

OPINION

OPEN FORUM *On Emerging Technologies*

Who's that inside that exoskeleton?

By Dov Greenbaum

Disruptive technologies are often launched 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, Ekso 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 Sigourney Weaver's 1986 industrial exoskeleton in "Aliens," 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 reactionary responses to underappreciated issues.

Like its FDA-approved counterpart ReWalk (also featured at CES), Ekso manufactures wearable robotics built 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 paralyzed 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 on 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: Ekso 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



Joel Kinnaman rocks the exoskeleton in "RoboCop."



Robert Downey Jr., exoskeleton-clad in "Iron Man 2."

injured by the semi-independent suit, by 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 neural 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



Russ Angold, co-founder of Ekso Bionics, with a robotic exoskeleton. The devices pose moral and practical dilemmas.



Nick McGill, University of Pennsylvania, in a Titan Arm.

can be modified to clarify the underlying humanity of up-armored soldiers. Employment laws can be rewritten to account for disabled indi-

viduals who, while they have regained some function, remain disabled. Additionally regulations can be revised to keep in mind that mechanized 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.

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