

## Next-Level Technology:

# Are Powered Exoskeletons in Your Future?

The hero in the 1970s TV series *The Six Million Dollar Man* was an injured pilot whom scientists had rebuilt with bionic limbs and implants. This seemingly impossible notion no longer seems so far-fetched. Today, all kinds of organizations are outfitting humans with exoskeletons—wearable devices that assist users with tasks that stretch the limits of their physical capabilities.

Exoskeletons, which can be passive (mechanical) or active (powered), enhance user mobility or physical strength and alleviate the side effects of repetitive motion. Some people mistakenly refer to powered exoskeletons as robots. While powered exoskeletons may contain robotic components, humans must wear them to initiate their functions. The role of exoskeletons is to assist—not replace—the wearers, who bring the necessary skills to complete specific tasks.

Across many industries, leaders are rapidly adopting exoskeleton technology to keep workers safe and productive in high-pressure, dangerous situations. [According to Forbes](#), the number of businesses designing, manufacturing, and selling wearable exoskeletons grew 350% from 2015 to 2020.

“The latest powered exoskeletons have sophisticated features that allow them to anticipate the user’s needs,” says Jose Vazquez, Director of Defense and Security at Boston Engineering. “Over time, these exoskeletons will learn from the way the wearer moves and become even more intelligent.”

Vazquez and his colleagues at Boston Engineering have spent 3 years testing and analyzing exoskeletons for an ongoing [U.S. Army exoskeleton project](#). The analysis revealed that selecting the right product for the job, ensuring proper fit, and providing training yield significant benefits. The team also learned that although some exoskeletons outperformed on certain measures, such as the amount of weight they could lift, others were nimbler and more effective with complicated maneuvers. When addressing military needs for exoskeletons, current (and future) products have room to improve in terms of form, fit, and function.

**Rather than searching for the best exoskeleton, business leaders and decision-makers should aim to find the right device for the task at hand.** Doing so boosts efficiency—and, more importantly, safety—in military, commercial, medical, and other settings.

### Military

Like many technological advances that have achieved widespread consumer adoption, exoskeletons were initially invented for the military. The first exoskeleton—which [General Electric](#) developed in 1965 as part of a joint Army-Navy initiative to amplify human strength—enabled individuals to lift 1,500 pounds. This early prototype paved the way for future iterations of exoskeletons that were smaller but more powerful.

Today, the military is exploring the use of exoskeletons for movement and combat support, reducing the physical burden on soldiers and permitting them to carry heavy loads. For example, devices that support

the upper body, lower back, and hips allow military personnel to load extremely heavy rounds into guns—a highly complex maneuver that requires an agile exoskeleton.

**“By taking the load off, an exoskeleton lets soldiers do that task more effectively and efficiently. It also reduces the metabolic costs and lowers the chance of injuries.”**

**- Jose Vasquez, Defense and Security Director**

When assessing exoskeletons for the military, features such as quiet actuators and lower snag risk are just as critical as the ability to lift heavy weights or support movement over long distances while carrying a load. In this case, sleek exoskeletons that support the lower body preserve soldiers’ strength, energy, and health so they can do their best work while protecting our nation.

## **Commercial**

The manufacturing industry adopted exoskeletons because they fulfill an urgent need for safety and productivity. These exoskeletons emphasize ergonomics to make repetitive actions less harmful and more efficient.

In this context, exoskeletons cut down on common injuries, such as shoulder injuries that occur when people are working on items overhead. For instance, in the auto industry, exoskeleton vests help workers raise their arms to reduce strain when reaching for vehicles and lifting heavy parts.

For commercial applications, exoskeletons that support the upper body reduce fatigue and improve efficiency. As a result, employees can concentrate on maximizing output rather than the distraction of physical burdens.

## **Medical**

Medical exoskeletons were the first exoskeleton systems to undergo more widespread testing, evaluation, and use. They are currently used for rehabilitation and mobility, such as assisting patients with limited movement or difficulty walking due to injuries or debilitating neurological conditions. The impact is immense, as patients can regain the ability to walk or do essential tasks such as feeding themselves.

Exoskeletons for patient use are classified as medical devices and therefore require regulatory approval. It is important to account for regulatory considerations when choosing an exoskeleton for patient care, because there are limits on who can use them and how.

The R&D timeline for medical exoskeletons differs from other industries because safe use for the proper medical is crucial, as is understanding emerging and evolving regulations.

In addition to serving patients, exoskeletons prevent injuries due to repetitive movements and heavy lifting in healthcare workers. The [Centers for Disease Control and Prevention](#) suggests that exoskeletons may be a valuable tool to reduce the risk of musculoskeletal disorders, which are common in healthcare workers. [Physicians in France](#) and [nurses in Finland](#) are now testing exoskeletons to relieve the physical challenges of their jobs.

## Evaluating Exoskeletons

If you have workers who are stretched to their physical limits, you may wonder whether a robot or an exoskeleton could be a solution. If people do not need to be on-site, a robot could be a fit. However, in cases that require the intuition and flexibility that only humans can provide, a wearable exoskeleton fills the gap between humans and machines to deliver the best of both worlds.

As the worldwide effort to develop, improve, test, and implement exoskeletons continues its upward trajectory, new products and product improvements are entering the market at a steady pace. Are you ready to shop for an exoskeleton? If so, remember that limited data are available to compare devices. When researching the best options, be sure to:

- Precisely define and understand your requirements. What problems are you trying to address?
- Compare your requirements with the features of commercially available exoskeletons or with industries that are implementing and using exoskeletons successfully.
- Select the closest match for the task at hand.
- Work with the manufacturer or a third party to modify the exoskeleton to fill any gaps between your requirements and off-the-shelf capabilities.
- Identify the best sources for data and information and reach out to standards and test methods organizations such as ASTM International (a Boston Engineering partner).
- Ensure you comply with emerging standards and test methods, National Institute for Occupational Safety and Health regulations, defense and military specifications, and any applicable specialized industry regulations and policies.

Safety and ease of use are important factors in the success of exoskeletons. After all, if an exoskeleton is easy to put on and take off—and, in the case of powered systems, is intuitive to operate—users will have better experiences that lead to enthusiastic adoption and superior outcomes. But to fully understand what an exoskeleton can or cannot do, you must wear it.

A thorough exoskeleton analysis also includes simulations, failure modes and effects analysis (FMEA), lab testing, field testing, and robotics testing with academic partners. If you are considering a powered exoskeleton, you must validate all robotic components; examine the power limitations; test the form, fit, and function; and confirm the system's security against potential cyberattacks.

The field of robotics is technologically challenging. Powered exoskeletons are even more complicated than stand-alone robots because people wear them. Forward-looking business leaders understand that the benefits of exoskeletons greatly outweigh the challenges, which is why these devices are increasingly moving out of science fiction and in to the advanced workplace.

**[Download our exoskeleton report](#)** to explore the possibilities for a safer and more efficient future.

Boston Engineering Corporation | 300 Bear Hill Road Waltham, MA 02451

[boston-engineering.com](http://boston-engineering.com) | [info@boston-engineering.com](mailto:info@boston-engineering.com)