they actually exist.The focus of the work carried out in this "living lab" is the process chain from the idea for a new product through to planning the product's manufacturing and assembly.

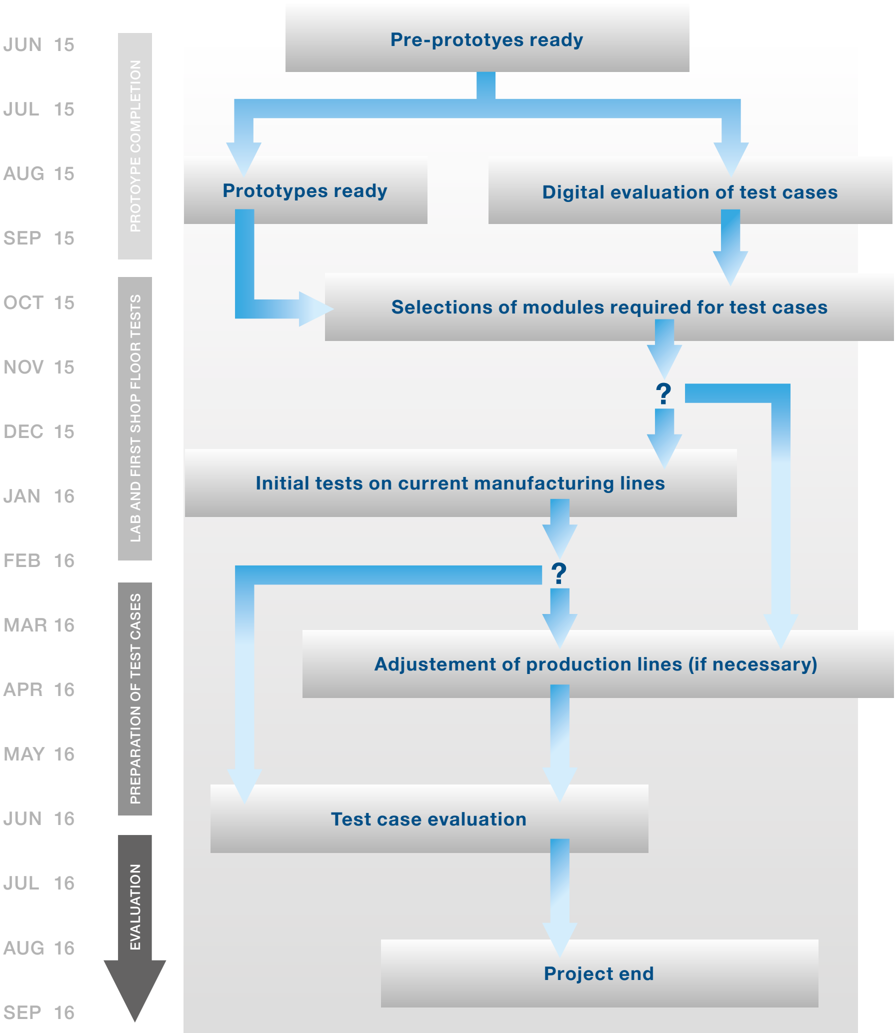


Our aim is to show the improvement of the manufacturing processes at factory and workplace levels when Robo-Mate is used. For this purpose, the impact of loads with and without Robo-Mate is evaluated based on biomechanical stress simulations in AnyBody. These results are then correlated to the digital factory environment (Jack) where Robo-Mate is tightly integrated to study ergonomic benefits and production efficiency of the manufacturing steps.

PROJECT OUTCOME



PROJECT STATUS



CONTACT

Prof. Dr. Wernher van de Venn
Robo-Mate Coordinator
Institute of Mechatronic Systems (IMS)
Zurich University of Applied Sciences (ZHAW)
Phone +41 58 934 77 89
Email wernher.vandevenn@zhaw.ch

www.robo-mate.eu