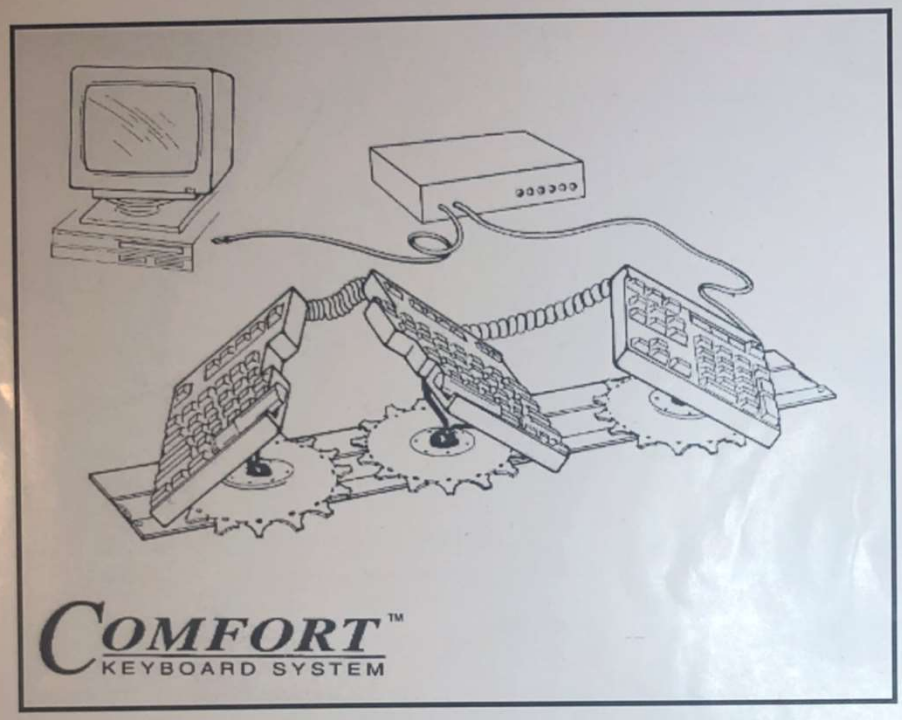
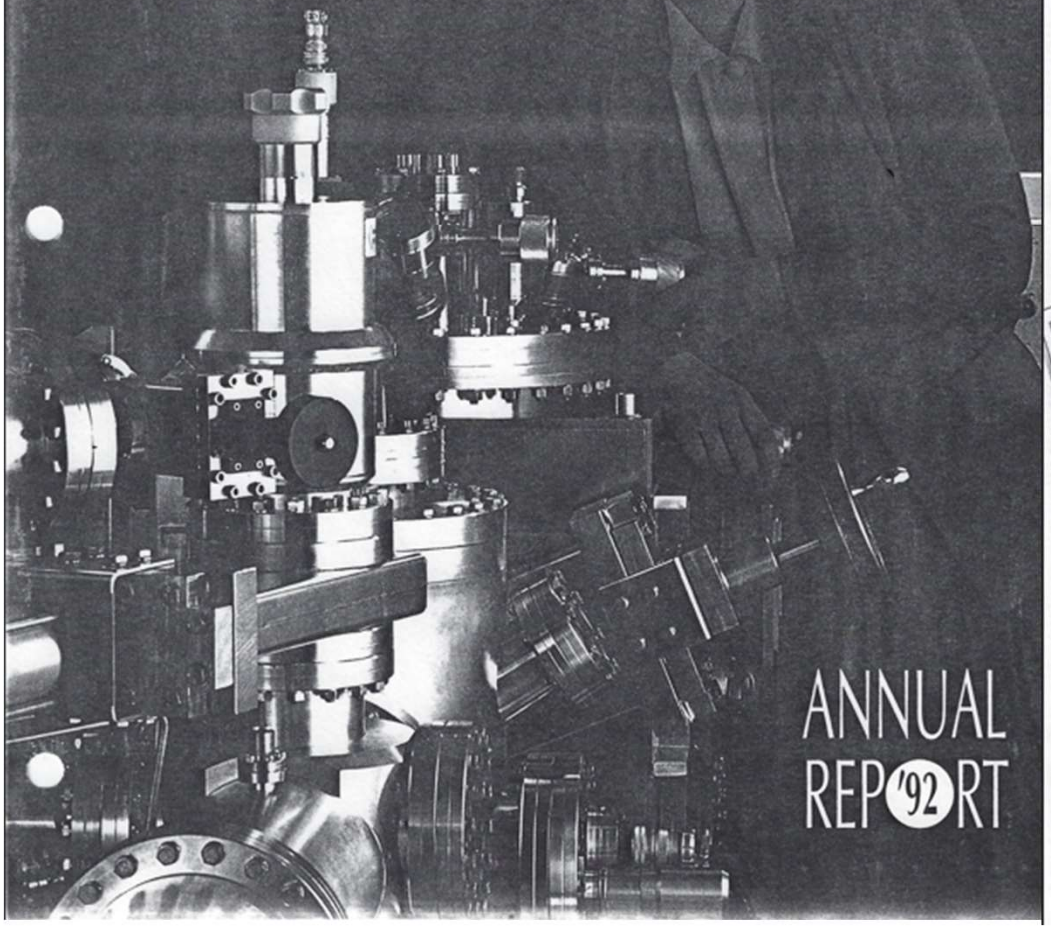


COMFORT™
KEYBOARD SYSTEM

Szmanda/Acly @ Health Care Keyboard Company, Inc. 1990 – 1996

The College of Engineering
University of Wisconsin-Madison

ENGINEERING EXCELLENCE

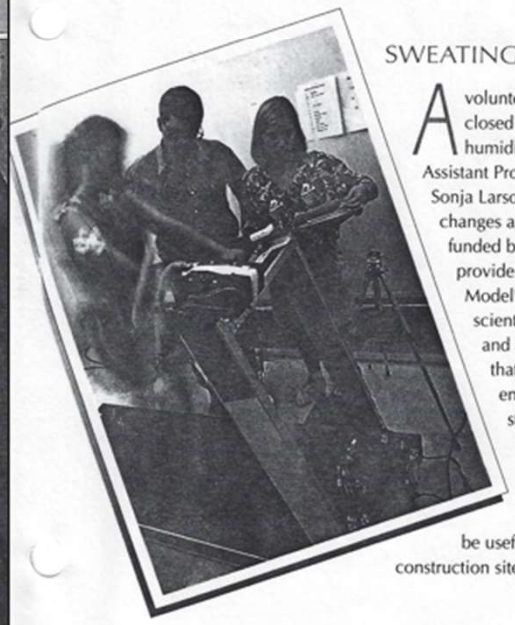


ANNUAL REPORT '92

A WRIST-RESTING KEYBOARD

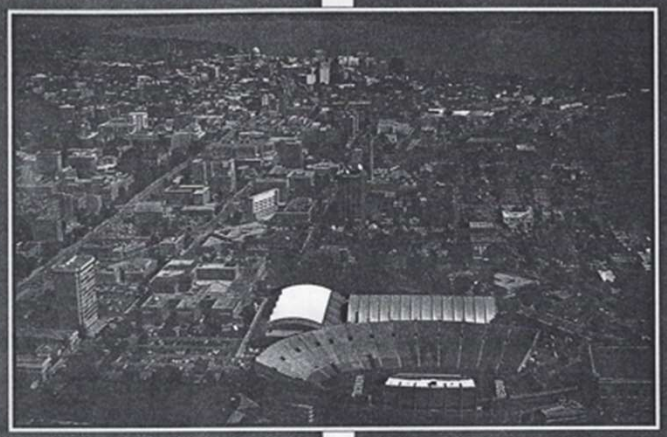
Industrial engineering graduate student Leah Newman tries out a Comfort™ Keyboard while Professor Mike Smith watches. The keyboard, developed and manufactured by Health Care™ Keyboard Company Inc. of Menomonee Falls, Wisconsin, is designed so that its three sections can be independently adjusted to accommodate the operator's natural posture. Bill and Jeff Szmanda, inventors of the keyboard design, came to the industrial engineering department seeking expert evaluation of both function and potential ergonomic benefit. Early research results indicate operators do at least as well with this keyboard in terms of accuracy and speed as with a traditional style. Originally designed to decrease wrist strain, the keyboard also has been evaluated for use by persons with physical disabilities which make traditional keyboards especially awkward to use. The keyboard's manufacturing process was recently designed by graduate students in the Manufacturing Systems Engineering Program under the direction of Professors Jerry Sanders and Rajan Suri. Early production should begin this fall.

SWEATING IT FOR SCIENCE



A volunteer subject (left) works on a treadmill in an enclosed cell that is heated to 85 degrees with 70 percent humidity at the UW-Madison Biotron. Meanwhile, Assistant Professor Steve Wiker (center) and undergraduate Sonja Larson (right) collect data on the subject's physical changes and her perception of heat stress. Wiker's study, funded by the Association of American Railroads, will provide data for creation of a "Job Energy Management Model" (JEMM). Wiker hopes the JEMM will help scientists understand how humans tolerate heat stress, and aid engineers in designing work and schedules that will reduce worker heat stress in hot and humid environments. One important difference in this study is the inclusion of changing climatic conditions and changing workloads, variables that Wiker says more accurately reflect actual working conditions for most jobs, including railroad track construction and repair. The JEMM should be useful in hot and humid work environments including construction sites, environmental cleanup sites, and factories.

The College of Engineering
University of Wisconsin-Madison



GRADUATE STUDY

INDUSTRIAL ENGINEERING

INDUSTRIAL ENGINEERS: MAKING A DIFFERENCE

Faculty members from the UW-Madison Department of Industrial Engineering have directed changes in the lives of people and organizations throughout the world. They have:

- Influenced federal policy related to **safety and health issues** in the workplace.
- Designed **ergonomically sound tools and workstations** to reduce worker injuries and health problems.
- Designed new approaches for implementing **office automation** to increase productivity and reduce stress.
- Developed tools to dramatically improve our ability to optimize **manufacturing systems**.
- Created improved methods to monitor **quality of care in nursing homes** and quality of products in manufacturing and service industries.
- Helped corporations create **factories of the future**, improving the United States' competitive position at a time when industrial vitality is a serious concern.
- Developed **mathematical models** that enable researchers to analyze diverse scenarios and recommend workable solutions to complex problems.
- Established new theories for enhancing **quality and productivity** in manufacturing, service industries and government.
- Developed theories and approaches for **re-engineering inner-cities** to enhance the quality of life for economically disadvantaged residents.

These ergonomically sound adjustable keyboards were tested by industrial engineers at UW-Madison.

Industrial engineering faculty members are frequent recipients of awards and professional recognition. Recent honors include the following: American Medical Association's Award for Excellence in Education; Society of Manufacturing Engineers' LEAD Award for leadership and excellence in the application and development of computer-integrated manufacturing curricula; American Nuclear Society's 1993 Women's Achievement Award; Ellis R. Ott Foundation's award for excellence in quality improvement; Joseph Orlicky Award for the Best Innovation in Manufacturing and Service Operations; and U.S. government's Superior Service Award for occupational health research.

Faculty members have received other recognition as well. One faculty member received international attention for his work in the theory of simulation. Two others have chaired recent international conferences. Two are editors of national academic journals, and one is past president of the Medical Decision Making Society. Two others hold endowed chairs. One has been elected to Britain's Royal Society and received the Deming Medal.

FOR MORE INFORMATION

If you are interested in the University of Wisconsin-Madison Department of Industrial Engineering, please contact us:

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UNIVERSITY-INDUSTRY
RESEARCH PROGRAM

Activity
Report
1991

UNIVERSITY OF WISCONSIN MADISON

REFERRALS ARE "KEY" FOR MENOMONEE FALLS COMPANY

UIR referrals have given a big boost to a young Wisconsin business, **Health Care Keyboard Co., Inc.** of Menomonee Falls. When the company first contacted UIR in July 1990, it was using a $35 model made of donated parts to demonstrate its product concept—a computer keyboard designed to reduce risk of carpal tunnel syndrome and other wrist injuries. A year and a half later, the firm has patented its concept, secured financing, placed prototypes with over a dozen Wisconsin companies, and is looking forward to manufacturing and marketing in 1992.

At each stage of its development, company vice president Jeffrey Szmanda asked UIR for assistance in finding people with the expertise to help the company advance. Referrals ranged from UW-Madison business faculty such as UIR associate director Robert H. Bock, who reviewed the company's business plan, to Wisconsin suppliers who could fabricate components.

Three referrals have had particular impact. Prof. Gregg Vanderheiden of UW-Madison's Trace Center suggested additional applications that would enable quadriplegics to use the keyboard, supplied specialized DOS-access software, and provided referrals to the disability and rehabilitation markets.

Another crucial contact was industrial engineering professor Michael Smith, an expert on ergonomic design of computer equipment. He provided advice on the Health Care Keyboard concept and related issues such as product liability, and currently is conducting technical evaluations of the keyboard at his UW-Madison laboratory.

Smith's assistance shows how referrals can "snowball" into an extensive network of resources. Because of his industry contacts, for example, Smith has generated widespread interest in the keyboard among the newspaper, telephone, insurance, and banking industries, fields that involve intensive data processing. He also helped arrange the first technical field evaluations of the keyboard, in which 40 units will be used by the IRS in mid-1992.

"Prof. Smith has been just terrific," Szmanda says.

"Another essential UIR referral," he adds, "brought Prof. Jerry Sanders into the project." Working under Sanders, a specialist in the design of manufacturing systems, a graduate student team will help design a state-of- the-art manufacturing process for the keyboard. The work will be part of an advanced industrial engineering course taught by Sanders and Prof. Rajan Suri.

Jeffrey Szmanda (right) of Health Care Keyboard Co. meets with UW-Madison graduate students Frank Conway and Suvedee Chumroum. The students are helping Prof. Michael Smith perform technical evaluations of the company's ergonomic keyboard.

Health Care Keyboard is now exploring the feasibility of developing a keyboard assembly industry in south Madison, where it could provide employment for economically disadvantaged residents. This project, being developed with city and county agencies and local businesses, also involves a UW-Madison professor of urban development and a minority graduate student of Smith's.

Of the key contacts UIR has helped him make, Szmanda says, "UIR's assistance is catapulting us into a leadership position in the ergonomic keyboard industry. We're extremely grateful that all these resources are available in Madison."

Award Recipients

The Best of State Products are qualified for the National Society of Professional Engineers New Product Competition.

1993 Best of State

Division I

Applied Power, Inc.
Butler
Electrohydraulic Automotive Suspension Valve
--A fast-acting hydraulic valve that responds to sensors in various parts of an automobile. It individually controls each of four shock absorbers and has a response time that can best be measured in milliseconds.

Division II

Radiation Measurements, Inc.
Middleton
GAMMEX/RMI Scintillation Detector, Model 446
--An instrument used in the design and management of radiation therapy for cancer patients. Its high spatial resolution helps focus radiation on the cancerous area and minimize the effect on surrounding tissues.

Division III

Health Care Keyboard Co., Inc.
Menomonee Falls
Comfort™ Keyboard System
--A three-piece computer keyboard which can be adjusted to offer the most comfortable position for each individual. It includes special keyboard functions which use macros and also remind users to take periodic rest breaks.

Award Recipients

The Johns Hopkins University
National Search

Presents this

CERTIFICATE of ACHIEVEMENT

to

Jeffrey P. Szmanda

In recognition of and appreciation for your dedicated and valued contribution to this national program for enhancing the quality of life for people with disabilities through the application of computing technology.

1992 National Finalist – Merit Award

Paul E. Hazan
National Search
Program Director

Carl O. Bostrom
Director
Applied Physics Laboratory

William C. Richardson
President
The Johns Hopkins University

Don Dalton

A PC Revolution

Aided by Computers, Many of the Disabled Form Own Businesses

Quadriplegic Runs His Firm By Using Only His Voice; A Blind Couple Prospers

Evening Up the Playing Field

By TIMOTHY L. O'BRIEN
Staff Reporter of THE WALL STREET JOURNAL

NAPERVILLE, Ill. — Don Dalton, who started Micro Overflow Corp. in his garage 3½ years ago, expects its sales to top $1 million this year. His success resembles that of many entrepreneurs, with a crucial exception: He is paralyzed from the chest down and confined to a wheelchair.

And his business, a distributorship that adapts computer technology for the disabled, is helping create more disabled entrepreneurs than ever before. "I want the millions of people who are disabled and unemployed to be working for a living and be happy with themselves," he says.

Opening New Avenues

Many of the disabled are indeed finding the best hope for entrepreneurship, and rehabilitation of the disabled generally, in the huge changes introduced by personal computers. Using PCs, the disabled can read, write, do research and interact with other people in much more sophisticated ways. Now, many of them are managing businesses in such fields as financial services, database entry, graphic design, architecture and desktop publishing.

"For many people, computers have represented the only way in which they have been able to work, given the extent of their disabilities," says Howard Shane, director of the Institute on Applied Technology, a Boston nonprofit group that does research and training on computer applications for the disabled. "Ten or 15 years ago, the same person who has a business today would simply not have been able to work. It's absolutely revolutionary."

To be sure, many disabled people, especially those born severely disabled, lack the skills needed to earn a living. But, bolstered by the Americans With Disabilities Act, which mandates workplace accessibility for the disabled, they are feeling a growing sense of entitlement — just when the PC is expanding their abilities.

With the computer making "the playing field more even," says Urban Miyares, president of the Disabled Businesspersons Association, in San Diego, "the increase in start-ups among the disabled has been tremendous, and we're getting three times as many inquiries from disabled entrepreneurs compared to three years ago."

According to state departments of reha-

Please Turn to Page A8, Column 1

bilitation in Florida, New York, Texas and Illinois, requests for technical assistance from disabled business owners have been increasing. In Texas, 503 new businesses received assistance in 1992, up from 365 in 1990. In New York, 77 got help, up from 55 in 1990. The National Foundation for Teaching Entrepreneurship, in New York City, says the number of disabled entrepreneurs it has aided has increased about 20% in the past four years.

Destroying Myths

Destroying myths is what Mr. Dalton says he hopes to do at Micro Overflow. "When people come in here and see me with a disability, they're shocked," he says. "That's why I work with clients and don't just administer. I want them to see that they can start a business and also do anything else they want."

Michael Smith, professor of industrial engineering at the University of Wisconsin. Several other countries are further along in protecting workers. Sweden, for example, has had a strict ergonomic standard since 1979, and in Germany insurance companies scale back benefits to companies that do not adequately guard against RSI.

Admittedly, personal traits and habits often influence who will develop RSI. A pioneer in treating the injuries, Dr. Emil Pascarelli, medical director of New York City's Miller Institute at St. Luke's-Roosevelt Hospital, points out how very heavy people can get into trouble. For their hands to reach the keyboard, they have to maneuver their arms around their own girth, and wind up contorting their wrists inward. Double-jointedness can also be a risk factor. Smokers may have fewer injuries, thanks to their periodic breaks away from the terminal to satisfy nicotine cravings. And what goes on outside the office can be just as damaging as what happens in it. Observes Katy Keller, a physical therapist at the Miller Institute: "Injured people go home and talk on the telephone, stir the supper and carry the baby all at the same time. All this does is add to the physical stress of the workday."

For many workers, physical stress is just part of the problem. A three-year study by the National Institute for Occupational Safety and Health of telephone workers at U.S. West Communications found that 111 out of 518 employees who used computers had RSI. The most revealing discovery was that all the sufferers reported high levels of psychological strain, such as job insecurity and pressures to work fast. Psychological stress probably does its mischief by creating muscle tension, which reduces blood flow to hard-working muscles and tendons; without enough oxygen, these tissues become fatigued and prone to injury.

Fearful of lawsuits or just concerned about the health of their workers, a few employers are beginning to take action. They are providing fully adjustable, ergonomic chairs and wrist supports to employees who complain of pain. Others are trying to break up the daily routine by giving people different tasks. The Los Angeles *Times* has set up its own repetitive stress injury room, stocked with a set of light weights for strengthening hands, a freezer full of ice packs to calm inflamed tendons and a floor mat for ailing workers to stretch out on. The paper has customized its software program to flash "Take a Break" reminders. IBM has given ergonomic furniture to many of its most pressured keyboard workers, including 800-number operators.

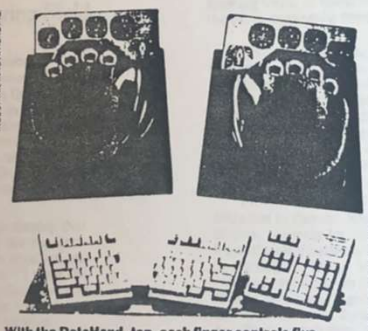
New, more benign technology would help. In the U.S. and elsewhere designers are scrambling to create radically different keyboards that will be easier on the hands. But the ultimate goal is to do away with the keyboard. Reuters has given McCool a voice-activated computer that can type words and perform other functions in response to his verbal commands. Such machines are still slow and unreliable and can "understand" only a limited vocabulary, but the technology is improving rapidly. When voice-activated computers spread through the workplace, probably sometime early in the next century, the only occupational risk might be an occasional bout of laryngitis. *—With reporting by David S. Jackson/San Francisco*

Building a Better Keyboard

WHO SAYS ALL COMPUTER KEYBOARDS HAVE TO LOOK alike? With more and more computer users complaining of wrist and arm injuries, keyboard designers are taking a fresh look at the one component that has hardly changed since the earliest days of computing—or, for that matter, the earliest days of typewriting 125 years ago. The result is a new crop of alternative keyboards that take the standard flat, rectangular input device and bend, split, fold and twist it almost beyond recognition.

Most new keyboards start with the familiar qwerty key arrangement (named after the first six keys in the top left row of letters) and try to shape it into a more ergonomic form. A keyboard made by Kinesis Corp. in Bellevue, Washington, moves the keys into two saucer-size wells about a hand's width apart, relocating hard-to-reach function keys and providing more support for the wrists. The TONY! keyboard, designed by Anthony Hodges in Mountain View, California, is hinged in the middle, between *g* and *h*, so that the hands can meet the keys in a more natural, thumbs-up position. The Comfort keyboard, developed by the Health Care Keyboard Co. of Menomonee Falls, Wisconsin, breaks the board into three parts that can be rotated in every direction to suit the needs of individuals typing in every conceivable position—even standing up.

Some designs take a more radical approach that would require users to master a new way of typing. The DataHand, developed by Industrial Innovations in Scottsdale, Arizona, abandons conventional keys altogether, replacing them with padded handrests and little finger wells. Each finger can produce five different characters by pressing forward, back, left, right or straight down. Infogrip, Inc., of Baton Rouge, Louisiana, goes one step further. It makes a seven-key "chordic" keypad that works like a court stenographer's machine: the operator presses a different combination of keys to produce each letter.



With the DataHand, top, each finger controls five characters. The adjustable Comfort keyboard, bottom, lets typists work in any position—even standing up.

The designers argue that by allowing hands to rest in a more natural posture and fingers to reach keys more easily, the new keyboards will reduce the stress and strain associated with RSI. But doctors specializing in treating keyboard injuries warn that none of the new models have yet undergone rigorous scientific testing.

Still, keyboard makers believe their new designs will find a ready market despite the high price tags ($200 to $2,000, vs. as little as $20 for a standard model). They figure that employers—and their insurers—which are required under various workers' compensation laws to pay injured computer users to stay at home, will happily pay a premium for a new keyboard if that is what it takes to get them back on the job. *—By Philip Elmer-DeWitt*

COMFORT™
KEYBOARD SYSTEM

has been seen on:

- **CNN**
  Science and Technology
- **Discovery Network**
  Next Step
- **ABC**
  Good Morning America
- **Fox Television Network**
  Network News