IT'S NOT SO SIMPLE

Why Some Engineering "Breakthroughs" Never Make It

In the Fall 1982 issue of Disabled USA, "To Walk and Work in Comfort" told about the prosthetics work of Jan Stokosa in East Lansing, Michigan. Because of his craftsmanship and some innovations in materials and techniques, Stokosa achieves great results in fitting prosthetic limbs to persons with amputations. Still, his limbs are basically similar to the prostheses with which most of us are familiar. Despite Stokosa's accomplishments, some readers might feel that the computer age and new technologies destine Stokosa's advances to an early obsolesence.

Stokosa and collaborator for this article Lee Whipple feel differently. "Will it work?" is the question typically asked of new inventions. "Does it have practical applications?," however, is a question that Stokosa and Whipple find too infrequently directed at new technologies for disabled persons.

Because his viewpoint can be trained on areas of rehabilitation engineering other than prosthetics, Stokosa's opinions are particularly provocative. Perhaps expectations about the value of some high technologies currently on our lips are not so much observations of future trends as pipedreams.

High technology is here! Slick articles in popular magazines point confidently to "new realities." Dazzling seven-second film clips on the evening news seem to prove it's true. It seldom is. Shown are the XYZ's of high technology. The ABC's are not so simple.

The potential high technology user, or investor, is implicitly invited to build a mental daisy chain linking the mere existence of high technology to its immediate application. News analysis focuses on the technology. The environment with which the technology will have to interface and the specific contexts in which the technology will have to function are ignored.

In order to realize the XYZ's of technologies that seem feasible (even plausible), roadblocks—often mundane in nature—in the environment and in specific situations must be removed. This is true of computerized military hardware as well as "monoclonal assays." It is true of "gigabyte memory electronic encyclopedias" and "recombinant DNA"-produced pollution controls. It is also true of prosthetics, where modern developments in the upper extremity prosthesis typify the problematic ABC's of high technology.

After World War II, persons with amputations heard much about cineplasty. This was an innovative method of controlling an artificial limb through surgically inserted, stainless steel rods. Cineplasty was supposed to revolutionize prosthetics. Upper extremity amputees, in particular, looked forward to being free of the straps used both to attach a conventional artificial limb to the body and to control the limb's movements.

It never happened. The specific context for this technology was the human body—and it rejected the rods. Furthermore, persons with amputations rejected the grotesque appearance of the new apparatus. Other problems with the new technology became moot, and straps remained the dominant technology. This was but a preview of coming attractions.

Myoelectrics was next. The "bionic arm." This device is electrically "tuned" to the musculature in a limb that remains after an amputation. Commands from the person's brain pass from nerve to muscle and then to the artificial limb. Unlike cineplasty, the idea is fundamentally sound and feasible. But some problems could not be resolved.

First, the specific context: The plastic socket that holds the stump of the remaining arm must be more exactly contoured in a myoelectric limb than in a conventional prosthesis. The "fit" must be better. Unfortunately, fitting is a general problem in the field of prosthetics. Fitting technology, in all but rare instances, is crude. Thus, the myoelectric arm (as good as it is by itself) depended on another separate, but related technology in order to function.

Second, the environment: To adjust and repair myoelectric limbs requires many specialized skills and much special knowledge that, in sophistication, is a quantum leap beyond strap technology. Most certified prosthetists have a base education of two years at college in any subject and 9 to 18 weeks of special courses. (This is less education than for a dental hygienist.) Doctors could not help with myoelectric limbs because physicians take no training in prosthetics *at all.* Who then is to implement this new high technology in prosthetics?—an unanswered question.

Finally, the myoelectric limb is significantly more expensive than the technology it was to replace. The components cost much; the time and labor of the few, highly trained technicians who can make it work costs even more. Who pays for all this? Presently, the vast majority of prosthetic care is paid by private insurance companies and government agencies. Allowable charges are based on historical data and are not readily permitted to increase. Before most third party reimbursers will accept a higher than normal charge, a new medical technology must prove itself and become a medical "standard." This is a "catch-22" in the environment.

Myoelectric arms have been available since the early seventies. Straps still dominate prosthetic technology.

Now another generation of high technology is here. All-purpose pundits on television and in magazines herald its arrival: artificial limbs that are motor-driven and controlled by computer chips. Reality, yes. Ready for production, no. Paraplegics in large numbers will not rise from their wheelchairs and kick footballs tomorrow. The ABC's, sadly, will get in the way.

As if this were not enough, more high technology prosthetics are allegedly "just around the corner." Prosthetic devices wired directly into the brain are finding their way from the minds of visionary, experimental engineers into the popular media. *Business Week*, September 1980, reported that scientists are:

"making rapid progress in connecting tiny wires from microelectronic implants and external prosthetic devices directly to the brain itself. Once these microsurgical techniques have been perfected, it would be comparatively simple to hook the other end of a synthetic nerve system to any kind of prosthesis—or to a muscle."

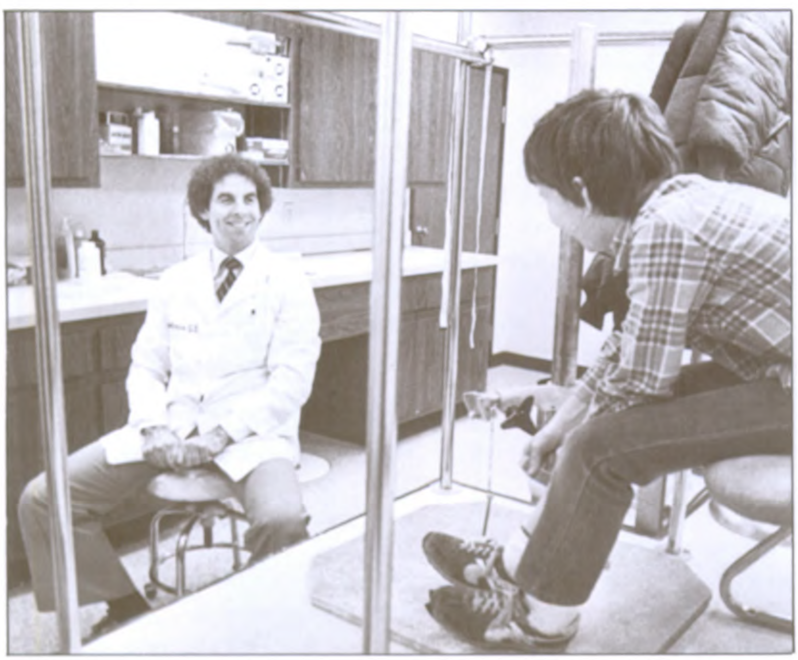
Words like "rapid progress" and "comparatively simple" often flavor reports about high technology, inviting visions of sugarplums to dance in our heads. High technology is here!

Don't believe it.

The mere existence of a technology does not necessarily lead to its application. A roadblock or two may obstruct the way.

High technology is a complex business. Its impact on human life and society is already great and its potential impact is awesome. So we must not shrink from its future use. But neither should we delude ourselves with naive notions about progress. The not so simple, often mundane, ABC's of high technology must be studied and mastered. Only then are the promises of the experimental laboratory kept. Only in this spirit does high technology have any mature meaning.

—Lee Whipple and Jan Stokosa



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