



CONTENTS

INSIDE HFES2
ANNUAL MEETING.....3
LETTERS4

NEWS4
PEOPLE4
IN THE NEWS5
STUDENT NEWS5

Member Profile: HF/E in the Stock Market

By *Bruce E. Friedman*

Note: Periodically the HFES Bulletin will feature work by HFES members in a variety of settings.

When the HFES Communications Department staff discovered that I am the only member of the Society employed at NASDAQ, they asked me to write about how I ended up designing software that runs a stock market and how my human factors background benefits my work.

The Road to NASDAQ

In the early 1980s I earned my bachelor's degree in physics from SUNY Albany and my master's degree in physics from Brown University. As I entered the workforce, I was unaware of the term *human factors* and had not considered working in the "soft science" field of psychology. I became a hard-core systems engineer for an aerospace company designing radar systems, and my work was about as far from human factors as you can get. I analyzed radar signal-to-noise ratios, designed antenna arrays, and modeled aircraft tracking systems. The only human element was that pilots flew the aircraft my system tracked.

In 1989, I joined Sikorsky Aircraft as a systems engineer writing software requirements. I was assigned to work on a new helicopter being developed for the Army: the Light Helicopter Experimental (LHX). This helicopter is now known as the RAH-66 Comanche and is in flight test and development. Had this been a traditional helicopter program, I'd still be ignorant of human factors, as my work would have focused on subsystem and integration requirements. The Comanche, however, was designed from the cockpit out, with much of its software revolving around the interface between the crew and the aircraft. I worked so closely with the human factors engineering team that I became an adopted member. Over the next seven years, I grew addicted to user interface design problems and joined HFES.

During the boom in personal computers I joined a small software company as a user interface designer, where I became, ironically, the human factors "expert." I worked closely with customers to understand their business needs and designed the functionality and screen layouts for customized software applications.

But after a while, I missed working for a larger organization and on projects of greater size. Then I heard about an opportunity at NASDAQ. Although the position was not specifically in human factors but in systems engineering, it involved the design of the inner workings of the market trading system, the algorithms that determine how buy and sell orders are matched together to form a trade. This sounded very interesting and important and would allow me to retap my mathematical and logic background,

and I had to decide whether to pass up an opportunity to become an integral part of a rapidly growing electronic stock market or continue searching for a purer human factors-related position. I decided to take the position at NASDAQ and resolved to find a way to integrate my user interface background.

Human Factors "Inside"

NASDAQ is a screen-based market system, in contrast to floor-based systems such as the New York Stock Exchange. There are no pits where traders yell and signal at one another in order to execute a transaction. NASDAQ traders are distributed across the country, entering quotes and orders into terminals that feed into large mainframe computers. The computers follow intricate algorithms to execute the trades, and in turn they report the trades back to the traders. A growing trend is for traders to use their own computer systems to interface with NASDAQ, thereby automating much of the decision-making and entry processes.

One wouldn't think there would be much need for human factors in a computerized virtual trading pit, but although much of the process is automated, the underlying mechanics remain the same as in the noisy pits. The end user selects options from his or her computer, the computer communicates the request(s), the request(s) are considered and acted on, and the result of the action (or lack thereof) is communicated back to the user. The design of the system that considers and acts on user requests benefits from human factors analyses in the management of end user expectations and in the responses that satisfy those expectations.

To start, all end user requests must be acknowledged, and acknowledged quickly. Time is money. If acknowledgments are not rapid, the request may be duplicated. Unfortunately, the speed at which requests are acknowledged depends on system capacity and performance; however, the nature of the acknowledgment can be designed to accommodate expectations by considering the current state of the market and the broader impact of the request. An understanding of the users' intent and a consideration of their expectations may determine whether requests are accepted or rejected (see the figure on page 6).

Here's a simple example. A user enters an order to buy 1000 shares of a stock. The order is accepted. Noticing that market conditions are changing, the user decides to replace the order with a smaller, 500-share order. However, before the system receives this replacement request, the 1000-share order is executed. When the system receives the 500-share replacement, it can either blindly accept the new order and put the user at risk for an *additional* 500 shares or it can understand the user's intent and inform

continued on page 6

HFES and MESA Summer Camp Institute

By Grayson CuQlock-Knopp, Chair, Diversity Committee

For a second year, the HFES Diversity Committee and the Maryland Chapter of the Mathematics, Engineering, Science Achievement (MESA) program conducted a MESA/HFES Summer Institute at Morgan State University (MSU). The four-week program began July 8 and concluded August 2.

The objective of the institute was to encourage students to take the prerequisite courses in high school needed for successful university study in human factors. The institute attempted to meet this objective by exposing the students to human factors through a series of lectures, research and design projects, and field experiences. The series of human factors lectures included hearing conservation, computer hardware and software design, design and analysis of human factors experiments, anthropometry, stress assessment, cognitive readiness, human factors in equipment design, human factors designs for special populations, games for explaining human factors, water quality testing, weather forecasting, human factors issues in helicopter maintenance, and aviation survivability.

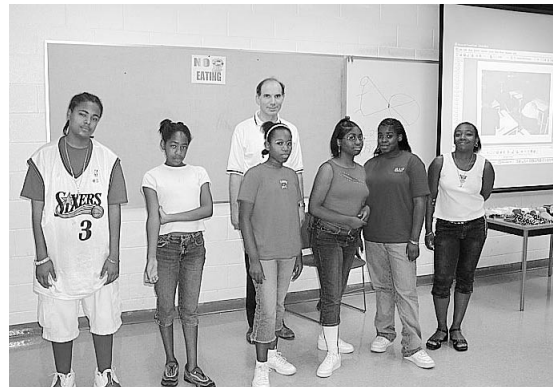
In addition to hearing the lectures, students participated in the human factors evaluation of mathematical software that was developed by scientists at MSU. During three field days, students prepared for the research experiments by attending lectures and participating in demonstrations given by the Department of Natural Resources, made field observations, and conducted research experiments.

The MESA students also worked on the following design projects: student Web sites, a backpack for the homeless, and a user-friendly device to restrain rats used in FDA research to detect cataracts. The last project will continue as a MESA science fair project during the 2002-2003 school year.

The Diversity Committee thanks the sponsors and supporters of the institute, primarily the U.S. Army Research Laboratory, the Maryland MESA Organization, Morgan State University,



John Schmidt discussing the role of human factors in naval aviation safety.



These students are the six finalists to win the title "Best Volunteer" during the MESA/HFES Institute lecture session, "Games to Explain Human Factors," presented by Ronald Shapiro (pictured in rear).

and Johns Hopkins Applied Physics Laboratory. Thanks are also extended to the U.S. Naval Safety Center; National Weather Service; Morehouse College in Atlanta, Georgia; Maryland State Department of Education; IBM Software Group; and the U.S. Food and Drug Administration.

Members of the HFES Diversity Committee, as well as other HFES members, have supported the development of the activities at the MESA/HFES Summer Institute by participating in the institute or by paving the way for others to support the classroom and field activities of the program. HFES members have written proposals for funding, presented lectures, given demonstrations, provided equipment, and assisted with the development of the educational programs at the institute. During the past two years, these members have included Joseph Knapik, U.S. Army Center for Health Promotion and Preventive Medicine; Ronald Shapiro, IBM Software Group; Kimberly Myles, U.S. Army Research Laboratory; John Waugh, U.S. Army Research Laboratory; Susan Meadows, U.S. Food and Drug Administration; Betty Sanders, Humanomics; Grayson CuQlock-Knopp, U.S. Army Research Laboratory; Dino Piccione, Federal Aviation Administration; Tonya Smith-Jackson, Virginia Tech; Jeff Alton, Naval Air Systems Command; and John Schmidt, U.S. Naval Safety Center.



Bulletin

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Election Results

The ballots have been counted, and the following individuals have been elected to serve three-year terms on the HFES Executive Council beginning in October 2002.

President-Elect

Betty M. Sanders
Humanomics, Inc.

Secretary-Treasurer-Elect

Paul A. Green
*University of Michigan
Transportation Research
Institute*

At-Large Executive Council Members

Peter A. Hancock
University of Central Florida
Carolyn M. Sommerich
Ohio State University

Clarification

In the nominations announcement in the June-July issue of the *HFES Bulletin* ("HFES Election," page 3) as well as on the HFES Web site and *Directory and Yearbook*, John Brian Peacock's employer was listed as NASA Johnson Space Center. To clarify, Peacock is a faculty member with the National Space Biomedical Research Institute at Baylor College of Medicine. His title is Discipline Coordinating Scientist for Space Human Factors Engineering. His office is located at NASA Johnson Space Center.

On-Line Articles Index Updated

The free, on-line cumulative index to HFES publications (*Human Factors, Ergonomics in Design*, and annual meeting proceedings) has now been updated to include articles published during 2001. In addition, a new feature has been added. Visitors can now select an option to display the results of key word searches alphabetically by the first word in the article title, or in date order with the most recent articles listed first. Go to <http://hfes.org> and click the link to "Index to periodicals" for the cumulative index search page.

List Your Consulting Services with HFES

If you're a full Member or Fellow, you're eligible to list your consulting or expert witness services in the Society's on-line *Directory of Human Factors/Ergonomics Consultants*. The directory, which has been live since February 2001, is freely accessible to all visitors to the HFES Web site (<http://hfes.org>). Each month for the last six months, between 400 and 500 visitors have viewed the main page; an average of 300 visitors per month conduct searches.

The fees for listing are \$150 for individuals and \$250 for companies; renewal rates for those already in the system are \$100 for individuals, \$200 for companies. If you'd like to place or renew a listing, go to <http://hfes.org> and access the Members-Only area of the site. (You will need your HFES member ID number, which appears on the mailing label of this publication.)



Items Wanted for Daily Newsletter

The HFES 2002 newsletter/on-site information editor is still accepting items for publication in the annual meeting newsletter, HFES2002News.

Topics may include descriptions of demonstrations; previews of panels, TG special session information, invited speakers, "Birds of a Feather" gatherings, recommendations for "Web Site of the Day" (resources to explore after the meeting), upcoming events, and other announcements.

E-mail submissions are encouraged. If you would like to submit an article please contact Newsletter Chair Tom Mayfield at 10547 Cliff Mills Rd., Marshall, VA 20115; 540/364-3452; tmayfield@evansincorporated.com. Submissions will be accepted during the meeting.

Standards Feedback Session at Annual Meeting

The HFES Executive Council's Standards Subcouncil, chaired by Hal Hendrick, will be holding a "Birds of a Feather" session at this year's annual meeting. The purpose of the gathering is to discuss the current state of HFES standards activities and to get feedback from interested members on new strategic directions, programs, and activities. The session will be held from 10:30 to noon on Thursday, October 3, in the Heron room at the Baltimore Marriott Waterfront Hotel. All members are welcome regardless of previous standards involvement; however, those who have been active in the development of standards are particularly encouraged to attend.

ETG Symposium

The Education Technical Group's symposium, "Teaching Techniques and Demonstrations: Let's Not Recreate the Wheel" (Thursday, October 3, 8:30 a.m.), will feature educators from psychology, engineering, and industry presenting five teaching techniques and demonstrations. Each presenter will discuss how the demonstration or technique helps students better understand the underlying human factors and ergonomics principles and the application of those principles. Audience participation is welcome during the discussion that follows, which will include other teaching issues and needs at the undergraduate, masters', and Ph.D. levels.

Display Educational Materials

During the HFES 46th Annual Meeting, representatives of graduate and undergraduate programs in human factors/ergonomics are invited to display brochures, applications, and other materials at an exhibit booth to be hosted by the HFES Education Technical Group and Student Affairs Committee. The booth will not be staffed, but program representatives who wish to be present

ANNUAL MEETING, cont.

during exhibit hours may do so (limited to four people in the booth at any given time). The exhibit will be open on Tuesday, October 1, from 3:00 to 6:00 p.m.; Wednesday, October 2, from 9:00 a.m. to 5:00 p.m.; and Thursday, October 3, from 9:00 a.m. to 2:30 p.m. Any leftover materials must be picked up during tear-down hours (Thursday, 3:30–8:30 p.m.) For further information, contact Andris Freivalds, Pennsylvania State University, 213 Leonhard Bldg., University Park, PA 16802; 814/863-2361, fax 814/863-4715; axf@psu.edu. ☒

LETTERS

Is Early Ergonomics Better Economics?

The following was written in response to Jane Fulton Suri's comments on HFES President David L. Post's piece in the March Bulletin entitled "Is Early Ergonomics Better Economics?"

I commend David Post for his balanced piece in the March *Bulletin*, "Is Early Ergonomics Better Economics?" I am reminded of some of his predecessors, such as Chapanis, Meister, and Sheridan, who likewise believed enough in the value of HF/E to be, at the same time, unafraid to suggest limits on its claims.

I'm less excited about the response (June/July 2002) from Jane Fulton Suri, who feels that the cost-saving issue "is no longer a useful question." This conclusion seems reasonable where "[the] principal goal is not to save money...but to spur innovation" (or research, or sales, or regulation, or whatever vision of growth is advocated). But to dismiss the question as no longer useful invites the further question, "No longer useful to whom?" The piece goes on to suggest the answer: It is no longer useful to advocates of the vision.

All else being equal, the sooner a problem is specified, the more likely it is to be solved. This is reasonable and justifies early HF/E involvement. However, the notion that we suffer cost overruns (or latent, catastrophic risks) due to inadequate front-end HF/E remains speculative. Could the growth of front-end complexity be more part of the problem than the solution? Yes, but (now it's my turn to be glib) this is frequently a less useful question. Front-end funding is a bird-in-the-hand; big projects take time and often are canceled.

In my 25 years in the nuclear power industry, I've seen many proposals for elaborate, top-down HF/E programs but few actual plants designed and built. Those plants that were built used conventional HF/E methods rather than the elaborate programs; today they operate safely. The next generation of plant designs is two orders of magnitude safer (in part, by reducing the need for prompt human action in emergencies). Yet the calls continue for increasing the role of HF/E in nuclear plant design.

As I recall, HFES found the top-rated human factors guideline to be "simplicity," and in various economic contexts it can be argued, from a human-centered perspective, that "small is beau-

tiful." Similarly, I believe in the value of early HF/E project involvement, if that involvement is proportionately modest (which is not to say hopelessly inadequate) because the ratio of potential benefits to costs is likely to be favorable. On the other hand, I'm highly suspect of elaborate, front-loaded proposals because they must produce monumental benefits, in the face of diminishing returns, to be cost-effective. Thus I oppose *carte blanche* for the *tabula rasa*. Cost is always an object, and the advocate of any proposal should be pressed to justify its value. I commend Bob Osgood for pursuing this goal.

– Bob Fuld

The following is HFES President David L. Post's response to Fuld's comments.

I'm loath to argue with someone generous enough to place me in the company of Chapanis, Meister, and Sheridan, but I will say this: I like Jane Suri's value-added case for HF/E. The cost-savings argument that was the focus of my article is the common one and – for better or worse – is deemed relevant in many work settings, but it's fundamentally defensive. Emphasizing our ability to bring innovation and product improvement, on the other hand, has an obvious positive quality. I think these two cases are complementary and that Jane did us a service by calling attention to the second.

– David L. Post

NEWS

Changing Organization of Work

A new report developed under the National Occupational Research Agenda addresses the dramatic changes that have characterized the organization of work in recent years. This report, entitled *The Changing Organization of Work and the Safety and Health of Working People*, was authored by a broadly constituted working group from disciplines allied with human factors. It is the first attempt in the United States to develop a comprehensive research agenda to investigate and reduce occupational safety and health risks associated with the changing organization of work. Obtain the report free of charge from <http://www.cdc.gov/niosh/02-116pd.html>, or from NIOSH Publications, 4676 Columbia Pkwy, MS C-13, Cincinnati, OH 45226-1998; 800/356-4674. ☒

PEOPLE

Kim J. Vicente will be spending the upcoming academic year as the Jerome Clarke Hunsaker Distinguished Visiting Professor of Aerospace Information Engineering at MIT. Kim's address, from September 1, 2002, until May 31, 2003, will be Massachusetts Institute of Technology, Department of Aeronautics & Astronautics, Room 37, 37177 Massachusetts Ave., Cambridge, MA 02139-4307.

Kristine Delano, senior HF engineer for HumanCentric Technologies, Inc., has moved to HCT's new northeast office at 89 Auburn St., Suite 9739-1159, Portland, ME 04104, 207/233-9374, kdelano@humancentrictech.com.

The HFES San Diego Chapter sadly reports the passing of our long-term associate and friend Eugene "Gene" Ramras. Gene, a past member of the Potomac Chapter, served in the Army Air Corps as a meteorologist in the Occupation Forces in Europe until the end of World War II. After the war he obtained degrees in education (Brooklyn College, 1949) and counseling psychology (Columbia University, 1950). His first position, in 1951, was as a research psychologist for the Personnel Research Division of the Bureau of Naval Personnel in Washington, D.C.

In 1955 Gene joined the Naval Personnel Research Field Activity and became head of its Occupational and Organization Research Branch in 1956. In 1964 he became director of New Developments Research at the U.S. Navy Personnel Research and Development Laboratory and eventually led that organization. In September 1967 Gene was named technical director and remained in that position until the lab was disestablished.

When the new Navy Personnel Research and Development Center was planned for San Diego, Gene took on the task of organizing, staffing, programming, and budgeting. He served as the deputy technical director of the lab from its opening in 1973 until he retired in 1986. In particular, he was instrumental in nurturing NPRDC's relationship with San Diego State University, and many employees were recruited from that effort. Gene was honored with the Navy Superior Civilian Service Award for "extraordinary achievements in the management of manpower, personnel, and training research and development programs for the Navy."

Gene was a long-term member of the Human Factors and Ergonomics Society, and his support for the San Diego Chapter science fair efforts was enduring. No comment about Gene can be complete without noting his love for travel, and that upon his retirement he and his wife, Lorraine, traveled the world. Perhaps most telling are the number and variety of messages I have received from across the country attesting to Gene's warmth and his many professional work and membership contributions. As someone who worked with him closely said, "Gene was a character, full of life and charm. We'll miss him."

A fuller obituary may be found on the San Diego Chapter's Web site, <http://www.sdhfes.org/>.

— George Edw. Seymour, President
HFES San Diego Chapter



Raja Parasuraman, Catholic University of America, was interviewed for an August 22 National Public Radio "Public Interest" broadcast hosted by Kojo Namdi. Parasuraman discussed neuro-ergonomics, a new field merging neuroscience and ergonomics.

Theodore E. Cohn, University of California at Berkeley, was featured in a July 27 *New York Times* article entitled, "Blinking Bumpers that Warn, 'Back Off.'" Cohn designed a light bar that can be attached to the back of any bus and is hooked up to a radar system that is mounted above the rear window and aimed at the road. When the radar senses that a vehicle is too close, it triggers the light bar. If implemented, Cohn's design could reduce the large number of collisions involving a car driver hitting a bus. ☼

STUDENT NEWS

TTU 5-Year BA/MA Program

The Psychology Department at Texas Tech University is pleased to introduce a five-year combined BA/MA program in experimental psychology with a specialization in human factors. This program allows outstanding students to accelerate their undergraduate degree programs, begin graduate work in the fourth year, and complete both the bachelor's and the master's degrees in five years. It is designed to train human factors professionals for positions in industry and government. The new program adds to the existing terminal master's and doctoral degree programs in human factors.

The Human Factors Psychology Program was initiated in 1967 and trains students in the physical and cognitive aspects of human factors and is a joint effort between the Departments of Psychology and Industrial Engineering. Graduates have been employed at Lockheed-Martin/Johnson Space Center, Lucent Technology, NSBRI-NASA, Roche Diagnostics, SBC Technology, and State Farm.

Core faculty include Patricia R. DeLucia, Paula A. Desmond, and Francis T. Durso. Students in the program are given immediate access to extensive research facilities, including the Visual Performance Laboratory with 3-D simulation, stereo, and virtual reality capabilities; the Human Performance Laboratory, which examines effects of stress and fatigue on driving, air traffic control, and visual monitoring; and the Cognitive Ergonomics Laboratory, which examines cognitive factors in dynamic environments such as air traffic control and human-computer interaction. Texas Tech University also has a Teaching, Learning, and Technology Center, where students can conduct human factors practica that focus on human-computer issues related to instructional technologies. Students in the program have been funded by grants from the FAA, NASA, NSF, and TxDot.

Texas Tech University was founded in 1923 and has about 26,000 students, a law school, and a health sciences center. It is located in Lubbock, Texas, a metropolitan area with about 200,000 people and a dry, mild climate.

continued on next page

For additional details about Texas Tech University, the Psychology Department, and the Human Factors Psychology Program, visit <http://www.ttu.edu>, <http://www.psychology.ttu.edu>, and <http://www.ttu.edu/~psyhfp> or contact the Human Factors Psychology Program Coordinator, Patricia R. DeLucia at p.delucia@ttu.edu. ☒

HF/E in the Stock Market (continued from page 1)

the user that the original order has already executed and it is too late to replace it.

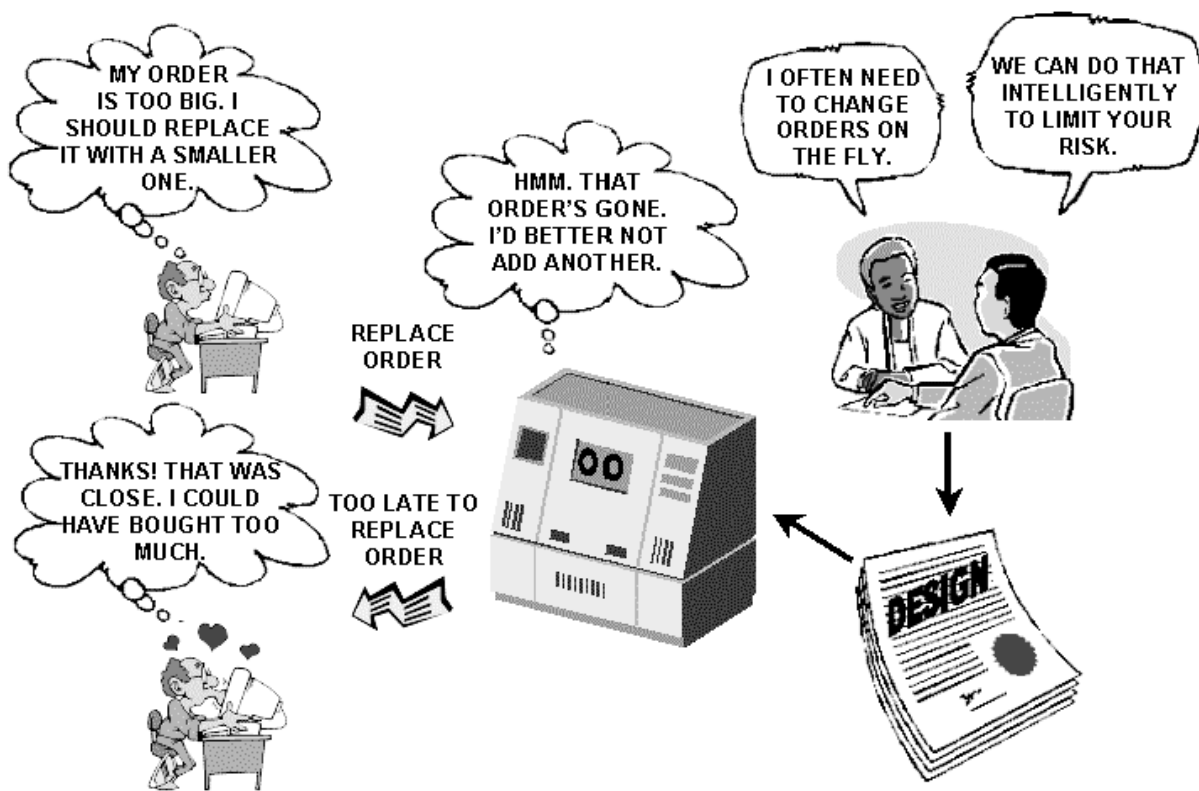
This exchange goes beyond simply acknowledging the receipt of a transaction. The algorithms I design meet a complex set of Securities and Exchange Commission requirements. Whether or not an order gets executed, the price at which it executes, and with whom it executes are dictated by a vast set of rules and regulations, which are not always transparent in their implementation. In applying these rules and in communicating their impact, I must again manage end user expectations.

For automated front-end systems, the human may be out of the loop, but the processes are the same. The front-end system places orders and other requests based on its current knowledge of the market, the goals of the trading firm, and its programmed interpretation of the SEC rules and regulations. I apply the same techniques in dealing with the computer-to-computer interactions as with human-to-computer interactions. The only difference is that the front-end computer never types in an extra zero or mistakenly enters a buy when it wants to sell.

Market Stability

The overall goal of a stock market is to provide a transparent, even-handed, and highly stable marketplace. When expectations are not met, price volatility can occur. Price volatility has a negative impact on the investor, the listed companies, and the national economy in general. When end user expectations are met, volatility caused by the marketplace itself, as opposed to outside forces, can be kept to a minimum, if not eliminated.

So although I no longer design screen layouts and button navigation – and I do miss this occasionally – I believe that my human factors background is being put to good use in a subtle but important way. And as for whether I can continue to meld my diverse backgrounds, only time will tell.



Using human factors to fulfill user intent in a highly automated, buy/sell stock market system.

Bruce E. Friedman is a senior applications designer at NASDAQ and may be reached at bruce.friedman@nasdaq.com. If you or someone you know is doing human factors/ergonomics work in a unique setting and would like to submit an article for consideration, please contact Communications Director Lois Smith, 310/394-1811, lois@hfes.org. ☒

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F L A S H !

Plan to Attend!

HFES 46th Annual Meeting
September 30–October 4, 2002

Now at the HFES Web site:

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