

thespin

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Engineering Success

Dr. Jaimie Borisoff has some big ideas about how to improve your quality of life through innovation and technology



A man with glasses and a black hoodie is sitting in a black wheelchair, smiling. The background is a light gray wall with various technical drawings and diagrams overlaid. The drawings include a cross-section of a mechanical part with dimensions like 0.000, 0.080, 0.125, 0.35, 1.75, 2.000, 1.35, 2.000, 0.52, 0.52, 2.75, 0.05, 0.05, R.125, and Ø1.000. There are also circular diagrams with dashed lines and arrows. The overall theme is engineering and technology.

Better Living Through Engineering

Dr. Jaimie Borisoff on the evolution of assistive and mobility technology — and why Robocop isn't in our future.

Jaimie Borisoff doesn't just solve problems, he does it with panache. When he and his wife had their first child, he added a gas spring and pivot to the front wall of the crib. The wall would then smoothly open up and out "like the door of a Lamborghini" to provide Borisoff with easy access to his son.

The husband and father of two is also a Paralympic wheelchair basketball champion, and he plays ball hockey on his off time. But Borisoff doesn't want to talk about any of that. Instead, he prefers to speak about innovation and how technology can enhance his own quality of life, and that of others with SCI.

And he has the credentials to do just that. Borisoff is the Research Director and the Canadian Research Chair of Rehabilitation Engineering Design at the British Columbia Institute of Technology (BCIT). He's also a Principal Investigator at ICORD, and Adjunct Professor at the University of British Columbia. This is a man who has a wealth of big ideas to talk about.

Recently, Borisoff completed the sale of his revolutionary Elevation wheelchair to PDG Mobility Technologies, which is now marketing and selling it. Borisoff sat down with *The Spin* to discuss the Elevation, his current work, and the exciting developments in his field of rehabilitation engineering.

Update us on the Elevation wheelchair. How is it different?

One area of my lab at ICORD and at BCIT is really thinking about equipment and technology for people with disabilities and impacting quality of life, health, function and that sort of thing.

This wheelchair was designed so that you can change your position throughout your day at any time, to suit whatever activity you want to do. You can change your seat height so you can have a lower centre of gravity and a better wheeling position to get around your community, or you can sit a bit higher at a desk or at a table, and you can also sit even higher if you want to reach a shelf, interact with people at eye level, or do whatever it is that you might want to do.

You can also change your backrest position easily to match your activities and maintain your comfort. For instance, if you move it forward, you'll find it easier to wheel up hills or ramps. You can also make it recline so it's easier and safer to go down ramps.

It's very quiet and simple. It's all mechanical. That's the key to the design. The goal was to make it very simple and natural to use. You have to have some hand or arm function or enough to move yourself. You have to put a bit of strength into it—it's not going to do it all for you.

What's next for the Elevation?

It's now owned by PDG, which is quite exciting as PDG is a successful Vancouver-based wheelchair manufacturer. I also have an ongoing role with PDG, helping to direct their expansion into high performance products. The Elevation is now available commercially in Canada. It's not yet being heavily marketed in some provinces, where coverage isn't yet in place. But we are pursuing this, and we're also going through the FDA approval process for USA sales.

With the Elevation now complete and commercially available, what are you working on these days?

One area that I'm really excited about right now is exercise equipment. What we have downstairs (in the Blusson Spinal Cord Centre) is the Physical Activity Research Centre (PARC). The Centre has adaptive equipment, and volunteers are available to help anyone, regardless of disability, learn to use that equipment.

One of the things I'm doing with my grad student, Jacqueline Cragg, is looking at the major issues in SCI that cause poor health and reduced life spans. People with SCI typically don't live as long or stay as healthy as someone without it, and one of the reasons is cardiovascular health and fitness.

It's hard for someone with SCI to stay fit and healthy, so we're taking a closer look at the benefits of regular use of arm and leg bikes. In particular, we've found that moving your legs passively in conjunction with your arms can be hugely beneficial with a very simple piece of equipment. We just did a case study with ICORD's Dr. Chris West about this, which we'll hopefully publish soon.

This is ongoing work taking place in several labs, but it's becoming clear that moving your legs—even passively—is beneficial to spasticity, circulation, cardiovascular health, maybe even bowel and bladder function, and a whole host of other things.

If you're using your legs while standing with exoskeletons, that might even improve your body composition, weight loss, and bone density. So yes, that whole area is very fascinating.

What do you think are some of the challenges faced by people with physical disabilities that can be solved through engineering?

When I think about the challenges we face, I'm not thinking in terms of finding a cure. I'm more interested in terms of quality of life with SCI, and having the fullest and healthiest life you can lead, for the longest you can live. It's more about participating in the community and the activities of daily living.

This sort of technology can definitely have an impact. We hope it can have an impact on general health with exercise equipment. With better wheelchairs you can have better participation in the community—you can get anywhere you want, and do the activities you want, wherever it is that you want to do them. That's where technology can have a big impact.

Why did you decide so early in your career to focus on quality of life as opposed to finding a cure?

Life isn't so bad. We're pretty lucky where we are. Spinal Cord Injury BC is a great example: there are some people who are living some pretty good lives regardless of their level of injury. We

“It’s cool that I can get up and walk...but no one wants to feel, look or sound like Robocop.”

have a pretty good community in that we don’t dwell on the fact that we do have a spinal cord injury, we’re just busy doing stuff that’s enjoyable and interesting.

At the same time, just as someone who rides bikes might want a better bicycle, someone who uses a wheelchair might want a better wheelchair. I’ve never really thought about it in any other way.

Tell me about some of the big technologies that have a lot of hype right now in this field, and what you think is overrated.

I think exoskeletons are a bit of both. If we think of equipment and technology for SCI, this is going to be one of the major pieces of technology we will continue to hear about that’s coming down the pipeline in the future.

ICORD just bought one, which you might have seen on the news recently. It’s a state-of-the-art walking exoskeleton that’s available commercially for clinical and research use only.

Exoskeletons are overhyped because the media and the public see this as a mobility device. They see people up and walking in them and think, “That’s awesome!” But in reality it’s not a mobility device; it’s only a therapeutic device.

It’s not a mobility device because it’s very, very slow. It takes a very long time to get from A to B so mobility is actually hampered, not enhanced. It’s very difficult to get in and out of it. It hasn’t been shown to be safe in the community at all. If you talk to the companies making exoskeletons, they’ll say these are designed specifically for inside use in institutions right now, under supervision. They acknowledge that it’s not a mobility device at this point. Of course, they want to get to that, so maybe we should throw some money at it because it could evolve into a mobility device over the years—maybe.

At this point it’s certainly a therapeutic device, in that exoskeletons can help you get standing and walking your legs passively. It’s very expensive, however.

So that’s what I’m interested in right now—comparing cost to effectiveness. I’m interested in the impact of exoskeletons, but I also want to know if there’s something that’s more accessible, say like an elliptical machine, which is a thousand dollar device that anyone can buy for their own home. We haven’t shown that these machines have the same benefits as an exoskeleton, but potentially they might have similar effects as well as exercising cardiovascular health - really two birds with one stone so to speak.

That’s the path that’s happening right now, so it might be overhyped, but it’s still very exciting and interesting.

Are you hopeful that one day exoskeletons will be a mobility device that is practical and accessible to individuals?

I didn’t talk about this earlier, but it’s something we considered with the Elevation wheelchair: dynamic natural motion, the concept of moving dynamically and quickly in real time to suit you, much like an able-bodied person would sit, squat, stand, or whatever as required. So if we think of an exoskeleton as a mobility device in the future, the ultimate manifestation would mean you could sit, stand, walk, et cetera, and that would be taking dynamic natural motion to the next level.

We wrote a concept paper on this, about putting an exoskeleton on wheels. I can think of it as a device that you would wake up in the morning and hop into it, transferring like you would into your wheelchair. Wheelchairs support daily life really well right now. So the question is, can we make the exoskeleton into a device like a wheelchair, so that when you want to, you could stand and walk?

I envision this as an exoskeleton that has wheels attached to it, and when you want to, you put the straps on and stand and go for a walk, leaving the wheels behind. So that’s how we’re thinking about making a mobility device and an

exoskeleton come together.

You need wheels because you just can’t beat wheels for mobility; that’s why we drive cars, that’s why we ride bikes. A wheelchair is not going to go away any time soon, because it’s an easy and efficient way to get around.

But there are all these great benefits to standing and walking. Should those benefits come from a different device? If I have to go to my closet to get my exoskeleton out and get into it, I would argue that these things won’t be used to their capabilities very well.

So your vision is of us being Robocop or something like that?

Well, hopefully not with the sound. That would be distracting. That’s what would limit the device—some people would say that it’s ridiculous, look at all that machinery you’re strapped to, look at the sound that it makes. It’s cool that I can get up and walk, and maybe I’ll use it a couple times for novelty’s sake or for special occasions, but no one wants to feel, look or sound like Robocop.

Like a bionic man, then?

Yes, but if you do want to feel like a bionic man, you want to do it with the least intrusion possible. Like with a wheelchair, you don’t want it to be a beacon that says, “Hey, I’m in a wheelchair over here!” You want it to be elegant; you want the focus to be on the person and not on the device that a person has to be using.

So how long does it take for a device like this to come into existence? In our lifetime?

Sure—that’s pretty broad.

What if I give you a crystal ball?

Well, if you look at the exoskeletons we have right now, it’s very sophisticated technology. They have the best batteries, computers, the best of everything. Now look at electric cars, and how far they have come recently. I think it’s just the tip of the iceberg. I think we have a long way to go. Ultimately I think these things take a long, long time. ■