



IN THIS ISSUE....

Invisible No Longer

In the movie, *The Invisible Man*, the protagonist moves about unseen. But when his presence is felt by others, the stage belongs to him.

For years, the assistive technology market has been nearly invisible. Technology giants all but ignored it because there were not enough potential customers to justify the cost of new product design and planning. Small "mom and pop" AT manufacturers adapted devices that had been proven successful in larger consumer markets for use by individuals with disabilities. Today, however, thanks to demographic evolution and the ripple effect of federal disability legislation, the invisible marketplace is invisible no longer as the AT market, and its consumers, move toward center stage.

The companies creating or adapting advanced AT devices for this growing market are no longer "mom and pop" operations, thanks to mergers which have given the new manufacturing entities economies of scale that encourage more attention from behemoths like Microsoft. The Redmond, WA-based technology colossus has formulated working relationships with hundreds of AT manufacturers to ensure that the AT market is better served now and in the years ahead.

The result, for families of children with disabilities, is more technologically state-of-the-art devices available right now and many more already in the design and production pipeline.

Dr. Stephen Bauer Speaks

"The AT market is systematically growing," declares Dr. Stephen Bauer, Project Director, Rehabilitation Engineering and Research Center on Technology Transfer (T2RERC), University of Buffalo. "Although experts can attribute the growth of the marketplace strictly to demographic trends, the whole truth is that, over the past 3-4 decades, the markers for this market's emergence are the legislative milestones of the disability rights movement." Today, he adds, the cumulative effect of this legislation has created major market drivers. "The Individuals with Disabilities Education Act (IDEA) required that AT be considered in all Individualized Education programs (IEP) for students with disabilities. That created market demand, which means that students with disabilities are now a viable market for manufacturers."

As a result, technology transfers – Dr. Bauer prefers to call them "knowledge transfers" because concepts, in the form of intellectual property, not tangible technology, are being transferred – between university-based generating entities like his T2RERC and federal labs to manufacturers are accelerating as more sophisticated AT devices are conceived and produced to meet the needs of a growing market.

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Technology Transfer: The Promise of Things to Come in AT Technology

*An Interview with
Dr. Stephen Bauer, RERC Director*

University of Buffalo lectureship. He was staff researcher during the T2RERC's first cycle and Director, Research and Development in the second cycle. During that period, Dr. Bauer developed and implemented the Demand Pull Technology Transfer program, based upon best practices drawn from the academic and private sectors. He led the team's search for advanced technologies, supervised technical teamwork and established strategic partnerships with and between dozens of public and private sector organizations.

After leading the past four Demand Pull Stakeholder Forums, he is conversant in technologies underlying assistive devices in the fields of mobility, hearing, speech and vision. He is the current chair of the RESNA Special Interest Group on Technology Transfer and a member of the Assistive Technology Industry Association (ATIA). His current interests include technology transfer, market research, public policy, AT and product design. Dr. Bauer earned his BS, MS and Ph.D. degrees from the University of Buffalo.

Supporting our interview with Dr. Bauer are resources to assist parents and others in developing further understanding of technology transfer and its impact on the AT devices available now and in the future for children with disabilities. We also feature members of our **Knowledge Network**. The members spotlighted this month focus on various aspects of technology transfer and product design. We invite you to contact these members for further information.

Please share this newsletter with other organizations, families and professionals who may benefit from it. We invite you to contact us at <http://www.fctd.info>. We welcome feedback, new members and all who contribute to our growing knowledge base.

When considering assistive technology, most people are unaware of the diversity and complexity of this marketplace. Although estimates vary greatly, perhaps a thousand AT manufacturers produce many thousands of products for people with mobility, vision, hearing, cognitive, communication and other impairments. These products are enabling technologies for education, vocation, independence and recreation. While assistive technology manufacturers are almost uniformly small companies (by definition less than 500 employees) with limited resources they produce many important and innovative products. The disability market and the assistive technology industry are both growing. Major federal legislation is increasing demand for assistive technology products. Large corporations are preparing for the burgeoning but complex elder market, as Americans age into disability. Mainstream corporations are seeking alliances with assistive technology manufacturers to leverage their knowledge and experience in disability markets.

Not a Sleepy Industry

Many small AT companies appear to be passive about integrating new technologies into their products, he explains. He refers to the U.S. Department of Commerce study of 250 AT manufacturing companies conducted in 1997-99 and published in 2003 entitled *Technology Assessment of the U.S. Technology Industry*. "There have been questions drawn about the study's conclusions," he concedes, "and there have been questions about the study's recommendations, but the study did produce some interesting facts."



AT companies, according to the study, did not appear to be aggressive about seeking out new technologies, he recalls. "Only 10-12% of respondent companies were writing SBIR (Small Business Innovation Research) proposals, for instance. Only a small percentage of the AT companies are actively collaborating with other manufacturers, universities or with federal labs."

When the companies were asked whether they were interested in obtaining externally developed technology – technology developed by a university, an inventor or a federal lab – about half said they are not seeking any external technology, he notes. "From that snapshot, you'd get the impression that the industry is sleepy, but that's not the case."

In order for AT manufacturers to move ahead, he observes, "They often must use materials and technology that have been introduced, refined and experienced price reduction in a mainstream market. Once those conditions exist, the AT manufacturers can then start building their products around these technologies."

AugComm Devices For Example

Augmentative and Alternative Communication (AAC) devices offer examples for this approach, according to Dr. Bauer. "Some of the older AAC devices have dedicated hardware and software, and that may continue. But many of the companies are writing software for PDA and laptop PC platforms that are already in the market. That's a way for AT manufacturers to quickly develop powerful products, while still holding their costs down." These companies, he adds, are taking advantage of product refinements that occur naturally in the larger markets.

Beyond Demographics: The AT Market Emerges

The Commerce Department study also revealed that the AT market, spurred by the disability community's legislative triumphs, is

systematically growing beyond the obvious demographic trends. Initially, Dr. Bauer says, "the disability rights movement was a bit disruptive. The general public didn't understand the movement and perhaps didn't recognize the problems that spurred the movement. Most members of the public didn't deal with these issues on a daily basis. Consequently, there were misunderstandings."

"But the disability rights movement proceeded to educate the public," he adds, "making Americans aware of the needs and making our government representatives aware of the political power of the movement." Eventually, he notes, this rights movement became part of a societal trend and was codified into legislation.

Kids with Disabilities: a Vibrant Market

"The Americans with Disabilities Act is the centerpiece, but there is other legislation of great significance, including the U.S. Rehabilitation Act, the Hearing Aid Compatibility Act, the Air Carrier Access Act and the Telecommunications Act." Today, he remarks, the cumulative effect of this legislation has been to create major market drivers as exemplified by IDEA in the educational market. "If you're a student with disabilities, AT must be considered as your IEP is developed. This creates a large potential market for AT manufacturers."

For Accessibility's Sake: Convertible Textbooks

Under IDEA, he explains, a major standard is being developed: the National Instructional Materials Accessibility Standards (NIMAS). NIMAS standards will be finalized next December and will become voluntary standards for the publishers of textbooks, another market impacted by AT.

The objective of NIMAS, Dr. Bauer explains, "is that any company producing a textbook must provide that textbook in a format that can be converted into an alternative, accessible media. For example, a textbook

would be readable using a refreshable Braille display interfaced to a PC or as part of a dedicated note taker."

Complications emanating from these standards, he says, are inevitable. For example, "What do you do with graphics? How can a publisher efficiently reproduce a map from a social studies textbook in sufficient fidelity?" Or math equations: If a student uses a text reader, how does that reader interpret an equation using voice in a way that's unambiguous, "because there are parentheses, opening parentheses and closing parentheses. How does a publisher make that understandable and not subject to misinterpretation? It's very difficult."

Involved in this effort are the Assistive Technology Industry Association (ATIA), the National Institute on Disability and Rehabilitation Research (NIDRR), the Center for Applied Special Technology (CAST) and the American Foundation for the Blind (AFB), among other organizations.

Companies have been involved as well, he adds. "For example, some manufacturers have recommended that a variant of Mathematical Markup Language (MathML) should be part of the NIMAS to deal with the math equation issue."

"Market-Pull" Legislation

Another example of the market impact of federal legislation, he points out, is Section 508 of the Rehabilitation Act, which requires that electronic and information technology be accessible to federal employees and the general public. "The law applies to all Federal agencies when they develop, procure, maintain, or use electronic and information technology. Federal agencies must ensure that this technology is accessible to employees and members of the public with disabilities to the extent it does not pose an undue burden. Section 508 is quite broad and covers things like computer, software, electronic office equipment and websites." What's really important, he notes, "is that now there are federal acquisition regulations

(FAR), which provide guidelines and steps that must be followed by federal agencies to ensure legislative compliance."

What does this mean? "It means that the federal government is buying hundreds of billions of dollars of material, of which a large percentage is for electronic and information technology. This creates huge market potential for AT and accessible products. Section 508 is an example of 'market-pull' legislation."

"The Elder Decision" and Its Implications for AT

The Supreme Court's 1999 Olmstead Decision was an important "continuation of disabilities legislation that says people with cognitive disabilities must be allowed to live in the least restrictive environment." The decision, he explains, was followed up by the Olmstead Executive Order in 2001, issued by President George W. Bush, that requires federal agencies "to work with States to help them assess their compliance with the Olmstead decision and the ADA in providing services to qualified individuals with disabilities in community-based settings; provide technical guidance; work cooperatively with States to achieve the goals of Title II of the ADA; and ensure that existing Federal resources are used in the most effective manner to support the goals of the ADA."

Dr. Bauer predicts that, "Someday we will see an 'Elder Decision' analogous to the Olmstead Decision that requires that the elderly in our society should live in the 'least restrictive environment.'" Projecting the impact of that decision, many elders currently in hospital environments would migrate to long-term care facilities, those in long-term care facilities would move to group homes, and those in group homes would move into homes, to live individually or with companions.

The implications of such a migration would be far reaching. Dr. Bauer predicts, "Think of products and technologies that will be

needed in the wake of an 'Elder Decision:' cognitive assistive devices, way-finding devices, health monitoring and telerehab products, security and safety products, accessible consumer electronic products, and an information and communication infrastructure that protects the privacy and security of our elders."

A Huge, Complex Trans-generational Market: Microsoft's Model

Such an environment would create "a huge market requiring a complex way to maximize that market's potential."

What does that mean for assistive technology? "It means a great deal," declares Dr. Bauer. "Companies like Microsoft and Intel have major initiatives underway in anticipation of some aspect of this trans-generational market trend." For example, Microsoft has created the Microsoft Accessibility Group, which collaborates with 90-100 AT manufacturers. Microsoft has developed these relations, Dr. Bauer claims, "because the trans-generational market is very complex." A company like Microsoft, he notes, "has a choice: it can work to understand diverse disability markets, build technical competency or develop a suite of accessibility solutions. Alternatively, Microsoft can support the AT manufacturers already serving disability markets so that they can develop better products, in shorter timeframes. Becoming experts in low vision and blindness, hearing, communication, mobility or cognitive issues, would be very difficult for any company, even one as huge as Microsoft."

According to Dr. Bauer, what Microsoft is now saying is this, "There are a lot of AT companies that are expert in each of these niches. We'll help these companies to make their products better. We'll work with them so that their products can make our products accessible. Those companies will help make Microsoft applications and operating systems accessible to individuals with low vision, mobility or hearing difficulties, for example." Microsoft, he points out, lists (URL:

<http://www.microsoft.com/access>) the AT companies with which it maintains collaborative relationships.

"Microsoft is anticipating that today's computer using workforce will still want to be computer users as they age with and into disability. The conclusions reached in two major market studies funded by Microsoft (<http://www.microsoft.com/access>) have broad implications for telecommunications (e.g. cell phones), consumer electronic products (e.g. microwave ovens, stereo receivers) and other industries. When today's computer users retire, what accessibility solutions must Microsoft (perhaps products provided by AT manufacturers) use to retain these people as a major customer base?"

A "Neat" Product for Children with Disabilities: An Expanded Keyboard

Microsoft's collaboration with AT manufacturers may be focused on the trans-generational market. However, products produced by these manufacturers such as screen readers, screen magnifiers, and refreshable Braille displays are also enabling technologies for children with disabilities in educational settings.

The Individuals with Disabilities in Education Act (IDEA) is a major driver in the educational technology market, which includes children with disabilities. Under IDEA, assistive technology must be considered in the Individual Education Plans for children with disabilities, which creates a business opportunity for AT manufacturers, leading to more and better product for our students.

Dr. Bauer explains that the T²RERC is helping to develop a "very neat" product for school-aged children with mobility impairments. Right now, he says, the Texas Instrument TI-83 calculator is the most common calculator in US schools. "Imagine that you are an instructor with the TI-83 calculator in front of you and your students. You are explaining to your students how to

use the calculator. You tell them which buttons to use and describe these buttons by placement, color, shape and function -- but children with mobility impairments can't use the standard TI-83 interface."

The solution is the "Expanded Keyboard," a large button interface into which any TI-83 calculator can dock. "The Expanded Keyboard will have the same configuration, key shape, color and placement, only much larger. It will also have key wells so that a child can easily select the right button without pressing other buttons by mistake. An AT company will manufacture, market and distribute the Expanded Keyboard. We are grateful to Texas Instruments for their assistance in developing this product."

The Expanded Keyboard, he says, will be accessible to children with mobility impairments "so that a classroom instructor can teach children with mobility impairments the same way that he or she teaches children who do not have mobility impairments. This makes it easier for the teacher, and for the child who does not have to use a specialized device, to participate in the classroom in a seamless fashion. Each school system will only need a few Expanded Keyboards in order to meet the AT needs of students with mobility impairments - so the Expanded Keyboard also provides a very cost effective solution."

"Hill Jane Fetch" Focusing Both Eyes on the Same Text

Dr. Bauer was recently introduced to a company Gemstone (<http://www.eyegem.com>) that conducts research and produces software products for children with reading impairments. Reading involves the ability to see and the ability to cognitively process the visual information. An intermediate step is the ability to systematically move the focus of both eyes through the body of text. It turns out that many children with reading impairments cannot easily train both eyes on the same text. These children have a problem with binocular tracking. In contrast, good readers

generally exhibit excellent binocular tracking. To understand this in practical terms, imagine reading the text "Jack and Jill ran up the hill to fetch a pail of water." Now imagine that your left eye sees "Jack and Jill" while your right eye sees "hill to fetch." What sense could anyone make of that? Recognizing an important unmet need, Gemstone developed a suite of software products that trains a child to work both eyes in tandem. Many children with reading disabilities could benefit from this software. It's also worth investigating whether all early readers could benefit from binocular training.

Sound Field Systems Enhance Learning

A sound field system, he explains, is another technology that offers great promise for children with disabilities in an educational setting. The self-evident premise for sound field systems is that children, who can hear the instructor better, will do better. Sound field systems are used to increase the volume of a teacher's voice uniformly throughout the classroom. Children with learning disabilities, children with hearing impairments, and children seated farthest from the teacher could all benefit. In speech the consonant sounds that carry most of the information to be communicated have higher frequencies. Sound field systems could enhance these higher frequencies to make these consonant sounds more distinctive. Children with hearing disabilities often employ body-worn microphones or FM systems, which enable the teacher to broadcast their voice directly to the student. These technologies could provide benefits to other children similar to sound field systems.

A Modest – But Potentially Electrifying - Assumption

"This requires systematic testing, however let's assume that Gemstone software was installed into computer labs used by children," Dr. Bauer says. "As part of their lab experience, every child would be trained on the Gemstone software and would as a consequence become a better reader. Children who read adequately would now

read well. Children struggling with reading disabilities might now read adequately. Every child would benefit. Let's assume that every classroom has a sound field system with enhanced high frequency. Children performing adequately in class because they can understand the teacher's voice will hear the teacher's words more clearly and completely. Children who had difficulty focusing on the teacher's voice can now follow along without difficulty. *Just a few simple changes might transform the educational environment at relatively low cost.*"

Everybody Will Support This

Dr. Bauer says he's looking forward to this scenario: "Populate a school system with technologies like those I've mentioned and evaluate the children's academic performances."

His prediction: "The appropriate use of technology will make that school system's educational environment significantly better for *all* children, not just the kids with disabilities – all kids. Everybody can support that. It's an example of universal design in an educational environment."

Product Trends: A Power Wheelchair with Manual Benefits

High performance materials are becoming more common in wheeled mobility products. "TiSport (<http://www.titaniumsports.com/>) is making lightweight, high-performance titanium frames that may *never* wear out."

New product concepts are also becoming more common. These include lever-drive wheelchairs from companies such as Wijit (<http://www.wijit.com>) and HandMaster (<http://handmasterdrives.com>) and power assist wheelchairs such as the Xtender (<http://www.sunrisemedical.com>) and iGlide (www.independencenow.com), "where the chair senses the torque being applied to the push rim by the person using the wheelchair and then augments this push."

What's the advantage? "In the past, a person transitioning from a manual wheelchair to a power wheelchair would lose many of the benefits associated with the manual chair: the power chair user no longer employs her upper body strength, and is not exercising her heart."

Why transition to a power chair at all, then, if serious and dangerous muscle atrophy is the result? "Perhaps because of the onset of arthritis; or the user may have suffered hand, wrist or shoulder injuries from propelling their wheelchair; or she's losing strength from aging or the progression of a disability."

By having these new products on the market, "the first transition might be to a lever-drive chair, then to a power-assist chair and finally to a power wheelchair. That way the user can optimally employ his or her physical abilities much longer." There are also self-perception issues. "People feel and are sometimes perceived to be more 'able' if they are able to do more. Clearly users are doing more if they are propelling themselves."

Lever-drive and power-assist systems also may allow the users to travel to destinations that were inaccessible earlier with a manual chair. "They can go to parks. They can garden. They can climb hills that were previously inaccessible." Users might utilize these chairs to broaden their horizon of activities, providing access to educational, recreational and workplace opportunities that may not have existed for them before.

Hearing Technology: Wireless Rules

All the wireless trends are important to hearing technology. There are different technologies, Dr. Bauer says, but hearing technology's cornerstone, the hearing aid, is now becoming wirelessly linked to sound sources by radio transmissions.

"A hearing aid could carry an FM receiver or a Blue Tooth receiver." Blue Tooth is a wireless standard, he explains. "If a user has

a Blue Tooth receiver and walks into an environment where there are other Blue Tooth devices, the devices can identify and communicate with each other." In principle, he says, "a person wearing a BlueTooth hearing aid could go into a movie theater, for example, and immediately receive the movies soundtrack without noise."

Hearing Directionality: A Device That Moves with the Sound

"When a person with normal hearing is looking in a direction, her ears are optimized to hear sounds that emanate from points along her direct line of sight." So called "directional hearing aids" have the ability to mimic normal hearing by attenuating sounds that come from either side or from behind.

According to Dr. Bauer, individuals with hearing impairments have a diminished ability to focus on a sound source. "The RERC on Hearing Impairment (<http://www.hearingresearch.org/>) has developed a very interesting technology called a direction-finding, beam-forming microphone array (DFBF) conference microphone." Beam-forming microphone arrays are "a very significant emerging technology." The DFBF conference microphone can be placed on a table and automatically focuses in the direction of the speaker and attenuate sounds from other directions. As different people speak around the conference table, the device quickly refocuses on the new speaker.

"The DFBF conference microphone is connected to an assistive listening system. A person with a hearing impairment, and wearing an appropriate receiver will hear the speaker (perhaps amplified) with very little noise. This does not require each speaker around the table to wear microphones, or lots of wires or other equipment. You just place the DFBF on the table; connect it to an assistive listening system; and give receivers for to each person with a hearing impairment."

The same type of beam-forming technology has been employed in digital hearing aids for a number of years, he points out. "Most hearing aids have two microphones. The sound signal is received by both microphones and processed by a small "computer" within the hearing aid. Basically, if sound reaches both microphones at the same time, then the sound is in front of the person. If the sound reaches the microphones at slightly different times, then the sound source is offset to the side or back. The hearing aid can recognize these tiny differences, amplifying sounds from the front and attenuating sounds from other directions." This provides limited improvement, "perhaps a two-to-four-fold improvement in a user's ability to hear sounds in front of her versus sounds from the side or from behind. That's good, but is still limited compared to intact hearing."

Siemens, the big German technology company, has developed hearing aids, he says, that communicate wirelessly with each other. Dr. Bauer explains, "hearing aids typically use the information that comes into the two microphones on each separate hearing aid." But Siemen's ACURIS hearing aids "actually communicate with each other through a wireless link. Both hearing aids have two or more microphones but information is also exchanged between these hearing aids so that they can adjust their performance for optimal hearing. This is much closer to the way a normal hearing system works."

Turning Hearing Aids into a Hearing System

According to Dr. Bauer, "as the computing power of each hearing aid improves, and as the wireless link improves, more and more information can be exchanged between the hearing aids. As the software algorithms improve, the hearing aids will begin to act more and more like intact hearing systems. The ability to focus on a single voice speaking at a cocktail party may someday become a reality."

In a noisy classroom, “a person with intact hearing can focus on the individual she’s looking at and shut out other noises that surround her. Eventually, these hearing aids will be able to do a better and better job of that. That’s a very desirable goal for someone with a hearing impairment.”

Cochlear Implants: Countering Early Onset Deafness

Cochlear implants are an important technology for deaf individuals, he declares. A critical technology for cochlear implants is the implantable electrode array. “The processing power of cochlear implants and the number of electrodes implanted into the cochlea should continue to increase. As a consequence, frequency resolution should continue to improve along with the ability to understand speech.”

Cochlear implants, he adds, are now a common choice for children experiencing early onset deafness. Cochlear implants are clearly beneficial in terms of the children’s ability to perceive sound. However, cochlear implant technology is a sensitive issue for the deaf community in the U.S., he cautions, because it is seen by some as a threat to deaf language and deaf culture, both having intrinsic worth.

Low Vision: Electronic Displays Offer Hope

For low vision and blindness, “we will see devices based on digital camera technology featuring electronic displays upon which the “scene” is available at two scales. The user will have the ability to focus on and enlarge one part of the image, for instance a sign, while seeing a stick figure representation of the broader environment so the she doesn’t lose context.” Electronic display technology, he predicts, “is going to get better and better. It augments an individual’s remaining vision and allows them to function in an improved way within the visual environment. It’s the analogue to advances in the hearing technology.”

Blindness: Refreshable Display is in the Offing

For the blind, refreshable Braille displays and, in the near future, full page refreshable tactile displays are very important technologies, he says. “Full-page displays are going to happen in the not too distant future. When you think of Braille books, you think of organized arrays of bumps on each page. Each Braille character is typically composed of six or eight dots. Refreshable Braille relies on electro-mechanical devices to individually move these bumps up and down. You can connect a refreshable Braille display up to a computer. As you read a text document on the computer, the text is translated into Braille. This Braille information is sent to the refreshable Braille display and is used to control the upward and downward movement of individual Braille dots.” As with paper-based Braille, the user reads the text by scanning their finger over the dots. These displays are very expensive, he concedes. “They cost thousands of dollars. Cost is a big barrier to their universal use.” Braille literacy has fallen dramatically in recent years due to the advent of “screen readers,” software that translates text into artificial speech. Unfortunately, this trend is paralleled by a drop in reading literacy. Recognizing that Braille literacy is strongly correlated with reading literacy, many states are passing laws to make Braille an accessibility choice for students.

In the future, the underlying technologies for refreshable Braille displays and full-page tactile displays will be available and will be dramatically cheaper, Dr. Bauer insists. That development will have a huge impact on education, on the workplace and on recreation, “because if refreshable tactile displays are that good, and that cheap they can be used, in many respects, as an alternative to a standard computer display.”

“Instead of a graphical user interface, there’ll be a tactile user interface. These displays could be configured not only as output devices but as input devices as well. A

person would press a spot on the tactile display. The tactile display will sense the pressure, interpret what the selection means (e.g. select a menu), and act upon this selection (e.g. open the menu). This is analogous to how sighted people use their mouse to select items and perform tasks on a graphical user interface."

Speech Technologies: More Natural and Improving Constantly

Artificial speech will continue to improve and become more and more natural, he predicts. Voice recognition technologies will also show steady improvement. He notes that a directional beam-forming microphone can be an important aspect of speech recognition "because these microphones can be focused on the speaker's mouth and significantly reduce irrelevant sounds. This can greatly improve the performance of a speech recognition engine."

Unfortunately, there is little agreement on how fast speech recognition will improve. According to Dr. Bauer, for speaker-independent voice recognition, experts predict timelines that range from 5 or 10 years to 50 years. Clearly, however, "this technology will continue to improve. There are huge market opportunities for speech recognition. For that reason, a lot of money will be invested to perfect it."

Identifying the Needs of AT Consumers: An Inexact Science

How do researchers and product developers identify and involve AT consumers and potential consumers in the process? According to the 2003 Department of Commerce study, Dr. Bauer recalled that 38% of assistive technology manufacturers never used consumers in product development, during the 1997-99 survey period. According to Dr. Bauer, "It's not like these companies have a lot of extra capital to conduct extended market studies or run focus groups to design or evaluate product prototypes. These companies would love to do all of these things, but they often can't."

When companies decide on which products to develop and how to design these products they'll often consult their sales and marketing staff, Dr. Bauer says. "Sales and marketing professionals work directly with consumers. They see which products sell, what people like or don't like about these products, and what new products people want. They substitute for consumers but they can't really do a good job speaking for consumers."

"Manufacturers will get feedback from consumers when the product goes to market. This feedback, as collected by the sales and marketing staff, may be incorporated into the next generation of the product. It's a form of iteration, but its nowhere near an optimal methodology for product design." In some cases, the company, "may also hear advice but judge that the product is "close enough," and won't make changes. For instance, if the company has a product that is just OK but no competitor offers a better product, the manufacturer may decide to leave it alone."

Yet, federal legislation, trans-generational markets, and collaborations with major corporations are changing the environment for AT manufacturers. Even the growth of industry associations like the Assistive Technology Industry Association (<http://www.atia.org>), is an important phenomenon, Dr. Bauer says.

"Industry associations are growing rapidly and systematically each year. They present a unified voice for the industry in the public domain. They place representatives on standards committees for instance or lobby for legislation that affects funding and reimbursement. Those parts of the assistive technology industry that lack a coherent voice are at a very big disadvantage."

Needed: More Consumer/Industry Group Cooperation on Key Issues

The environment for AT manufacturers is changing, says Dr. Bauer. Business

opportunities, markets, sales volume and revenue are all growing. Mergers are also changing the landscape. The industry now consists mainly of small, but healthy, companies. As AT manufacturers continue to grow, they may be better positioned to expand consumer involvement. Manufacturers employing customer centered product design, produce better products that ultimately do better in the marketplace and do a better job serving consumers.

Dr Bauer adds, "On the level of public policy, industry and consumers share many common issues. Federal legislation impacts both the producers and consumers of technology including: product availability, product quality; and product reimbursement through federal programs such as Medicare and Medicaid. Federal legislation impacts the supply of technology through, for example, the Small Business Innovation Development Program (SBIR) and demand for technology through, for example, IDEA and the Rehab Act. Increased funding to the SBIR Program increases technical innovation and the number of products in the marketplace benefiting both manufacturers and consumers. Strengthening IDEA or the Rehab Act increases demand for new products again benefiting both manufacturers and consumers."

There are about 600 Centers for Independent Living nationwide, he says. "Many of these centers are distribution points for AT, or training/service points for AT. All of these centers serve as key information dissemination points for AT loans, products and services. "As a member of ATIA, I often discuss the benefits of working with CIL and consumers generally. From my perspective, it's always a good thing when consumers and industry seek to understand each others needs and perspectives, and work together on common issues."

When Should Families Purchase AT?

How should families think about purchasing AT with respect to the potential for something newer and better being around

the corner? How can they know when to buy and when to wait for "the next big thing?"

Dr. Bauer replies, "If money is the issue for a family, they need to find out what resources are available, like school systems. Some school systems understand IDEA and its implications and also have well trained assistive technology experts. The family needs to know that the school system, under IDEA, has to provide that technology. The family also needs to know that it need not accept a technology." For many reasons, a school system may recommend less appropriate technology, he cautions. In that case, "the family needs to advocate for the appropriate technology."

In his opinion, "Most school systems will try to accommodate as best they can. The family's responsibility is to do its own research, which means learning what educational technology products are available, which requires them to research various websites, talk to AT professionals and people with disabilities who use the technologies. This information will allow the families to ensure that the school is aware of the most appropriate technology solutions. In some cases, the school staff charged with performing AT assessments and evaluations are not up to date on what types of assistive technologies are available, providing the information to the appropriate school staff will help to ensure that the student gets the technology they need for a free and appropriate public education.

"There's various screen magnifiers and screen readers. There are specialized software products. It's very difficult for the layperson to grasp the potential of all these AT options without assistance."

Many school systems don't have AT specialists, he admits. "Most school systems, I believe, are happy to help families, but the school systems also suffer from AT knowledge deficiency, just like families."

Families, he warns, must do research “and the best method of research is the Internet.” His advice to the family of a child with disabilities: “Get the information and then advocate for yourself. If you advocate for the technology, if you tell the school exactly what you want and why you want it and why it’s necessary, the school system will have a difficult time saying no.”

The Speech-Language Pathologist Paradox

He adds, “Some special education teachers are familiar with AT, as are some speech-language pathologists, although most speech language pathologists are not trained on computer-based augmentative and alternative communication (AAC) devices.” The majority of speech-language pathologists, he claims, have never used an augmentative communication device. “Maybe 70% have never used such devices.”

According to Dr. Bauer, speech-language pathologists were historically trained to help individuals improve their speech, not to augment their speech with technological aids. At the same time, however, “they are the professionals who know when a child needs an augmentative communication device.” Many AAC manufacturers are reaching out to the SLP community, providing technical training and introducing these clinicians to the appropriate use and potential benefits of AAC devices for people with communication impairments. Once AAC devices are well-integrated into the practice of SLP, “they’ll be the ideal source to help a family select the right one and train the child how to use language on the device.” Organizations such as the American Speech-Language Hearing Association (ASHA) have an important role to play, he continues, “helping to introduce their members to the benefits and capabilities of AAC devices.”

Where Does Assistive Technology Occur?

Does technology transfer occur primarily in AT hardware or does it also occur in other

areas of accommodation, for example when researchers learn more about how the brain functions, does that result in AT accommodations in the classroom that do not rely on hardware?

“That’s an interesting question,” Dr. Bauer replies. “The research conducted by Gemstone (and others) served as the basis for the development of a new type of product used to train binocular eye tracking and improve reading performance. I think that this same research could raise the awareness of teachers and change the way our students are taught. Research can lead to both desirable results.”

As for university-based research, “the Patents and Trademarks Act (Bayh-Dole) states that universities own the intellectual property (research outcomes) produced by its faculty and staff. This intellectual property can be licensed to a private sector company, or the university might take an equity position in a start-up a company.”

The Technology Innovations Act (Stevenson-Widler) provides a mechanism for technology developed in federal laboratories to reach the marketplace. An example of technology transferred from the federal labs is the EyeGaze System (<http://www.eyegaze.com>) from LC Technologies. The EyeGaze System is used like a “visual mouse,” where cursor movement on the computer display follows the direction of the person’s gaze. Items are selected by letting the cursor “dwell” or a separate switch can be employed. The Eye Gaze System allows person’s with quadriplegia and other mobility impairments to access and control computers. Since that time other eye gaze systems (e.g. Tobii Eye Tracker at <http://www.tobii.se>) have come into the marketplace but LC Technologies was a pioneer.

When Mainstream Product Innovation Results in Less Expensive AT

The cost of AT is often high because special technology is developed for small markets. For this reason, AT manufacturers often

piggyback on technological innovations that first occur in mainstream markets.

Augmentative and alternative communications devices, Dr. Bauer says, “may be a software program running on a PDA or laptop computer. Lever drives for manual wheelchair propulsion may adapt components that were first developed for bicycles.”

A Convergence of Technologies and Applications

According to Dr. Bauer, there is a growing convergence between the interests of mainstream and assistive technology companies. “It works two ways. Most of the time it’s happenstance that a technology developed for a mainstream market has a disability application, but more and more mainstream companies are thinking about the broadest possible market or the aging of the current market, while products are in the design stage. Academics call this universal and trans-generational design.”

Mainstream companies, he insists, “are sometimes fearful of the term ‘universal design’ because they interpret these words to mean that a product must satisfy persons of every level of ability. Such a product could be frightfully complex, costly and unappealing to customers seeking simple, efficient products. When we (the T2RERC) talk to companies, we usually don’t mention ‘universal design.’ Sometimes we don’t even mention trans-generational design. We just provide input on ‘product design’ for the purpose of capturing new markets, broadening current or retaining markets as they age. Different words but closely related to universal and trans-generational design. A universal product (an approximation) will often meet the needs of people with disabilities and everyone else as they age into disability or acquire disability through injury or disease. That’s all of us. When we work with companies we always work closely with their design teams. We also provide access to a wide consumer base – including people with disabilities and people who are elderly. Input from a broad spectrum of

customers provides a good basis for ‘universal’ or ‘trans-generational’ product design.”

Consumer Involvement Means Good Product Design

How should product developers and consumers think about the needs of the person with disabilities, and their support network of teachers, parents and aides when picking and choosing what features to include in a product?

Dr. Bauer responds, “This is really at the heart of good product design - almost always customer-centered. By customers, I mean primary and secondary consumers, which includes the individual with disabilities, his family and his support network. If companies aren’t even bringing the primary consumers into the design of products, then it’s a challenge to come up with a really good product.”

On the other hand some AT manufacturers provide wonderful models for consumer participation in product design. Bauer cited Blue Sky Designs saying “this company follows a very systematic customer centered design process. Persons with disabilities are involved in all phases of design, evaluation, and testing. Blue Sky Design (<http://www.blueskydesigns.us/>) has just licensed an accessible tent to Eureka that’s great for wheelchair users, elders, and any camper who wants easy access to their tent space.”

AT Companies Suffer from Lack of Institutional Memory

Dr. Bauer cites another problem discussed in the Commerce Department study: AT companies, because they are small and cannot provide the salary and benefits of a major corporation, suffer a huge turnover in technical staff. As a result there’s a strain on knowledge retention - institutional memory, which deprives these companies of the ability to ramp up capacity. Talented technical staff persons are often hired away

by larger companies with higher salaries and more benefits to offer. This can greatly slow product refinement and new product introduction.

Government Funding of AT Research and Development

One of the principal mechanisms for funding AT research and development is the Small Business Innovation Research program. “We’re doing a public policy study here that will show that there’s tens of millions of dollars being invested by agencies such as NIH annually into AT product development. That’s much more money than most recognize.

As a percentage of the total NIH budget, however, “it’s a very small amount. I don’t know how to interpret that. Should people be happy that millions of dollars are going into AT product development or unhappy because it’s 0.5% or 1% of the total SBIR budget? Given the many people with disabilities and the huge segment of our population aging into disability, are these numbers appropriate? An interesting public policy discussion.”

The National Institute on Disability and Rehabilitation Research is another important federal agency (<http://www.ed.gov/about/offices/list/osers/nidrr>), according to Dr. Bauer. “It funds the Rehabilitation Engineering Research Center system, which consists of 20-plus national centers doing applied research on disability and assistive technology.” The Rehabilitation Engineering Research Center on Technology Transfer (<http://cosmos.buffalo.edu/t2rerc>) has been facilitating the development and transfer of technology and commercialization of products for over ten years.

Unfamiliar with the End-User

Manufacturers are more familiar with clinicians and special education teachers and speech-language pathologists than they might be with the end user, Dr. Bauer notes. Many times, he explains, companies work

with secondary consumers as the representative of the end user. Instead of attempting to work with 10 end users of an AugComm device, for example, “maybe a company will work with one speech-language pathologist serving 10 end users.” Companies use secondary consumers as expert advisors for product design, he adds.

The hearing industry is different because a lot of market research is readily available to manufacturers, Dr. Bauer says. “There’s a company called Knowles Electronics has published a comprehensive study of the hearing market (MarkeTrak Consumer Tracking Survey) every two years for about a decade. Knowles is a major supplier of electronic components to many of the manufacturers in the hearing industry.” Identifying unmet customer and technology needs, Dr. Bauer explains, provides a target for hearing aid and assistive listening system manufacturers. If these companies design, manufacture and sell more products – they will also buy more components from Knowles. This is an example of market cultivation.

The Future: A Marketplace Serene on the Surface, Dynamic Underneath

Dr. Bauer likens the AT manufacturing landscape to the surface of a mountain lake in midsummer: a languid, smooth surface, but churning underneath with forms of vibrant life that are invisible to the untrained eye. “Those life forms are merging and reproducing and changing the ecology of the lake with their dynamic energy. In a nutshell, that’s the future of the AT technology transfer marketplace.”



RESOURCES

ARTICLES

Opportunities and Forecast

Microsoft Corporation 2003

In 2003, Microsoft Corporation commissioned Forrester Research, Inc., to conduct a comprehensive, two-part study measuring the current and potential market of accessible technology in the United States in order to better understand how accessible technology is being used today. Phase I of the study devotes a chapter to the opportunities available to technology companies such as Microsoft that are willing to aggressively understand and pursue the growing market for accessible technology. <http://www.microsoft.com/enable/research/opps.aspx>

Predicting the Future of Assistive Technology

By Wylie Goodman
Half the Planet 2004

An interview with Dave Clark, Director of Technology and Accessibility, Marathon Ventures, discusses new assistive technologies that will be available in the near future. He predicts an increase in "pervasive computing" – computers embedded in all areas of our environment – as well as an accelerated evolution in accessible wireless technology. http://www.halftheplanet.org/departments/technology/the_future.html

Technology Assessment of the U.S. Assistive Technology Industry

U.S. Department of Commerce 2003

A groundbreaking survey of 250 AT manufacturers compiled between 1997 and 1999, this study represents the most penetrating, and most contemporary, look at AT manufacturing in the U.S. Most

companies surveyed were very small businesses that grew into somewhat larger companies, thanks to a series of mergers, providing more efficient economies of scale and thus a greater ability to manufacture targeted AT products. For the most part, the study found, AT manufacturers adapt devices that have already been proven successful in the larger consumer marketplace for use by individuals with disabilities. The study discusses markets and future demand for AT, AT industry composition, the market strength and reach of U.S. AT manufacturers, positioning AT companies for growth, financing and investment and the role of government in the AT industry. <http://www.bxa.doc.gov/DefenseIndustrialBasePrograms/OSIES/DefMarketResearchRpts/assisttechrept/>

Technology Trends

Consortium for Citizens with Disabilities
2004

This short article summarizes current trends in AT, which include the following: smaller, miniaturized devices for more portability, more power; wireless communications for voice, text messaging, data transmission, seamless connectivity; broadband development for faster Internet communication speeds; delivery of traditional services via telecommunications such as telehealth, telework, e-government, and e-learning; the prevalence and use of personal data assistants (PDAs). All have accessibility issues that must be resolved to facilitate their use by persons with disabilities. <http://www.c-c-d.org/techtrends.htm>

Trends and Issues

AT Training Online Project
University of Buffalo 2005

A primer on the current state of AT, the article decries the lack of information among professionals, administrators and parents on the availability and use of devices that promote access to the school curriculum.

The article addresses the following AT-related trends and issues: assessment, cultural and family and universal design trends along with training, funding and maintenance issues.

<http://atto.buffalo.edu/registered/ATBasics/Foundation/intro/introtrends>

Trends in Assistive Services and Technology

By Sandra R. Osborn

Florida for Assistive Services and Technology (FAAST) 2005

This article examines the current status of AT. The focus is on Florida, but the issues are applicable nationwide. The author includes recommendations for legislative and agency action on the state level as well as for federal action in support of assistive technology issues.

http://faast.org/atr_trends.cfm

FACT SHEETS

Assistive Technology and Special Education

Legislation, particularly IDEA, has had an accelerant effect on the market for assistive technology in education. This compact fact sheet outlines legislation's impact on AT and on other issues regarding AT in special education.

<http://www.protectionandadvocacy-sc.org/Assistive%20Technology%20and%20Special%20Education.htm>

Math Markup Language

World Wide Web Consortium (W3C) 2001

Although the mark-up language HTML has a large repertoire of tags, it does not cater to math. MathML consists of a number of XML tags that can be used to mark up an equation in terms of its presentation and also its semantics. MathML attempts to capture the

essence of the meaning behind equations rather than concentrating entirely on how they are going to be formatted out on the screen. This fact sheet, prepared by W3C, defines the purpose Math Markup Language (MathML), which is intended to facilitate the use and re-use of mathematical and scientific content on the web as well as applications such as computer algebra systems, print typesetting and voice synthesis. MathML encodes the notation of mathematical notation for video high-quality display and mathematical content, for applications where semantics are important, such as in scientific software or voice synthesis.

<http://www.w3.org/Math/>

FORUMS

The Future of Assistive Technology

A discussion among AT luminaries Chuck Hitchcock, Arjan Khalsa, Dave Malouf, Phil Parette, Joy Zabala and Dave Edyburn focuses on the ways all children can benefit from the use of AT without leaving behind children in special education.

<http://www.ciconline.com/NR/rdonlyres/e2pz23rmiozcerlclyy3us5sfhlhormgfvcsit4sdjxzgksadoicc3rjxt5tieol2pxv154i4a5dzcanfnxajm3tc/T-Win05-ATForum.pdf>

LEGISLATION

Summary of the Assistive Technology Act 2004

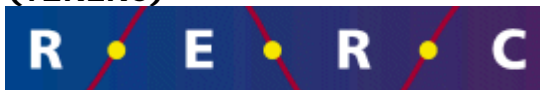
Education and the Workforce Committee
U.S. House of Representatives 2004

Many current trends in AT – and markets for AT – emanate from national legislation. This document provides an easily understandable summary of the provisions contained in the Assistive Technology Act of 2004.

<http://edworkforce.house.gov/issues/108th/education/at/billsummary.htm>

KNOWLEDGE NETWORK MEMBERS

Rehabilitation Engineering Research Center on Technology Transfer (T2RERC)



T2 RERC facilitates the transfer and eventual commercialization of innovative technologies to the marketplace for use by individuals with disabilities and the elderly.

The organization's website provides an overview of the technology transfer process as it relates to AT and transgenerational technology. Four research and four development projects are described in detail on the site along with the goals and the resources allocated to each. Acknowledged as a successful technology transfer broker, T2RERC provides manufacturer listings, publication news and links pertaining to AT and transgenerational technology research.

The T2RERC is supported by the National Institute on Disability and Rehabilitation Research (NIDRR) and is in the second year of a third 5-year funding cycle. The organization is housed in the Center for Assistive Technology within the University of Buffalo's School of Public Health and the Health Professions.

According to Project Director Dr. Stephen Bauer, "Technology transfer is defined as a process for conceiving of a new application for an existing technology. It is also defined as a process for converting research into economic development. The term "technology transfer" is also used to mean licensing intellectual property to a manufacturer for production in a product, or reducing an idea to practice in a prototype, or even the process of recording concepts of technology know-how in a professional paper or patent application. The noun "technology" is simultaneously used to mean concepts, descriptions, components, processes and

products. People use the verb "transfer" to mean moving from one point to another, but there is little consensus about the source or destination of the movement within technology transfer."

For more information on the T2RERC, contact:

T2RERC
Center for Assistive Technology
University at Buffalo
322 Stockton Kimball Tower
3435 Main Street Buffalo, NY 14214-3079
Phone: (800) 628-2281(V/TT); (716) 829-3141
Fax: (716) 829-2420
<http://cosmos.buffalo.edu/t2rerc/index.htm>

Assistive Technology Industry Association (ATIA)



ATIA helps represent the AT industry and works closely with electronics & information technology (EIT) companies and government on matters of common interest such as Section 508 of the Rehabilitation Act and the Americans with Disabilities Act (ADA).

ATIA holds annual conferences in Orlando, Florida. The conferences provide a forum for practitioners serving those with disabilities, including teachers, occupational therapists, rehabilitation counselors, physicians, psychologists and others.

For further information on ATIA, contact:

Assistive Technology Industry Association
(ATIA)
401 North Michigan Avenue
MC: 2200-1
Chicago, IL 60611-4267 USA
Phone: Toll-free: (877) 687-2842 (toll free);
(312) 321-5172

Fax: 312-673-6659
Email: Info@ATIA.org
<http://www.atia.org/about.html>

Federal Laboratory Consortium for Technology Transfer (FLC)



FLC is the nationwide network of federal laboratories linking laboratory technologies and expertise with the marketplace. Founded in 1974 and formally chartered by the Federal Technology Transfer Act of 1986 to promote and to strengthen technology transfer nationwide, FLC now consists of more than 700 major federal laboratories and centers and their parent departments.

FLC develops and tests transfer methods, addresses barriers to the process, provides training, highlights grass-roots transfer efforts, and emphasizes national initiatives where technology transfer has a role. For the public and private sector, the FLC brings laboratories together with potential users of government-developed technologies.

For additional information on FLC, contact

Federal Laboratory Consortium for Technology Transfer (FLC)
950 North Kings Hwy. Suite 208
Cherry Hill, NJ 08034
Phone: (856) 667-7727
Fax: (856) 667-8009
Email: flcmso@utrs.com
http://www.federallabs.org/content/basic_information_about_the_flc.html

Assistive Technology Solutions



ATS provides computer access, augmentative and alternative communications (AAC), worksite accommodations, mobility vehicle modifications and custom design and modification to individuals with disabilities in the Puget Sound region of western Washington State.

Evaluation and training services are provided at the client's workplace, home or school, eliminating the need for clients to travel and enabling the organization to provide services in the actual environments where AT will be used.

The organization does not sell equipment or have sales relationships with equipment vendors, ensuring objectivity in its client relationships.

For further information about the organization, contact:

Assistive Technology Solutions
5316 125th Ave. SE
Bellevue, WA 98006
Phone: (425) 373-1315
fax: (425) 373-1320
email: mark@atsolutions.biz
<http://www.assistivetechsolutions.com/index.htm>

National Instructional Materials Accessibility Standard (NIMAS) Centers



NIMAS guides the production and electronic distribution of digital versions of textbooks and other instructional materials so they can be more easily converted to accessible formats, including Braille and text-to-speech. CAST administers two centers that are dedicated to furthering the development and implementation of the NIMAS standards.

Version 1.0 of the NIMAS standard was developed in 2002-2004 by the National File Format Technical Panel comprised of 40 technology specialists, educators, disability advocates, and publishers and is based on the ANSI/NISO Z39.86 (DAISY 3) specification.

The NIMAS Development Center aims to improve the original standard by identifying new research and technological advances relevant to that standard. The center will also explore existing and new distribution models for the provision of accessible materials to students with disabilities.

The NIMAS center works with states, school boards, and publishers to raise awareness of the benefits of accessible materials while also advising on the efficient production and distribution of NIMAS-compliant materials. For additional information on NIMAS, contact:

CAST
40 Harvard Mills Square, Suite 3
Wakefield, MA 01880-3233
Phone: (781) 245-2212
Email: nimas@cast.org
<http://nimas.cast.org/>

Gemstone Educational Management



Gemstone identifies vision problems common to poor

readers and provides doctor-monitored, Internet-based vision training to help correct them. Typically, vision training is available through local doctors' offices and vision centers, where, due to lack of insurance coverage, services can be expensive. The company's Dynamic Vision Training program (patent pending), seeks to provide vision training for all students who require it, in their schools and at a low cost to the school district.

The program includes a series of screening tests to identify students with vision

conditions. The assessment measures tracking ability, accuracy of focus, the ability of the eyes to work together, and measurements not included in standard vision screening tests. For students who demonstrate problems, the program provides Internet-based vision therapy, including practice skills and exercises that train the eyes to become more efficient and thus make reading easier.

For more information on this program, contact:

Gemstone Education Management
575 San Pablo Ave., Suite D
Rodeo, CA, 94572
Phone: (510) 799-0234
Fax: (510) 245-3418
<http://www.gemstonevision.org/about.htm>

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**Family Center
on Technology
and Disability**

www.fctd.info