Open Forum

On Emerging Technologies

Who's that inside that exoskeleton?

By Dov Greenebaum

Disruptive technologies are often hatched at the Consumer Electronics Show, one of the largest trade shows in Las Vegas. In past years, the videocassette player, as well as CD, DVD and Blu-Ray technologies, first emerged at the show. This year, Elco Bionics, a Richmond company, featured its exciting exoskeleton technology, which offers promise — and also raises a number of ethical, legal and social concerns.

Most of us know exoskeleton devices from their appearances in film, from Sigmund Neuman Weaver's 1966 industrial exoskeleton in "Alien," to Robert Downey Jr.'s superhero suit in "Iron Man," to RoboCop's crime-fighting cyborg and the military exoskeleton in "Avatar." Exoskeletons have seemed the stuff of futuristic science fiction.

But they are not fiction: you can buy them now.

That's why it is important to raise the questions around this technology before the mature technology becomes widespread so that policy makers, legislators and regulators are not surprised and forced to implement knee-jerk, posthurri- tary responses to underprepared issues.

Like its FDA-approved counterpart ReWalk (also featured at CES), Elco manufactures wearable robotic suits to amplify human strength and agility and replace diminished or lost functionality. The devices are particularly suited to help those suffering from restricted mobility due to paralysed or weakened limbs. Yet the technology raises many concerns, such as:

**Social justice:** With exoskeletons costing as much as a luxury car, who should have access to this technology? How do we think about the eventual dependencies of such an expensive device? As a society, we may need to reconsider able-ness, in light of these and other technological opportunities for overcoming our limitations. Employment lawyers will need to work out whether someone who regains ambulatory functions while working in an exoskeleton is still disabled in the eyes of the law and/or to what degree.

**Human enhancement:** Elco is reportedly pursuing military-grade as well as industrial-grade exoskeleton solutions, enabling soldiers and workers to perform longer and harder. In upgrading our soldiers, however, we run the risk of treating them more like machines than humans, further dehumanizing warfare and its very human actors. Moreover, this augmentation of otherwise healthy individuals — as distinct from treatment focused on achieving sustaining or restoring health — raises ethical concerns relating to human enhancement. These issues are not only limited to our regular daily interactions, but also arise in sports, as the disabled (and now disgraced) Olympian, Oscar Pistorius, has shown us.

**Personal and product liabilities:** With the potential for semi-autonomous, or even autonomous, exoskeletons (i.e., those that work with little to no human intervention), courts will need to determine whether a person injured by another in an exoskeleton suit was injured by the semi-independent suit, the person wearing the suit, or something in between. These uncertainties will be exacerbated with the continuing development of prosthetic devices implementing brain-computer interfaces that provide for intuitive control of the device through interpreting natural activities of the user. Was the offending action caused by an exoskeleton suit the result of conscious or unconscious thought? Should that make a difference?

There are no simple solutions, although many solutions may arise organically, for example, costs and access issues may be lessened as the technology becomes more widespread and cheaper.

Many of these issues can be dealt with through well-thought-out regulatory solutions. Rules of engagement can be modified to clarify the underlyingly human of up- armored soldiers. Employment laws can be rewritten to account for disabled individu-

als who, while they have regained some function, remain disabled. Additionally, regulations can be revised to keep in mind that mecha-
nized humans in industry retain many of their human limitations.

But, for society at large, exoskeletons raise much more long-standing and complex questions that will eventually force us to redefine how we perceive humanity and self.

Dov Greenebaum is the director of the Zvi Muller Institute for Legal Implications of Emerging Technologies, Radzyner Law School, Interdisciplinary Center, Herzliya, Israel. He is also an assistant professor in the Department of Molecular Biophysics and Biochemistry at Yale University. (To see how an exoskeleton works, go to http://www.com/8470695)