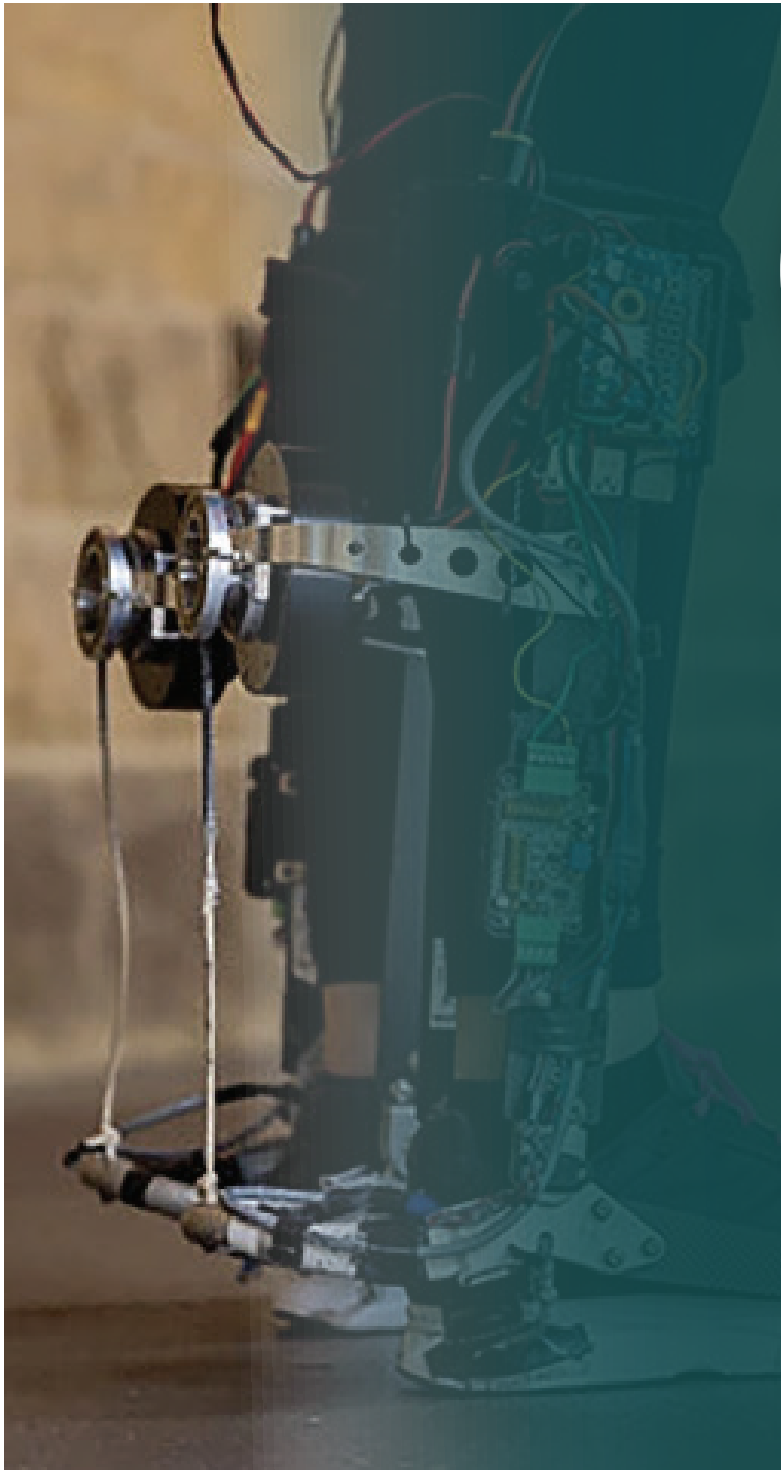
TechSci Research
from NOW to NEXT

Interview on Exoskeleton Industry

TechSci Research Analysts in Conversation with

Borislav (Bobby) Marinov

(Co-founder of the Exoskeleton Report (ExR) and a founding member of the ASTM International Exo Technology Center of Excellence (ASTM ET CoE))



In Conversation with

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How is your work related to smart exoskeleton industry?

My name is Borislav "Bobby" Marinov and I am the founder of the ExoskeletonReport.com news and resource website. In addition, I am a founding member of the ASTM International Exo Technology Center of Excellence, which focuses on research-to-standards in support of ASTM Committee F48 on Exoskeleton and Exosuits. Committee F48 has now published 22 consensus-approved standards on exoskeleton technology, and I am happy to be the current vice chair for it.

What made you develop Exoskeleton Report? Can you elaborate the journey.

Originally, I wanted to create my own exoskeleton company and create a physical product for able-bodied individuals that needed some augmentation or those suffering or recovering from a physical impairment that could use some assistance.

I have been following exoskeleton development since 2001, and I thought that in 2015 the technology had reached sufficient maturation for me to focus more of my attention on it.

I quickly came to discover that there were more exo companies and devices in the prototype or early production phase than I could have imagined. However, there was limited communication, coverage, or excitement around this emerging technology.

It was then I decided that I could be more influential in furthering the proliferation of this technology to those who may benefit from it, not by being another engineer making devices in a silo but someone who openly talks about it.

How is exoskeleton report platform helping the world? Is it the only platform or are there others as well.

The goal of the Exoskeleton Report is to create news and reference information on exoskeleton technology that is independent, impartial to any developer or distributor, and is free of hype or science fiction. There are now multiple other platforms that include exoskeleton technology as part of their portfolio. One recent addition is https://orthexo.de/en/.

How has the scenario of adopting exoskeleton changed over the last few years? How do you see the future of the exoskeleton industry?

Exoskeleton adoption has changed dramatically over the past five years. The focus is now shifting to long-term implementation. Earlier, these types of devices were eager to get their foot in the door and demonstrate that they can have a positive return on investment (ROI).

The focus was, therefore, on discovery, selecting the right exo for the right task, and running a pilot study that determined if the wearable was beneficial or not. It turned out that this was not sufficient. As it stands, exoskeleton technology needs additional help with long-term adoption past a 2-6 weeks pilot program at the buyer's site. Is it clear how the exoskeletons, once purchased, will be cleaned or stored? How often should they be inspected? Who at the customer's site is responsible for checking them, and to whom within the organization can issues be reported? Who is responsible for informing all interested parties at the customer's site? For example, if a person wearing an exoskeleton has a cardiac emergency, does the local emergency response team know if the purchased exoskeleton will interfere with an AED, and if so, have they been shown how to remove it?

This above is just one simple example of how the "book" on exoskeleton implementation is being re-written over and over again at the moment. Unfortunately, there has been little sharing of information. The Automotive Exoskeleton Group (AExG) was created for this purpose. Unfortunately, their members have been slow to release any guide or lessons learned in the public domain. This is not to be taken as criticism but as reality. I have seen some guides on selecting and implementing exoskeleton technology, but I have not seen one available to the general public and reviewed and approved by at least a handful of organizations.

This is why the work of ASTM International, ISO, IEEE and others is so important. It needs to become easier for the right device to be selected for the right task, and the buyer or integrator of the technology should have some help in the form of guides, white papers or standards. As it stands, there is no exoskeleton trade association that is actively assisting with this. The closest that we have is WearRA (wearablerobotics.com) which host the WearRAcon conference series and 3E, the organization of EU exo distributors.

What is the difference between a normal exoskeleton and a smart exoskeleton?

"Smart" exoskeleton is not a commonly used term in North America. Usually, exoskeletons are divided by passive (also sometimes referred to as elastic) and active. In short, it comes down to the power source. If an exo uses electrical motors, or a hydraulic or pneumatic is referred to as "active." If it uses elastic elements that store potential energy, springs or dampeners, it is commonly referred to as "elastic."

There are some exoskeletons that are both, usually called quasi-passive. For example, a small electric motor can control when a spring is engaged or disengaged. The industry has recognized that exoskeleton adoption is partially dependent on data and data collection.
These days, even purely passive exoskeletons with no electrical or other power supply can have 3rd party or even specially made wearable sensors that track the exo's use, thus making even the simplest system a "smart" device.

Can you comment on the demand for normal exoskeleton and a smart exoskeleton worldwide.

The demand for exoskeletons is steadily increasing at what appears to be a linear rate. Again, there is no exoskeleton trade association, so there is no definitive way to prove this. This has come to the disappointment of exoskeleton enthusiasts around the globe who see a great deal of potential for this technology to make the lives of people better, but the rate of adoption is only steadily increasing.
Passive exoskeletons are outpacing powered devices. Mainly, powered exoskeletons are more expensive, have a higher cost of ownership, and still struggle with their controls. Even if a powered exoskeleton's sensors can predict the desired movement of the user 95% of the time, that can still lead to over 100+ mismatches during a single work day.
A passive exoskeleton, on the other hand, will always compress the same way, leaving the user with few surprises. This is not to say that one device is better than another. For example, all powered exos come with data collection, while additional sensors have to be attached to a passive one. There are also some tasks that a passive exo will just never be able to perform.
Over time, I expect that all exoskeletons will have "smart" functionality added to them. The users and buyers of these devices, on average, want to have some usage statistics at a minimum.

Even after so many years exoskeletons and smart exoskeletons have not gained so much popularity. Please comment.

This is the heart of the Exoskeleton Report, and it is important to emphasize that things have improved dramatically over the past eight years. The main reasons why exoskeletons have not gained much popularity have been poor communication and the interdisciplinary nature of the technology.
Communication: up until a couple of years ago, it was impossible to find an exoskeleton article in the general media without some confusion with

IronMan and science-fiction. Furthermore, each company had a different way of explaining exoskeletons. In one extreme example, a Japanese exoskeleton manufacturer had switched their own terminology in their patent applications three times in just a few years, making it very difficult to search or accumulate information.

Things have gotten a lot better since then! How the industry talks and communicates what an exoskeleton is, and what it can and can't do has dramatically improved over the years. Sooner or later, this will yield a positive effect and bring more interested parties to the table. Just last week, for example, Boston Engineering held a mini exoskeleton demo day at the US Senate, the first of its kind that I know of. And they have plans for a much bigger one soon.

The second hurdle is just how interconnected and interdisciplinary the exoskeleton industry is. Exoskeletons are tools (mechanical engineering), that may have some power or sensors (electrical engineering) that interact with people (ergonomics, anatomy & biology), that need to be accepted by the users (psychology) because they can't be dropped and picked up whenever.

An older name for exoskeletons was bio-mecha-tronic devices. An intersection of biology, mechanics, and electronics. And now that we know that long-term adoption is a challenge, we have to add psychology and change management as well. This is not easy. In general, it is very hard to master all of these disciplines simultaneously.

The interdisciplinary nature of exo technology and desynchronized communication is being addressed on a daily basis.

For what purpose is smart exoskeleton majorly used and why? Can you elaborate the use case scenario across different industries.

This is challenging to summarize. There are main branches depending on the use case:

Medical: exos can help ambulate patients using fewer trained staff and/or reducing the risk and burden to the staff. They can also deliver more repetitions that are far more reproducible and consistent. However, the "so what" has not been definitely determined. For this application, medical exos are tools to be used until the person gets better. There are also medical exoskeletons for functional compensation, where we don't expect the person to get better over time but could still benefit from the technology to regain some independence.

Occupational: people around the world work tough jobs and get injured and retire with injuries. That is how it has been in the past, and it is culturally accepted. However, that doesn't have to be the case. Exoskeletons can be an additional protective layer against injuries and in some cases, can produce better quality work. For example, see camera stabilizers. The Steadicam has existed for 40 years independently of the exoskeleton industry and devices like it are only increasing.

Military: the dream of active-combat exoskeletons is finally being put to rest. The technology isn't there and won't be there for decades. However, there are multiple non-active combat applications. US soldiers are

getting injured in training from being overburdened. Exos can help with that. They are still being tested and evaluated, however.

First responder: same as above.

Recreational / Consumer: there have been some successfully crowdfunded exoskeletons, and exoskeletons to assist with skiing have been around for a decade. The growth is slow but there. For example, they can be used as a fitness device that adds resistance exactly at a joint.

Can you comment on the penetration of smart exoskeletons across different parts of the globe.

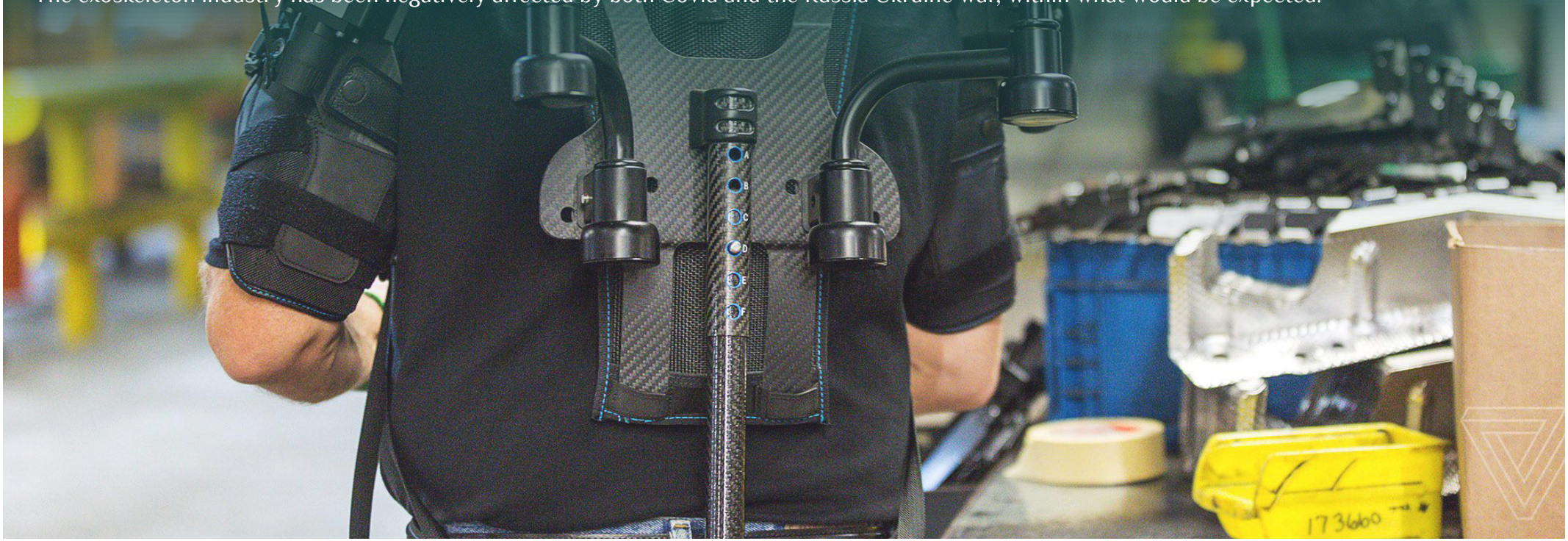
There are two modes to predict exoskeleton penetration: a country's GDP (US, Canada, Italy, Spain, France, Sweden, Japan, South Korea) or a country's government involvement (China). This is unfortunate because it seems that those who lack resources and can benefit the most from making sure they don't get injured at the job will likely get access to this technology last.

How do you foresee the future of smart exoskeleton industry?

The future is what we make of it. A major goal post will be if an active, independent, and well-funded exoskeleton trade association can be created soon. No technology, be it drones, robotics, Al or cryptocurrency, just organically came to be without significant investment and support. It is up to the exoskeleton community to secure its own future.

Any kind of changes or developments that you would like to highlight related to smart exoskeleton in the last few years. Was the industry affected by the pandemic and Russia-Ukraine War?

The exoskeleton industry has been negatively affected by both Covid and the Russia Ukraine war, within what would be expected.



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