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A+A 2021 Safety and Health at Work thanks to Exoskeletons

Young technology: power packs for the back

Exoskeletons are external support or assistance systems worn on the body. They are available as so-called active and passive models. Both are designed to relieve people in jobs with physically demanding movement sequences. Some companies such as VW or Ikea are already working with them, others are still in the test phase.

Despite all the advancements in the working environment there still exists: jobs in logistics, industry or skilled crafts where heavy objects have to be regularly lifted and lowered in ergonomically unfavourable postures, where tasks have to be performed above the shoulder and head time and time again and where robots cannot (yet) take over these jobs from humans. These are the areas of application for exoskeletons. They take the burden off their users because over time these physically demanding activities can make you ill.

Musculoskeletal disorders – the technical term for this – are diseases, disorders and injuries of the postural and locomotor apparatus. They are among the most common disorders in Germany. They cause chronic pain, physical functional impairments and result in a loss of quality of life. Even today they result in high absenteeism figures. According to the RKI these disorders increasingly occur in old age. Considering demographic change we can assume that the number of people affected will rise dramatically.

“Power backpacks” for more ergonomic working

Exoskeletons are designed to help prevent musculoskeletal disorders. This is why bigger companies as well as smaller ones have already bought these “outer skeletons” – they can be purchased or leased. Others are currently testing them as assistive technology. By using them, employers hope to reduce sick leave and absenteeism while achieving higher productivity and relieving exhaustion over the duration of the shift. After all, these “power backpacks” – they are put on like a backpack, closed in front of the body and can be adapted to various body lengths and girths – can make for improved work and a lower susceptibility to injuries after a well-planned and in part supplier-supported introductory phase. Beyond this, the employer’s care can have a positive impact on staff motivation.

So-called passive exoskeletons operate mechanically. They can be used for dynamic and static jobs in inclined postures to reduce the load. Depending on their design they are suitable for executing jobs above shoulder and head height as well as for load handling. Suppliers include Ottobock, Auxivo or Hunic. The effectiveness of these power backpacks



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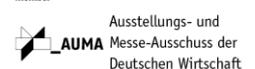
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was testified by wearers in trials. They were perceived as relieving even though the assisted working and re-distribution of forces from the back to the hip and legs require some time to get used to.

Exoskeletons as Ultima Ratio

With a view to relieving its warehouse staff when performing physically demanding jobs with lifting and turning movements, logistics company DB Schenker has put several models (Paexo Back and Paexo Soft Back by Ottobock, Auxivo, Hunic, German Bionic Cray X, to name but a few) to the test at various sites in Germany, Poland, Switzerland and Sweden. The jobs here include sea freight (container unloading), air freight, land transport as well as contract logistics (picking and packaging of parts, parcel handling). The exoskeletons that combine machine power with human movement competence are designed to assist staff on these jobs in a preventive manner by saving their lumbar vertebra and back muscles. "We regard this as Ultima Ratio," says Gerald Müller, Head of Industrial Engineering at DB Schenker in Germany, and goes on to say: "Centrestage for us is the efficient design of workplaces to start with. There are various possibilities such as the automation of processes, technical aids or work-organisation measures. If these measures do not make technical or economic senses the use of exoskeletons can be one solution approach." Here, workers' acceptance is first and foremost.

Acceptance more important than the product

At DB Schenker both passive and active skeleton models were tested. "At the beginning lots of explanations are required and trials have to be accompanied by coaching. The introduction is not always easy – you have to convince people of this novel solution," explains Gerald Müller who knows this from experience. After all, he says, exoskeletons are high-tech devices and not everybody can acquire a taste for working with an assistive device or even robot on their backs.

The fact that acceptance is a key point is also confirmed by Dr. Sönke Rössing, Manager of Ottobock Bionic Exoskeletons. "We always develop our products in close cooperation with customers. To this end their workstations and workflows are analysed in detail. Users are meant to feel as if they were working without outside assistance when moving," he says. "Our ergonomics experts provide support for the on-boarding and evaluation." The exoskeleton Paexo Back operates biomechanically. Like with a professional backpack the load is absorbed at the shoulder and diverted to the thighs by means of the supporting structure. The energy storage system absorbs force while bending and releases it again when lifting. This leads to up to 25 kilograms less load on the lower back. Major enterprises like VW, Airbus, Daimler, SNCF and Toyota in the USA but





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also small and medium-sized companies such as pre-fabricated house manufacturer FingerHaus already work with Paexo.

Connected exoskeleton platform, for IoT integration and smart factories

Sharing this view is Dr. Peter Heiligensetzer, founder and CTO at German Bionic. The start-up company specialises in “Smart Exoskeletons”. Here, too, the introduction is a crucial factor. “Cray X is the first and only smart exoskeleton on the market,” says Heiligensetzer. It is software controlled and takes over up to 60% of muscle activity, the major part when straightening the body. During this movement the smart power suit supplies energy thereby providing active support. The load is re-directed from the back to hips and legs. This saves the back and requires less oxygen, work is perceived as being less tiring overall. The Stuttgart Airport and Ikea have already equipped their employees with Cray X.

The smart robotic exoskeleton by German Bionic can be seamlessly integrated into any IOT environment and any smart factory. It can collect and retrieve data, it can be remotely maintained and constantly learns thanks to Artificial Intelligence. This means it can be adapted to individual processes and to its wearers by means of movement and weight data. Updates can be installed by mobile phone overnight. Cray X can even tell wearers that the load they are lifting is too heavy or that they should take a break.

DB Schenker: Practical tests as a basis for sourcing

The results of the field tests at DB Schenker were positive across the board. Room for improvement was only seen for wear properties with both the active and the passive exoskeletons during the first trial run. “Industrial exoskeletons are a fairly young discipline. We cooperate very closely with the suppliers here. Our feedback was fed directly into the successor models, which we were able to try out already,” says Gerald Müller. Despite its higher weight of 7kg the active Cray X exoskeleton has reduced the muscle power required by up to 50 %. The Paexo models by Ottobock in trial run 2 also provided convincing results. Proving especially lightweight at approx. 1 kilo are the textile exoskeletons by Auxivo and Hunic: “They are particularly suitable for applications requiring high physical flexibility,” says Gerald Müller.

Not every exoskeleton is suited for every job. Decisive criteria for their selection are spatial conditions, weight, the radius of movement at the workplace as well as flexibility when it comes to driving forklift trucks. In the final analysis, all models tested produced convincing results in different fields of application. DB Schenker has compiled the experiences





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gained from the trials in a kind of decision matrix. It is to serve sites as a basis for decisions when sourcing exoskeletons.

Exoskeletons in Action at A+A 2021

Find everything on exoskeletons at A+A pooled in Hall 10. It houses the Robotics Park where exoskeleton manufacturers are presented together with the Fraunhofer IPA. At the adjoining Selfexperience Space visitors can experience and try out these innovations for themselves. In addition, as part of the Robotics Park, the Fraunhofer IPA and the Stuttgart University IFF will present a live study with the EXOWORKATHLON. For more information visit: www.aplusa-online.com/en/Home/Program_2021/Robotics_Park

Captions

1. Practical test at DB Schenker in Leipzig
2. Overhead work in the workshop with Ottobock Paexo Shoulder
3. Lifting heavy loads with Ottobock Paexo Back
4. Hunic: Lifting heavy loads with Hunic SoftExo Lift work
5. Hunic SoftExo Back view
6. Laevo Collage
7. Auxivo_Freedom: Wide range of applications



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