



HUMAN FACTORS AND ERGONOMICS SOCIETY

Human
Factors and
Ergonomics
Society:



*Stories
from
the First
50 Years*



**THE HUMAN FACTORS
AND ERGONOMICS SOCIETY:
STORIES FROM THE FIRST 50 YEARS**

Edited By
Jack Stuster



**Human
Factors
and
Ergonomics
Society**

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PREFACE

One of the great moves of my 47-year career in human factors was asking my colleague, Jack Stuster, to collect and document stories from the first 50 years of the Society. His many pleasurable interactions with those who contributed to this effort and the wonderful stories that resulted turned out to be, according to Jack, truly a labor of love. Moreover, I think that whatever time you spend with these stories will be enjoyable for the insights and humor they contain, and for the understanding and appreciation they provide of our profession.

The stories are still coming in even as I write this. Jack had several new stories waiting for him as he returned to work at the start of the week; Stu Parsons just called to make sure that an additional story he rounded up will make it in before the publication deadline. Although it took some initial effort to get members thinking about their professional and Society experiences, and still more effort to convince them that their stories would be of sufficient interest to document in a Society publication, once the dam broke, the stories flooded in.

So, this document has one editor and many authors. Some have written about the formation and early years of the profession and the Society. Fortunately, these reports come from members who were there and can provide first-hand accounts of these significant events. Some members have written about special events from their own careers, ranging from briefing Werner Von Braun's staff on the intricacies of a submarine ballistic missile system, to reviewing the impact of the Chernobyl nuclear power station explosion in the Ukraine, to the trials and tribulations of teaching seagulls to detect downed pilots in the ocean. Others have contributed tales that, while they saw little humor in them at the time, seem pretty funny now, many years later.

Some of the early pioneers of our field are no longer with us and, as a consequence, not immediately available to contribute stories of their own. However, they appear in this document in stories provided by their friends and colleagues. I'll leave you with the words of one of these pioneers, David Meister, who was probably one the most prolific and critical observers of our profession. David actually did admit in writing that the history of our profession was a success story and that human factors and ergonomics had become academically respectable as a distinct discipline. But he also admonished that, "our eyes should not be fixed on how far we have come, but on what we need to do in the next 50 years."

Douglas H. Harris
Chair, HFES 50th Anniversary Task Force
Santa Barbara, California
August 2006

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INTRODUCTION

The Human Factors and Ergonomics Society is unusual, if not unique, among professional organizations. The primary purpose of the Society is to promote the discovery and exchange of knowledge concerning human behavior that is relevant to the design of tools, devices, equipment, vehicles, vessels, inhabited spaces, procedures, processes, and systems composed of these and other elements. That is, our field encompasses the entirety of material culture and, indeed, all human activity. The broad scope of our collective work is accompanied by enormous responsibility, and for this reason we are, first and foremost, advocates for the users, operators, maintainers, and personnel—the “human components” of technological interaction. In the words of the late David Meister, “The purpose inherent in human factors research and application is to contribute to overall human well-being.”

All aspects of human life have benefited from efforts to apply an understanding of human capabilities and limitations to the designs of equipment and procedures. Workplaces, aircraft, and vehicles are safer now than ever before, and the goods and services that are the products of our economy are made and delivered more efficiently. Warfare was among the first human activities to be rendered more effective by the systematic application of this knowledge and the military continues to be a source of support for human factors research and development. However, the discipline has evolved during the past 50 years and extended its influence into nearly all human endeavors, from software development to space exploration.

The history of our discipline is composed of countless occasions in which the applications of our methods and data have overcome skepticism, inertia, and design flaws by producing immediately useful results that contribute to human well-being. We are justifiably proud of our accomplishments and prepared for future challenges. In anticipation of the 50th Anniversary of the Human Factors and Ergonomics Society, members were asked to submit descriptions of 1) personal encounters with professional or institutional skepticism; 2) contributions to the designs of particularly successful devices, products, or systems; 3) humorous anecdotes concerning HFES or the field of human factors and ergonomics; and 4) accounts of historical relevance. Responses to the request are presented in this brief document in the following three categories.

- Human Factors - Notes on the Origin of the Discipline;
- Stories From the Careers of Human Factors Professionals; and
- Tales From the Human Factors and Ergonomics Society.

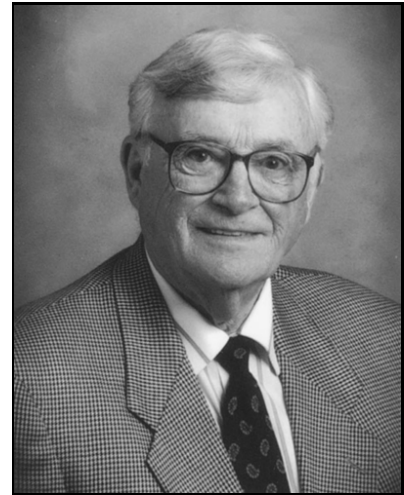
Jack Stuster, Editor
Santa Barbara, California
August 2006

HUMAN FACTORS:
NOTES ON THE ORIGINS OF THE DISCIPLINE

HUMAN FACTORS AND ERGONOMICS

by Stanley N. Roscoe

Soon after the turn of the 20th century, psychologists started being concerned with the capabilities of aviators and the effects of their limitations on flight operations. Of course there were no human factors specialists in those days, but general psychologists, along with physicians, were called on to help select the best candidates for pilot training. Soon, psychologists would be studying the effects of oxygen deprivation, temperature, noise, and G-forces on human perception and performance in this strange new environment. Later, during World War II, psychologists would start recognizing the effects of airplane cockpit design features on the errors made by pilots and, later yet, the effects of circadian rhythms on the pilots themselves.



Stanley Roscoe

The terms *human factors* and *ergonomics* are closely associated with engineering psychology, the study of human performance in the operation of systems. Human factors psychologists and engineers are concerned with anything that affects the performance of system operators—whether hardware, software, or liveware. They are involved both in the study and application of principles of ergonomic design to equipment and operating procedures and in the scientific selection and training of operators. The goal of ergonomics is to optimize machine design for human operation, and the goal of selection and training is to produce people who get the best performance possible within machine design limitations.

Principles of Design

Human factors specialists are concerned first with the distribution of system functions among people and machines. System functions are identified through the analysis of system operations. Human factors analysts typically work backward from the goal or desired output of the system to determine the conditions that must be satisfied if the goal is to be achieved. Next they predict—on the basis of relevant, validated theory or actual experimentation with simulated systems—whether the functions associated with each subgoal can be satisfied more reliably and economically with automation or human participation.

Usually it turns out that the functions assigned to people are best performed with machine assistance in the form of sensing, processing, and displaying information and reducing the order of control. Not only should automation unburden operators of routine calculation and intimate control, but also it should protect them against rash decisions and blunders. The disturbing notion that machines should monitor people, rather than the converse, is based on the common observation that people are poor watchkeepers and, in addition, tend to be forgetful. This once radical notion is now a cornerstone of modern system design.

Selection and Training

The selection and training of system operators enhance performance within the limits inherent in the design of the system. Traditional operator selection criteria have tended to emphasize general intelligence and various basic abilities believed to contribute to good psychomotor performance. Although individuals without reasonable intelligence and skill do not make effective operators, it has become evident that these abilities are not sufficient for all tasks. For example, to handle emergencies while at the same time maintaining routine operations calls for breadth and rapid selectivity of attention and flexibility in reordering priorities.

The more obstinate a system is to operate and the poorer the operator selection criteria, the greater the burden on training. Modern training technology is dominated by computer-based teaching programs, part-task training devices, and full-mission simulators. Human factors psychologists pioneered the measurement of the transfer of training in synthetic devices to pilot performance in airplanes starting in the late 1940s and demonstrated the effectiveness of these relatively crude machines. More important, some general principles were discovered that can guide the design of training programs for systems other than airplanes, principles that could reduce the trial and error in learning to use computers and the Internet, for example.

Application

Fortunately, improved human performance in system operations can come from all directions. Ergonomic design can make the greatest and most abrupt differences in performance, but improvements in selection and training can be made more readily by operational management. More immediate, though usually less dramatic, improvements in system effectiveness can be made through the redesign of the operational procedures used with existing systems. A brief history of how all this got started is best told by focusing on the trailblazing individuals and the Society that helped make it happen.

THE EARLY YEARS

by Harold P. Van Cott

The Human Factors Society of America came into official existence in September 1957, in Tulsa, Oklahoma. I was there and have attended every HFES annual meeting since then, until recently, when travel has become an issue. Today, at 80, I look back with pleasure on the knowledge I have obtained and the good friendships I have made through my association with the Society. Best of all, HFES has been fun.

Our organization didn't suddenly spring into existence; many of the 90 members who met in Tulsa had attended earlier meetings jointly sponsored by representatives of the Office of Naval Research, the Naval Electronics Laboratory, the Army Research Office, and the Air Force Office of Scientific Research. These agencies were instrumental in fostering a culture of research and applications that focused on the role of humans in operating complex military systems. Instrument interfaces, performance in extreme environments, training technologies, and humans in closed-loop control systems were some of the R&D issues posed by submarines, high-performance aircraft, and radar.

In the Eastern United States, these challenges spawned the creation of military "engineering psychology" labs and consulting organizations, such as Dunlap & Associates and the American Institutes for Research. Up and down the West Coast, aircraft companies formed human factors departments: Hughes, Douglas, Lockheed, and Boeing all had large groups devoted to human factors issues. The rivalry between the research and guideline-oriented East Coast and the design-oriented West Coast expressed itself in the alternation of Society presidents between the two regions during the early years.

HFES members clumped around Washington, D.C., and Los Angeles, where human factors specialists began meeting informally to exchange ideas, learn about job opportunities, and listen to papers, as well as to eat and drink. The first such group in D.C.—numbering 15 or so people—enjoyed monthly dinner sessions and were happy not to have bylaws, officers, or dues. But that couldn't last. By the early 1960s there were probably 150 human factors people in the Metropolitan Washington-Baltimore area. A more formal structure was needed, and the Potomac Chapter was formed in response. Meetings were well attended; a well-known speaker could attract as many as 100 members and guests. A similar process occurred on the West Coast.



Harold Van Cott

The Society has struggled with the scope and definition of the field and the understanding and acceptance of the discipline by others since the beginning. Adding *ergonomics* to the name of the Society in the United States expanded both definition and scope. I have enjoyed being a human factors professional from the first meeting 50 years ago, through the publishing of Van Cott and Kinkade (*Human Engineering Guide to Equipment Design*) and my term on the Executive Council and as HFES president, to great opening sessions and debates at annual meetings.

HAPPY ANNIVERSARY, HFES!

AH, THE GOOD OLD DAYS

by Walter R. Harper

Back in the 1950s, before Elvis and before the Beatles, there were no PCs and TV was black and white. Nor was there a Human Factors Society. There was, however, the Ergonomics Research Society, which was formed in 1948 as a successor to the operations research groups used to great effect by the British Forces during World War II.

In the USA, Taylor and Gilbreth founded a discipline aimed at improving human performance. Taylor concentrated on determining time standards for industrial work and Gilbreth was concerned with improving methods for repetitive industrial tasks. The same problems existed in military environments as in industry, prompting those working in both areas to exchange information about their research. The U.S. Army held its first annual Engineering Psychology Conference in Vicksburg at the Waterways Research Establishment; the second annual conference was held at the Army Medical Research Laboratory in Fort Knox. Dr. Dick Weiss, Chief Scientist U.S. Army, and Dr. Lynn Baker, Chief Psychologist U.S. Army, organized the meetings.



Walter Harper

The U.S. Navy's Human Engineering group was led by Drs. Arnold Small and Max Lund of the Naval Electronics Laboratory (NEL), located in San Diego, and Dr. Frank Taylor of the Naval Research Laboratory, located in Washington, D.C. Dr. Karl Kryter of the Air Force Human Performance Laboratory is the only representative of the Air Force who I remember. Incidentally, the lab where Karl Kryter worked was on the second floor of the building that housed the Naval Research Lab. It was in the Blue Point area of D.C., on the Potomac River where the sewage plant is located.

Arnold Small was an accomplished violinist and played with the San Diego Symphony Orchestra. Wesley Woodson also was a violinist with the symphony and asked Dr. Small for help in finding additional employment. Arnold found him a job as a lab assistant in the NEL human factors area. After spending some time there, Wes wanted to enhance his understanding of human factors and found, to his amazement, that there were few worthwhile texts available. (Probably the best known, and perhaps the only one at the time, was *Applied Experimental Psychology* by Chapanis, Garner, and Morgan.) In response, lab assistant Wes Woodson set to and authored the seminal textbook, *Human Engineering Guide for Equipment Designers*. He once said that he did it in self-defense!

The Canadian Defense Research Medical Laboratory in Toronto had an Applied Psychology section that worked on many human performance problems, such as developing a lettering system for Air Defense Centers' tote boards, communications protocols for aircraft carriers, instrument panels for aircraft, and pain threshold standards, among others. Only seven people were actively involved in this work, and four of them maintained direct liaison with their U.S. counterparts: Dr. R. B. Bromiley, Dr. C. H. Baker, W. R. Harper, and Dr. R. Hoyt. Dr. Hoyt was renowned not only for being the only woman to attend the early human factors meetings, but also for always wearing a stylish hat.

Who attended those early meetings? The question reminds me of a British Army story in which a new recruit asks an old, grizzled sergeant, “What was your regiment number, Sarge?” To which he replied, “Number? Number? When I joined the Army we all knew each other!”

So it was during the early days of the human factors profession in the United States and Canada. There were approximately 200 people in all of North America working in the field, and most of them showed up regularly at the meetings. We made friends and exchanged information about our research, and like the old sergeant, we all knew each other, some well, some only by sight. (I don’t remember any of the meetings being classified.) The meetings were rather stark by today’s standards; that is, there were no formal dinners and no evening functions that I recall. We would simply find the closest bar or restaurant and socialize! Sometimes the host lab would organize a tour at the end of a day. In Vicksburg we toured the 60-foot model of the Mississippi River that the U.S. Army Corps of Engineers used to perform flood control studies. At Fort Knox we were treated to viewing work on vibration research, which consisted of a lot of primates bouncing up and down on vibrating platforms. Dr. Kraft arranged a tour of the Boeing plant during the meeting in Tulsa.

That formative meeting of the Society was held in a Tulsa hotel ballroom. After a few words of welcome from Arnold Small, the 100 or so attendees were divided into groups of 10 to 15 people and assigned a topic to discuss and to develop a consensus opinion. The results of the discussions were to be presented as recommendations for the initial set of rules to govern the conduct of the new Human Factors Society. For example, one group discussed membership criteria, another was assigned to identify the goals of the organization, and so on. I was in the group that discussed dues. We decided the dues should be \$10 per annum! Ah, the good old days.



Organizational Meeting of the Human Factors Society
Tulsa, Oklahoma, September 25, 1957

THE WEANING YEARS

by Stanley N. Roscoe

The Human Factors Society came into official being in 1957 at a meeting in Tulsa, Oklahoma. But things didn't move on with any semblance of organization, despite the appearance of the first issue of the journal *Human Factors* in September 1958. In fact, there was little visible action by the elected officers, except for deciding where the next annual meeting would be held, finding some local group to organize and run the meeting, and nominating a slate of candidates to fill the next year's offices. During the first two years, the Society was held together primarily by the *Human Factors Society Bulletin*, published by Charles Simon working out of his home and his office at Hughes Aircraft Company.

Laurence Morehouse was the first president (1957–1958), followed by Renato Contini (1958–1959) and Arnold Small (1959–1960). I was president-elect that year and continued the practice of doing nothing. As president the preceding year, Contini was primarily responsible for nominating three East Coast engineers as president-elect candidates. All were unknown on the West Coast and virtually unknown in the human factors field. None had been active in Society affairs. With a majority of the members of the Society employed in the aerospace industry in Southern California, Charles Simon and Charles Hopkins instigated a write-in-ballot campaign, and I became the president-elect in 1959 and succeeded Small in the fall of 1960.

The first thing I discovered was that the Society's articles of incorporation as a not-for-profit California company called for the timely adoption of a constitution and by laws to replace the sketchy interim constitution. The new documents would have to meet certain requirements if we were to qualify for an IRS tax-exempt status for charitable contributions to the Society. So Charles Hopkins, Bill Knowles, and I put together an appropriate constitution and associated by laws, with guidance from a friend and neighbor, attorney Alan Cassman. They were approved in 1961 by the Executive Council via mail ballot, with only minor amendments many years later.

The 501(c)3 tax status still didn't come easily. When the application was submitted, the IRS came back with a list of questions, the answers to which elicited more questions. After a few resubmissions, Alan Cassman decided the problem was that we were volunteering too much information in our answers, so the IRS could find new things to question. We were careful to answer the final round of questions as simply as possible, just rewording our earlier answers and not introducing any new information. That bit of bureau-gamesmanship did the trick, and our 501(c)3 tax status was approved.

While this was going on, several irate members complained that the list of names kept in John Lyman's office at UCLA, to whom *Human Factors* and the *Human Factors Society Bulletin* were mailed, was not identical with the list to which dues statements were sent from Bob Sleight's Applied Psychology Corporation office in Arlington, Virginia. Consequently, some "members" who had never paid dues were receiving publications, and some dues-paying members were not. A single, accurate membership list was needed. That wasn't easy, either, because of some gentle tugging and pulling between the East Coast and West Coast members over control of the Society.

More specifically, Al Chapanis, whose opinion was highly respected by all of us, thought that the headquarters of any national society should be in Washington, D.C. However, the Human Factors Society was incorporated in California, and Alan

Cassman's legal opinion was that having its headquarters elsewhere might elicit further questions from the IRS, plus the fact that the concentration of activities was in the Los Angeles and San Diego areas. So I had the touchy task of retrieving the dues-collecting function from Bob Sleight, who had been doing it unofficially until the new constitution established the Secretary-Treasurer position, first filled in 1962.

In 1962, on John Lyman's recommendation, the Executive Council appointed Charles Simon as Executive Secretary, with a small room in the Dunlap & Associates offices in Santa Monica. Simon straightened out the business affairs of the society, maintained accurate membership records, and continued to work with Stan Lippert and John Lyman, who were publishing the journal *Human Factors* as Editor-in-Chief and Managing Editor, respectively. Simon resigned as Executive Secretary in the fall of 1963, and then-president Al Chapanis, with Council approval, hired Marian Knowles as Executive Assistant and moved the operation to a new central office in a small portion of its present location on Montana Avenue.

Few current members have lived long enough to remember the 1963 Annual Meeting of the Human Factors Society in Los Angeles. Stan Lippert's announcement that he was retiring as Editor of *Human Factors* after serving for five years was, for me at least, the most touching moment in the history of the Society. After the standing ovation had been going on for what seemed like a minute or two, I glanced at my watch, and the ovation continued for almost four minutes thereafter. Surely nobody contributed more to the early survival and weaning of the present Human Factors and Ergonomics Society than Stan Lippert and Charles Simon, and Marian Knowles raised it to adulthood.



HFS Meeting, Cambridge, Massachusetts, 1960

THE ADOLESCENCE OF ENGINEERING PSYCHOLOGY¹

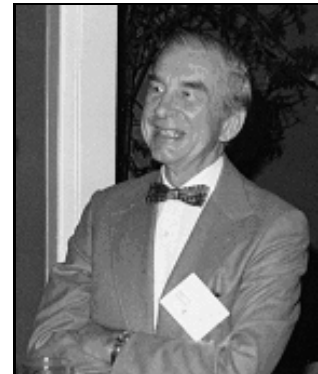
by Stanley N. Roscoe

Pilot Error

While most of the psychologists in the British Royal Air Force and the United States Army and Navy during World War II were involved hands-on in aviator selection and training, others were occasionally called on to deal directly with the subtle problems aviators were having in operating their newly developed machines. The term *pilot error* started appearing with increasing frequency in training and combat accident reports. It is a reasonably safe guess that the first time anyone intentionally or unknowingly applied a psychological principle to solve a design problem in airplanes occurred during the war, and it is possible that the frequent wheels-up-after-landing mishap in certain airplanes was the first such case.

It happened this way. In 1943 Lt. Alphonse Chapanis was called on to figure out why pilots and copilots of P-47s, B-17s, and B-25s frequently retracted the wheels instead of the flaps after landing. Chapanis, who was the only psychologist at Wright Field until the end of the war, was not familiar with the ongoing studies of human factors in equipment design. Still, he immediately noticed that the side-by-side wheel and flap controls—in most cases identical toggle switches or nearly identical levers—could easily be confused. He also noted that the corresponding controls on the C-47 were not adjacent and their methods of actuation were quite different; hence C-47 copilots never pulled up the wheels after landing.

Chapanis realized that the so-called pilot errors were really cockpit design errors and that the problem could be solved by coding the shapes and modes of operation of controls. As an immediate wartime fix, a small, rubber-tired wheel was attached to the end of the wheel control and a small wedge-shaped end to the flap control on several types of airplanes; the pilots and copilots of the modified planes stopped retracting their wheels after landing. When the war was over, these mnemonically shape-coded wheel and flap controls were standardized worldwide, as were the tactually discriminable heads of the power control levers found in conventional airplanes today.



Alphonse Chapanis

Peak Clipping

The intelligibility of speech transmitted over the noisy aircraft interphones of World War II presented serious problems for pilots and their crews. At Harvard University's Psycho-Acoustic Laboratory, S. S. Stevens, J. C. R. Licklider, and Karl D. Kryter, with help from a young George A. Miller, later the 77th president of the American Psychological Association, conducted a series of articulation tests of standard and modified interphones at altitudes of 5,000 and 35,000 feet in a B-17 bomber. Intelligibility was improved by peak clipping the powerful vowel sounds in human speech and then amplifying the remaining balanced mixture of vowels and consonants. Incidentally, the psychologists also showed that the B-17 could operate effectively at 35,000 feet, which the Air Force had not yet fully realized.

¹ Excerpts from *The Adolescence of Engineering Psychology*, 1997, Volume 1, Human Factors History Monograph Series, edited by Steven M. Casey.

In the Aviation Industry

The students of Alex Williams and Paul Fitts invaded the aviation industry in the early 1950s.² The boom was on, especially in southwest Los Angeles, where one could park along Airport Boulevard at the east end of LAX Runway 25 Left and see new North American and Douglas planes being rolled out and tested every day. Douglas–El Segundo alone had five different production lines running simultaneously in 1952. From a small hill near the airport, one could see the plants of Douglas, North American, Northrop, and Hughes, which were growing to enormous size, and Lockheed was just over the Hollywood Hills in Burbank. Strange planes like the Northrop flying wing flew low over the Fox Hills Golf Course.



I was Williams' first student at Illinois and received my PhD in 1950 but stayed on at the lab for two years to complete a flight-by-periscope project for the Navy's Special Devices Center. Then, in 1952, I was recruited by Hughes Aircraft Company to organize a Cockpit Research Group and went on to become manager of the Display Systems Department. Earlier that year Walter Carel, who had completed all but his dissertation at Columbia University, was hired by General Electric to do research on flight displays, and William B. Knowles joined GE soon thereafter. In 1955 Charles Hopkins and Charles Simon joined Williams and me at Hughes, and Knowles and Carel soon followed.

Starting in 1953, several of the airplane and aviation electronics companies hired psychologists, but few of these had training in engineering psychology, and fewer yet had specialized in aviation. As the graduates of the universities with aviation programs started to appear, they were snapped up by industry and by military laboratories as it became painfully apparent that not all psychologists were alike. In a few cases groups bearing such identities as cockpit research, human factors, or human factors engineering were established. In other cases the new hires were assigned to the "Interiors Group," traditionally responsible for cockpit layouts, seating, galleys, carpeting, and restrooms.

² Alexander Coxe Williams, Jr., and Paul M. Fitts helped pioneer the field of human engineering in aerospace and, as a consequence, the broader field of human factors and ergonomics. During the exciting years following World War II, Alex Williams influenced many careers as a professor at the University of Illinois while Paul Fitts did the same at Ohio State. Later, Williams contributed to the design of cockpit displays and other systems while with Hughes Aircraft; he worked on moving map displays and display and control system simulators, and even collaborated with J. C. R. Licklider and Harold Hance on the invention of the pulse-Doppler radar, which first appeared on the YF-12 long-range interceptor. Both careers were cut short by heart attacks, Williams at 48 and Fitts at 53. Each year our Society honors the memory of Alexander C. Williams with an award for excellence in the application of knowledge and method, and the memory of Paul M. Fitts with an award for outstanding contributions to the education and training of human factors professionals. – Ed.

In this environment, Neil Warren in the Psychology Department at the University of Southern California and John Lyman in the Engineering Department at UCLA introduced advanced degree programs for many who would distinguish themselves in the aerospace field. Starting in the late 1940s, Warren had used the human centrifuge on the USC campus (at that time the only one on the West Coast) to do display research. It was in Warren's facility that it was first demonstrated that a single "drag" on a cigarette would measurably reduce the number of Gs a pilot could withstand before "graying out" in the centrifuge.

Harry Wolbers, a 1955 USC graduate and student of Neil Warren and Floyd Ruch, was the first engineering psychologist hired by the Douglas Aircraft Company and the human factors leader for Douglas in its prime contract for the Army-Navy Instrumentation Program (ANIP).³ Other USC products during this period were Bob Mackie, Stu Parsons, Don Buckner, Nick Bond, and Glenn Bryan. Bryan became the first director of the Electronics Personnel Research Group at USC in 1952 and went on to head the Psychological Sciences Program at the Office of Naval Research for more than 20 years. Gerald Slocum, who joined Hughes Aircraft in 1953 and later earned his master's degree with Lyman at UCLA, would rise to be a Vice President of the company and eventually of General Motors.⁴

In the east, Jerome Elkind, a student of J. C. R. Licklider at MIT, formed the original human factors engineering group at RCA in the late 1950s. Lennert Nordstrom, a student of Ross McFarland at Harvard, organized the human factors program at SAAB in Sweden in the late 1950s. Thomas Payne, Douglass Nicklas, Dora Dougherty, Fred Muckler, and Scott Hasler—all students of Alex Williams—brought aviation psychology to The Martin Company in the mid-1950s. And, Charles Fenwick, a student of Ernest McCormick at Purdue, became the guru of display design at Collins Radio in the early 1960s. Managers in industry were gradually recognizing that engineering psychology was more than just common sense.

³ Harry Wolbers switched from the design of advanced aircraft systems to the design of space systems when NASA was created. His first space station study was conducted for *The London Daily Mail's* "A Home in Space" competition in 1959 ("when drive-ins had car hops and automobiles had tail fins," in Harry's words), and he worked continuously to design manned and unmanned spacecraft from 1963 until his retirement from McDonnell-Douglas in 1991 as Deputy Director for Flight Crew Systems on the International Space Station Program. Many of us in the field learned from Harry Wolbers that there is no such thing as an "unmanned" system; that is, even the most autonomous, "robotic" spacecraft requires human interaction, with clear implications for design. His 1984 technical report, *The Human Role in Space*, is a classic example of high-level function allocation and will be instructive to future generations of spacecraft designers. – Ed.

⁴ As was the case with Alex Williams at the University of Illinois and Paul Fitts at Ohio State, many of the faculty in the USC Psychology Department during the 1950s were veterans of WWII and had been exposed to actual military operations. Faculty members such as Neil Warren, William Grings, J. P. Guilford, and Milton Metfessel had been commissioned officers serving in the Army Air Forces Aviation Psychology Program during the war. Many of their students also were veterans and attended USC under the GI Bill. – Ed.

THE EMERGENCE OF SMALL HUMAN FACTORS GROUPS

by Bob Blanchard

An interesting historical note (at least to those of us who were involved) was the emergence in the late 1950s and early 1960s of small human factors (systems) R&D groups of 15–20 professionals whose primary market was Department of Defense-funded contracts. The aerospace industry was a lucrative source of business in the Los Angeles area. The individual aerospace companies also had in-house human factors staffs, such as Hughes Aircraft's group headed by Alex Williams and Stan Roscoe. These groups really provided the organizational and marketing basis for the support and growth of the human factors R&D movement in the private sector. Even though the groups were in direct competition for business, there was considerable interchange and camaraderie among them. I was employed by the Western Division of Dunlap and Associates, Inc., in Santa Monica (headed by Joe Wulfeck) during the period, and we would have periodic bowling and softball competitions against Psychological Research Associates (PRA), located in "The Valley." As I recall, Kay Inaba had a terrific fast ball that our Dunlap team had difficulty hitting. Smoke Price was also a member of the PRA team, but a little slow on the base paths.

These LA-based groups also provided a job market for graduating PhDs in the late 1950s and early 1960s. Purdue University had a substantial representation in the area, including Doug Harris, Kay Inaba, Otto Kahn, Bob Besco, Dick Hornick, and myself, all employed within a one-year period! It was a formative period for most of us who aspired to careers in human factors and later an avenue for entrepreneurship. This group supported the development of the Los Angeles Chapter of HFS, helped stage the 1966 HFS Annual Meeting, and later, several members served the Society in various capacities. Two members, Doug Harris and Dick Hornick, served terms as President.



HFES Presidents, 1987

ON THE PASSING OF DAVID MEISTER

by Jim Baker (with Stan Roscoe and Tom Ryan)

I first met Dave when he worked at Thompson–Ramo Wooldridge (if memory serves me correctly). I was working for the USAF Command & Control Development Division at L. G. Hanscom Field in Bedford, MA. C²D² had a contract with Thompson–Ramo to develop an advanced computer terminal for application in one of the L-Systems we were developing. I was on TDY there to be briefed on their progress on our effort when I first heard about the legendary Dave Meister from his coworkers. He was already known for his fantastic, innovative mind, his “brook no nonsense” attitude toward any engineers who tried to cut corners by treating the human component as simply a pain in the butt, and his ability to follow his normal working day with “all-nighters” writing great, readable/winnable competitive proposals. After this, our initial meeting, we stayed in touch fairly regularly.

A few years later I left the USAF to go overseas to start a human factors group for the Army Research Institute (ARI) in Heidelberg, Germany. This was in support of the Army’s TOS development effort. TOS was the Army’s Tactical Operations System, the first and largest mobile command and control system ever developed (and it may still hold that distinction). It was a huge effort, and in addition to the government scientists on site, there were also contractor personnel working on the system. They were made up of human factors, computer programmer, and engineering types from Bunker–Ramo and Stanford Research Institute (SRI). The Bunker–Ramo people had the good fortune to be able to draw liberally on support from their home office in California, with the bulk of that HF conceptual support coming from the mind of Dave Meister. Again, we were linked at a distance. As I recall, it was around that time that Dave, who was then a heavy smoker, was diagnosed with lung cancer. But through whatever means, and with his indomitable spirit, Dave managed to become a cancer survivor.

After we had successfully fielded the TOS system (thereby contributing to “winning the Cold War” against our adversary—the Russian Army), I returned to the United States and went to work at ARI’s home base in Washington, D.C. It was about this time, again if memory serves me correctly, that Dave went to work at the Navy’s Personnel Research and Development Center (NPRDC) in San Diego, where he worked with another good friend of mine (now also deceased)—Fred Muckler. Because ARI and NPRDC were sister service labs, and because we had yearly brief-and-be-briefed idea exchange meetings—sponsored by DoD’s funding agency, DDR&E (with the meetings chaired by then-USAf Col. Hank Taylor)—we had the opportunity to renew our friendship person to person once again. It was always a stimulating and fun get together, which, after duty hours, we continued with our traditional “martini symposia.”

But the best time for me was when Dave decided to come on board ARI and we had an opportunity to work together on a day-to-day basis. Ah, the stories I could tell about Dave’s encounters with the bureaucracy and his short fuse when it came to what he considered terminal idiocy. But our working together was too short-lived because Dave, the perennial Californian, decided to return to NPRDC to finish out his government service. Another old mutual buddy there was Gene Ramras (he was at the time

NPRDC's Technical Director), and Gene would keep me amused with additional Dave Meister tales as Dave valiantly struggled to suffer fools lightly.⁵

Sprinkled along the way were other interactions I had with Dave involving both our deep commitment to, and support of, the Human Factors Society. For example, in 1976 I was a member of the committee putting together the first joint Human Factors Society–International Ergonomics Association meeting ever hosted in America. It took place at the Conference Center of the University of Maryland. The Committee Chair was Al Chapanis, who had a well-deserved international reputation of his own, but the other person well known to scientists all over the world was Dave Meister. So if we needed an additional bit of leverage to draw on star performers, we would call on Dave and he would always deliver.

One other memorable interaction with Dave came when the total DoD budget for human factors research was threatened with cancellation. It was around 1978, and Gloria Grace was the HFES President (the first female President of the Society, if memory serves me correctly). We were at the Annual HFS meeting in Dallas, Texas, when we first heard this catastrophic news about the government's plans to line-out our complete budget. Since we were located in the Washington area, Smoke Price, Dean Havron, and I started developing, with Gloria's blessing, a presentation as to why this would be a short-sighted budget-cutting move on the part of Congress. Shortly thereafter we were scheduled for an appearance on the Hill to defend the HF program, and we were busy putting together as many case studies as we could produce to support our argument. Then, like an old-time Western movie where the cavalry comes over the hill just in time, Dave Meister showed up in the D.C. area. He spent an entire night in Smoke's office at BioTechnology putting together precise, concise, well-articulated and attention-grabbing stories as to why HF research was the greatest thing since sliced bread. He did it all from memory, working through the night, and immeasurably helped our effort.

So over the years, though my direct interactions with Dave were sporadic, no matter how much time had elapsed since our last interaction, he always picked up as though no time gap had occurred. Dave never disappointed me. He was always irascible, inspiring, and illuminating and an intellectual giant. The only way he ever let me down is that I also thought of him as immortal. I guess I was wrong. So, Dave, old friend, all I can think of to say by way of goodbye is *Pace in Requiem*.

Then, Stan Roscoe responded to my e-mail to correct what he thought was an error in the timeline I had presented. I am sure that Stan is right. Stan doesn't make mistakes. Anyway, here is what he had to say.

⁵ Bob Blanchard writes: "Gene Ramras was Technical Director of NPRDC during the center's formation. He became Deputy Technical Director when Jim Regan was brought aboard as Technical Director in 1975. I joined NPRDC as a program director in 1975 and served as Director of the Human Factors and Organizational System Laboratory from 1980 through 1987. 'Technically,' I was Dave Meister's supervisor for those years. I knew Dave from earlier interactions in HFS activities, so I knew I was not about to do any traditional 'supervising' where Dave was concerned. He was very prolific and authored several books and papers during the time frame mentioned. I'm not sure he ever contributed directly to a laboratory project, but he served a useful purpose as a consultant and mentor for the 30 or so human factors types we had in that department. Dave occupied an undefined and informal position as 'Chief Scientist' of the laboratory and was still performing in that capacity when I departed in 1987. In short, Dave decided what his duties were, and for the most part, that's what he did!"

Jim,

Quite a memory you have! I didn't know Dave as well as you did, but I must have known him earlier. That would be around 1959 when he was head of a technical writing group at the General Dynamics facility on the mesa across the gulch north of San Diego, and Chuck Hopkins, Don Bauerschmidt, and I were doing a display and control system design for the Apollo spacecraft competition under subcontract to GD. Dave didn't have anything to do with our project, but we did get to know him slightly. Evidently he went from that job directly to TRW (if your memory is correct on that one), but I have no recollection of his being there. I thought he went directly to Bunker-Ramo from GD. During that time Bauerschmidt and I had a subcontract from Bunker-Ramo to build a Boeing 727 flight simulator for them in support of an FAA contract they had, but all our dealings were with Fred Muckler and Scott Hasler and none with Dave. Incidentally, we underbid Link by about 40% to win that job and still made a 43% profit. Ah, those were the days!

Stan

And, then I replied to Stan:

You know Stan, I think you are right. Dave did work first for GD and then went to Bunker-Ramo. With that memory jog, I recall that it probably was GD that had our USAF contract for developing the "latest state-of-the-art" display console for an L-System we were working on (may have been for 425 L, the Cheyenne Mountain complex, or 495L, the Space Tracking System). It would have been in the 1959-1960 time frame. My memory may have been colored by the fact that I never forgot reading an article at that time written by Simon Ramo. It had to do, again if memory serves me correctly, with his concept of "Intellectronics" (the extension of man's intellectual capabilities electronically, just as the block and tackle extended his strength mechanically). As to Link, you well know I worked for them for a while (you and I went to Little Rock, Arkansas, together sometime in the late 1980s to help settle a Link dispute with the USAF about Link's C-130 training/simulator system and Jesse Orlansky, then at IDA, was also involved in that dispute *vis-a-vis* a cost-effectiveness analysis). Anyway, I'm glad you managed to beat out Link because once the Canadians took them over I left and so did my corporate allegiance. But I'm especially impressed that you were able to do it with a low bid and still show a high profit. You are right. Those were fun days. I don't get the feeling that today's HF types are having as much fun, or finding as much excitement doing their jobs, as we did.

Finally, I received the following message from an old friend, Dr Tom Ryan. He was a colleague of mine at ARI and later worked for the NRC and the DoT. He too has retired and, like Dave, has just returned to the state he loves—California. His response to my earlier e-mail about the passing of Dave Meister adds to (and really sharpens) some of my recollections about Dave's time and place in our Society's history.

Jim:

I'm deeply saddened on hearing about the death of Dave Meister. He and I go way back. He interviewed me for my first job in the profession, in late 1965, at Bunker-Ramo Corporation, in Canoga Park, California. He sort of took me under his wing and showed me the ropes, a kindness that I never forgot. At the time Dave was famous for

writing proposals from start to finish, including references, capabilities of the people being bid, and financial information, all off the top of his head and with ashes from his ever-present cigarette dropping all over the typewriter and surrounding area. God help the administrative person or manager who changed one word during the publication process. Also, he used to walk up and down the halls of Bunker-Ramo loudly proclaiming that all management was bad only some was worse than others, especially at Bunker-Ramo.

I later encountered and worked with Dave at ARI 1971–73. Dave loved San Diego, and I think that was one reason why he never lasted at ARI. He also never missed a chance to tell Drs. Uhlaner and Zeidner what he thought of their management capabilities and those of the remainder of the federal government. In later years I would encounter Dave at conferences and meetings. He was always the same Dave.

I can only conclude that he's giving St. Peter a hard time at the front gate of the better world up yonder, and offering the Good Lord himself unsolicited advice on how to organize and run the place.

Tom Ryan



Second Annual Army Engineering Psychology Conference
Army Medical Research Laboratory, Fort Knox, Kentucky, 7 – 9 November 1956

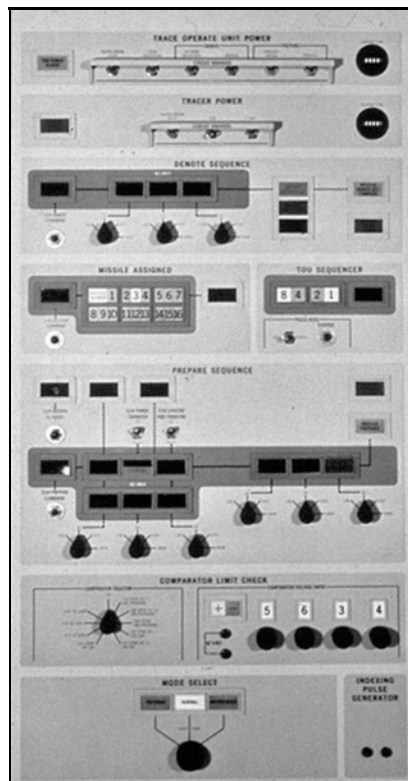
EARLY LARGE SYSTEM HUMAN ENGINEERING STANDARDS

by Stuart Parsons

Two classes of ballistic missile submarines had been constructed in the United States with minimal standardization in controls and displays before work began on the SSBN 616 class in 1960. The Navy's Special Program Office and its Human Factors Section, headed by Captain Jack Kinsey, hired Dunlap and Associates to serve as the human engineering integration contractor. The company's solution to the absence of standards was to conduct a series of meetings attended by the human factors specialists from all of the major system contractors: Electric Boat (submarine), Lockheed Missiles and Space (Polaris missile), North American Autonetics (ship navigation), General Electric (fire control), Westinghouse (launch), Nortronics (missile checkout), and Sperry (Ship's Inertial Navigation System). During these meetings, the participants discussed the relative merits of various options for switches, indicator lights, warnings, demarcation lines, the use of color, and the font and wording of labels, among other issues. The objective was to arrive at a



Joseph Seminara (1970)



consensus on each issue, but the number of companies represented in the discussion, each with its own customary approach to interface design, made it a lengthy and sometimes contentious process. However, the traditions of cooperation and user advocacy, on which the field of human factors engineering were founded, prevailed. Informal design standards were developed and followed by all of the contractors involved. The result was a control center that appeared as if it had been designed and fabricated by a single contractor. Standardization improved operability, maintainability, component stores, and logistics. The control interface was superior in both form and function to all previous designs and rendered the SSBN 616 submarine a truly modern complex system.

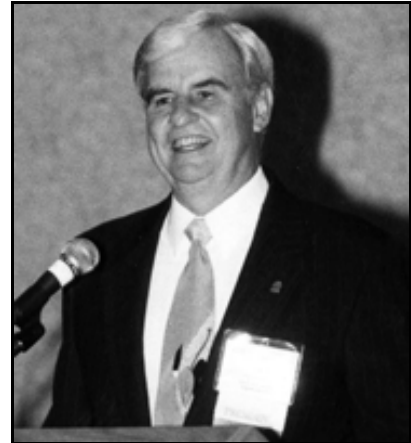
The console shown here, designed by Joe Seminara, was for the final onboard check-out and launch of the Lockheed missile. It uses a color patch to clearly differentiate and functionally demarcate Test and Operational panel elements. The rotary control at the bottom allowed the same panel to be used for Normal Operations, Maintenance, and Training.

MACROERGONOMICS: TOP-DOWN, MIDDLE-OUT, & BOTTOM-UP

by Hal W. Hendrick

The ultimate purpose of macroergonomics is to ensure that work systems are fully harmonized and compatible with their sociotechnical characteristics. In terms of systems theory, such a fully harmonized and compatible system can result in synergistic improvements in various organizational effectiveness criteria, including health, safety, comfort, job satisfaction, and productivity.

Conceptually, macroergonomics can be defined as a top-down, sociotechnical systems approach to work system design, and the carry-through of that design to the design of jobs and related human-machine and human-software interfaces. Although top-down conceptually, in practice, macroergonomics is top-down, middle-out, and bottom-up. In other words, structures and processes that constitute the overall work system can be analyzed and designed starting with (a) the overall work system structure and processes and then working down through the subsystems and components, (b) the components and systematically building up to the overall system structure and processes, or (c) the intermediate levels of the organization and systematically building both up and down. Most often, a combination of all three strategies is used. The macroergonomics design process tends to be nonlinear and iterative and usually involves extensive employee participation at all organizational levels.



Hal Hendrick

Development of the Subdiscipline of Macroergonomics

- 1980: Report of the HFES Select Committee on Human Factors Futures, 1980–2000, presented at the HFS Annual Meeting in Los Angeles, noted profound changes taking place in technology, values of those born after World War II, world competition, workforce demographics, increased ergonomics-based litigation, and the failure of purely microergonomics interventions to achieve the improvements in safety and health that both managers and ergonomists intuitively thought should be possible. The report concluded that to meet the impact of these factors in the future, ergonomists would need to take organizational design and management (ODAM) factors into consideration in their research and practice.
- 1984: The HFS ODAM Technical Group was formed. Similar TGs formed in the Japanese and Hungarian ergonomics societies, and informal groups formed in other societies.
- 1984: The first International Symposium on Human Factors in ODAM, organized by Hal Hendrick and Ogden Brown, Jr., and sponsored by the IEA and HFS, was held in Honolulu, Hawaii. A hardback proceedings was published by North-Holland (Elsevier). All subsequent ODAM international symposia also have resulted in hardback proceedings, with the first six being published by North-Holland.
- 1985: The IEA organizes a Science and Technology Committee, with ODAM being one of its first eight Technical Committees, based on inputs from the IEA federated societies as to the areas most needing international sharing of research and practice. It has remained one of the most active of the now 18 TCs of the IEA.
- 1985: Two sessions on human factors in ODAM were held at the 9th IEA Triennial Congress in Bournemouth, England.

- 1985: First HFS sessions on human factors in ODAM were presented at the HFS Annual Meeting in Rochester, New York. ODAM sessions have been held at every annual meeting since.
- 1986: The 2nd International Symposium on Human Factors in ODAM (ODAM II), organized by Hal Hendrick and Ogden Brown, Jr., and sponsored by the IEA and the HFS ODAM TG was held in Vancouver, Canada, in conjunction with the Human Factors Association of Canada's Annual Meeting. Based on both general and sociotechnical systems theory, Hal Hendrick introduces the concept and coins the term *macroergonomics*; he predicts work system effectiveness criteria improvements of 50% to 90% or more when a true macroergonomic intervention takes place.
- 1987: A paper, "Macroergonomics: A Concept Whose Time Has Come," authored by Hal Hendrick, is published as the feature article in the February issue of the *HFS Bulletin*.
- 1988: Human Factors in ODAM was made one of the five major themes of the 10th IEA Triennial Congress in Sydney, Australia.
- 1991: Human Factors in ODAM made one of the 12 major themes of the 11th IEA Triennial Congress in Paris, France.
- 1994: At the 12th IEA Triennial Congress in Toronto, Canada, HFES ODAM TG members and the IEA ODAM TC organized a multisession symposium on human factors in ODAM. More papers were presented on this topic than on any other at the Congress.
- 1997: At the 13th IEA Triennial Congress in Tampere, Finland, a multisession symposium on human factors in ODAM again organized by HFES ODAM TG members and the IEA ODAM TC. Again, more papers were presented on this topic than on any other at the congress.
- 1998: HFES ODAM TG was renamed the Macroergonomics TG in response to the considerable methodology, research findings, and practice experience that had developed during the 1980s and 1990s.
- 2000: At the 13th IEA Triennial Congress in San Diego, California, macroergonomics was one of the three topics on which the largest number of papers were presented.
- 2003: At the 14th IEA Triennial Congress macroergonomics again was one of the topics with the most papers.

ALEX WILLIAMS, INVESTIGATOR AND INVENTOR

by Stan Roscoe

The research contributions of Chris Poulton, Paul Fitts, Al Chapanis, and a few other early giants in the emerging field of engineering psychology are much better known than the experiments and inventions of Alex Williams at Illinois and at Hughes Aircraft Company, and I'd like to help correct that oversight.

Alex was hired by Herbert Woodrow, Head of the Psychology Department at Illinois, who had been involved in pilot selection during World War I. Woodrow recognized the unprecedented opportunity to develop an aviation psychology program in conjunction with the university's new Institute of Aviation, and he saw in Alex a man who had the education, experience, motivation, and creativity to do just what Woodrow had in mind. The Graduate College provided Williams with \$10,000 annually as seed money, enough for a secretary, two graduate research assistants, an instrument maker, office and shop supplies, and travel expenses for Williams to pursue research contracts.

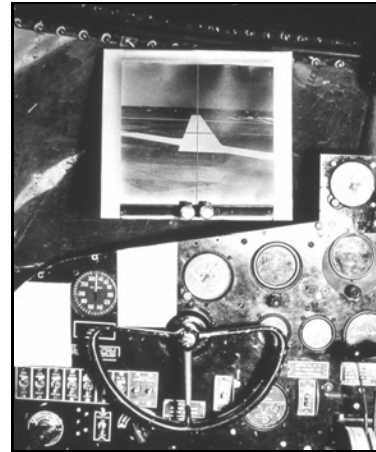
Alex had arrived in Illinois in January 1946, and when I arrived for the fall semester as a graduate student the program was under way. Support had come quickly from the Wright Air Development Center and the Special Devices Center of the Office of Naval Research. Other contracts followed with the Civil Aeronautics Administration via the National Research Council and the Air Force Human Resources Research Center (later to become the Air Force Personnel and Training Research Center, known as "Afpatrik"). With the contracts came support for a stream of graduate students, most of them World War II pilots, who were soon swept up in Alex's zeal to solve scientifically the operational and training problems of pilots and air traffic controllers.

Human Engineering

The initial focus was on the "human engineering" of flight instrument displays, starting with Williams' dial-reading studies with Walter Grether of the AeroMedical Lab at Wright Field. These were followed in rapid succession by the rotating-room studies of vestibular and visual orientation as a function of display characteristics, and then came the main-line experimental programs.

Flight by periscope. Flight by periscope experiments were started in early 1947 and continued until mid-1952. The idea of flying an airplane by periscope was conceived in response to the Navy's interest in the potential of television for the flight control of airborne vehicles, whether flown from the cockpit or remotely. It was obviously impractical to install a laboratory full of optical and electrical hardware in a flight test airplane at that time, so a TV display was simulated by means of a periscope that projected the image of the outside world on a screen mounted above the instrument panel in the cockpit of the lab's Cessna T-50.

In both field and flight experiments, bias errors in the perceived sizes and distances of objects visible on the periscope's viewing screen were discovered and quantified. Although it was speculated at the time that the misjudgments might be associated with the accommodation of the eyes to the near distance of the screen, that possibility was not pursued experimentally until practical optometers became available in the 1970s. The strong dependence of the apparent size and distance of objects on the distance at which the eyes are focused has implications for the design of both real and virtual imaging displays.



On the left, Stan Roscoe relaxing in the doorway of the twin-engine Cessna T-50 he used in his “flight by periscope” research during the summer of 1950; the periscope housing can be seen projecting from the aluminum windshield at the far left. The image on the right shows the pilot’s forward view on a final approach to the airport runway. Roscoe’s dissertation, titled *Airplane Pilot Performance as a Function of the Extent and Magnification of the Visible Horizon*, was the first in the new field of engineering psychology.

Integrated displays. In parallel with the flight-by-periscope experiments and the concurrent transfer-of-training studies—to be discussed later—the lab undertook a program for the National Research Council to develop the optimum display of bearing and range information to be provided by the Civil Aviation Administration’s new VOR-DME radio navigation facilities. Williams had advanced the notion of the integrated presentation of flight information, which led to his conception of map displays on which the airplane’s position and heading are plotted automatically. Early paper-and-pencil tests, in which pilots made rapid navigation decisions in response to drawings of various instrument displays, supported Alex’s thesis.

With the evident superiority of map displays, Williams had graduate student John Bell build the first CRT map display, and Al Bowman, the lab’s machinist, installed it in the cockpit of a 1-CA-1 Link trainer for experimental evaluation. On the strength of the striking improvements in the pilots’ performance of terminal area instrument flight procedures, the CAA embarked on its pioneering program to develop airborne map displays and to test them in flight at the Technical Development and Evaluation Center in Indianapolis. Meanwhile at the lab, Williams and Tom Payne pursued the investigation of the principles of control-display motion compatibility in map displays.

Air traffic control. In parallel with the map display work, the CAA asked Alex to develop the first air traffic control simulator. Al Bowman built four long, narrow tables in the lab, with four large, identical maps equally spaced on each table. Surplus navigation “crabs” for Link trainers were used to simulate airway traffic, and an electromechanical device was mounted above each map to sense the bearing and range of a crab from the center of its map, which represented the ground location of the air traffic control radar. The same was done for the crabs of the two Link trainers, and the positions of all 18 crabs were “telemetered” to a large radar scope in the “air traffic control tower.”

Pilots “flew” the crabs with heading, speed, and altitude controls in compliance with the clearances issued by the “controllers” to study the feasibility and effectiveness

of various experimental terminal area ATC procedures. The Director of the CAA's Technical Development and Evaluation Center saw the potential of the simulator as a research and training tool. He had it moved to Indianapolis and integrated with the real-world ATC system so that controllers in the Indianapolis tower could get "high-density" practice by controlling the simulated airplanes (crabs) intermixed with the real airplanes in the terminal area.

Transfer of Training

Contact and instrument flight. In 1947, reports of the motor skill studies at the University of Iowa gave Alex the idea that the transfer paradigms of the basic learning theorists were equally applicable to the quantitative assessment of the training value of the lab's new School Link contact flight trainer. Soon thereafter the prototype 1-CA-2 Link became the first true simulator of a specific airplane, the North American SNJ/T-6 Texan. A salvaged forward cockpit of a wrecked Texan, with its controls and displays made operative, was mounted on the bellows of a 1-CA-1 Link (the last of the "blue boxes") and delivered to the lab for evaluation. The impressive transfer-of-training experiments that followed led to the first postwar procurement of P-1 Link trainers by the Air Force.

Visual takeoffs and landings. The initial transfer-of-training experiments in the 1-CA-2 Link had demonstrated its effectiveness in teaching all primary flight tasks except takeoffs and landings. Ralph Flexman had also shown, with many doubters, that landings could be taught with significant positive transfer using a picture of an airport runway drawn on a blackboard that was tilted about its horizontal axis by the instructor as the student in a School Link "rounded out" for a "landing." Surely, Alex reasoned, if such a crude display had any transfer value, a closed-loop visual system could be highly effective in teaching beginners to land, thereby reducing the hazards of early dual-landing trials.

Point light sources had been used in celestial navigation trainers, and for the contact landing trainer, a small, bright source was used to rear-project a properly dynamic geometric image of a runway on a screen set up in front of the 1-CA-2 Link. A sheet of aluminum, with a slit cut out to represent a landing runway, was mounted over a Link trainer crab with an elevator mechanism driven by the simulator's "altitude." The crab traveled over a table behind the screen in direct response to the simulator's "heading" and "speed." The error reduction of 85% and the saving of 61% of the flight trials relative to a control group would be hard to match with present-day computer image generators.

Alex the Inventor

Alex Williams was as much an inventor as he was an investigator. The use of an airborne periscope to simulate a television set, the use of a pictorial map display to integrate aircraft position and flight path information, the use of a room full of Link trainer crabs to simulate high-density traffic in a terminal area, and the use of a point light source to generate a dynamic image of an airport runway were all his original ideas. And when he moved on to Hughes Aircraft Company in 1955 to direct an enlarged display system organization, he collaborated with fellow psychologist "Lick" Licklider, with help from physicist Harold Hance, on the invention of the pulse-Doppler radar, which revolutionized the detection of airborne targets in the presence of ground clutter and electronic noise.

**STORIES FROM THE CAREERS OF
HUMAN FACTORS PROFESSIONALS**

HUMAN FACTORS ON THE MOON

by Thomas B. Malone

Apollo 11 successfully landed American astronauts on the surface of the moon on July 20, 1969. Watching it happen, I was proud to be an American. However, I was also proud to be a human factors practitioner who helped to make it happen.

It was 43 years ago that I left Fordham University with a PhD in experimental psychology and joined Grumman Aircraft's Human Factors Division in Bethpage, Long Island. Grumman was the prime contractor for the Apollo Lunar Module (LM), which would land two astronauts on the surface of the moon. My assignment was to the Simulation and Evaluation Group of the LM Crew Systems Department. I worked there for three years, which were among the most professionally rewarding and challenging years of my career.

While the birth of human factors had come about some years earlier in the military aircraft industry, Project Apollo began the growth of human factors as an accepted systems engineering discipline. Human factors professionals have continually demanded that they have an influence on system design, and this influence has never been as clearly manifested as in the design and development of Project Apollo systems in general and the lunar module in particular. Human factors specialists made a major contribution in the LM program, first and foremost to the design of crew accommodations, controls and displays, lighting, workspace layout, and other elements of the human-machine interface. However, the influence of human factors went far beyond the conventional domains of the discipline to also embrace such vehicle design disciplines as flight controls, dynamics, structures, thermal systems, weight controls, electrical systems, stabilization and control, and logistics.

In order to have an influence on system design, the trick is to provide your input early in the design process, before many of the design decisions have been mandated and before design freezes begin to reduce the number of alternative concepts. In order to advance the human factors position on a design issue in the face of the constraints posed by the other engineering disciplines, it helped to have quantitative data to support your position. What better way to acquire performance data on alternative system design approaches very early in the design process than to conduct high-fidelity simulations of selected mission operations, flown not only by persons representative of the intended system users, but by the actual users themselves, the astronauts. The basis for most of the human factors input into the early design of the LM was computer-driven/high-fidelity simulation, back when virtual reality was only produced by LSD.

The LM Simulation and Evaluation Group conducted human-in-the-loop simulations of LM-Command and Service Module (CSM) rendezvous and docking, LM powered descent to the lunar surface, descent with an abort and emergency return to the CSM, powered ascent, and lunar landing. The test subjects for these simulation programs were initially Grumman test pilots, then NASA test pilots, and finally the astronauts. We regularly hosted the original Mercury Seven and most of the 22 who followed them in the second and third groups of astronauts. The objective of the astronaut participation in LM simulations was fourfold: 1) They verified the fidelity of the simulation in the context of their flight experience with Mercury and Gemini; 2) They served as expert test subjects; 3) They supported the development of standard flight procedures and techniques; and 4) They provided invaluable insights and opinions concern-

ing alternative human-machine interface design approaches. Most of the important design decisions posed to LM program management were significantly influenced by data from the Crew Systems simulations, including such issues as determination of the optimal role of the human versus automation in flight control operations; demonstration that the LM crew could dock with the CSM using only the top hatch (resulting in the elimination of the front hatch and its weight penalty); determination of LM window size and configuration; development of rendezvous, docking, and landing aids; and design of consoles, displays, controllers, lighting, alarms, and workspace.

The position of human factors specialists on the LM design team, and the weight given to human factors requirements in system trade-offs, was helped immensely by the advocacy of the astronauts. When the astronauts agreed with the human factors position on a design issue, as they usually did, that position carried the day. When the astronauts disagreed with the human factors specialists, both sides were professional enough to agree that the difference would be settled by empirical data. In the few cases when the astronauts didn't agree with us, and we were not able to acquire the data to resolve the difference, the astronauts won the argument by force of their authority (they had been there, we hadn't), but such cases occurred infrequently. More often the battle lines were drawn between the combined might of the astronauts and the human factors people (with data in hand) on one side, and, on the other, the system engineers seeking to reduce weight, volume, or power, or strengthen structures, at the expense of crew effectiveness, accommodations, performance aids, or safety margins. The more often we won those battles (and we usually did), the more respect we achieved within the Program and the more often we were called on to consult to the very engineers who had earlier been our adversaries. More and more, human factors was seen as a credible contributor to the system design, with an unwavering concern for that element of the system under its purview, the human component.

After leaving Grumman, I continued to contribute to manned spaceflight programs concerning human factors issues. By the time Neil Armstrong took his giant leap for mankind, I had participated in the human factors design of the Apollo Applications Program, the Lunar Rover Program, the Lunar Surface Experiments package, the Manned Orbiting Laboratory, and Skylab, and I was just beginning to support the newest manned space system, the Space Shuttle. What had made the Lunar Module Program special to me was the fact that it was not only at the frontier of manned space exploration, it was at the frontier of human factors as an accepted contributor to the design of complex manned systems.



PUTTING “FLIPPER” TO WORK

by Bob Blanchard

In the late 1960s, the then Navy Ocean Systems Center, Hawaii Division, was involved in marine biosystem research to explore possible applications of various species to Navy missions. One species being studied was the Atlantic Bottlenose Dolphin. Our group, Integrated Sciences Corporation, of which I was a principal, was contracted to provide man-dolphin integrated human factors support. Using its echolocation prowess, the animal was to be used essentially as a sensor subsystem with means provided for interrogation and response that were compatible with animal capabilities and level of training. Our tasks were to identify, and consider jointly, animal-human factors design principles in support of system interface design, and to design the operational tests to be conducted.



A Mk 8 Bottlenose Dolphin, wearing an acoustic tracking device on its fin, takes a quick break from clearing seaways for relief ships to deliver supplies in the Arabian Gulf.

This was exceedingly intriguing and interesting work in that we had to research the capabilities and limitations of the animal component of the system to understand the implications for optimal design, as well as the more traditional design principles for the human operator. Actually, we designed hardware interfaces and procedures for a unique, integrated, man/animal biosystem. This was accomplished through joint work with the Navy’s marine mammal trainers and engineering staff in Hawaii, by refreshing our memories of operant conditioning techniques, and through design and testing of various candidate interface designs. During operational testing, we developed probabilities of detection for each subject animal based on target range and type. Methods of transporting and handling the animals also were studied. This was highly sensitive work, not only from the standpoint of the mission but also because of animal rights groups who objected to the Navy’s Marine Mammal Program. But, from the standpoint of a human factors research project, it was challenging, rewarding, and a lot of fun!⁶

⁶ Sea mines have been responsible for 14 of the 19 U.S. Navy ships destroyed or damaged since 1950. It was primarily the threat to ships that motivated the Navy to “enlist” the support of marine mammals to help find mines. Upon receiving a cue from its handler, a trained dolphin searches a specific area by emitting a series of clicks that bounce off an object and return to the dolphin, which allows the dolphin to construct a mental image of the object. The dolphin reports back to its handler, giving one response if a target object is detected and a different response if no target object is detected. If a dolphin reports a mine-like target, the handler instructs the dolphin to mark the location of the object so it can be avoided by vessels or rendered safe by Navy divers. The Navy’s Marine Mammal Program is an accredited member of the Alliance of Marine Mammal Parks and Aquariums, an international organization committed to the care and conservation of marine mammals. – *Ed.*

My final project for the Navy was to develop a test battery for screening and selecting candidate marine mammal trainers for the Navy and five commercial oceanariums that cooperated in the study. It involved the use of multidimensional scaling techniques to develop a performance criterion scale for marine mammal trainers and development of a battery of predictor instruments (some were tailor-made knowledge and training strategy tests) to validate the tests and resulting multivariate regression model. I'm not sure if the selection device was ever put to use, but it gave me a chance to exercise all the tools in my bag of "psychometric tricks" and the opportunity to work with a lot of dedicated and sincere individuals in the marine mammal training business.

A HUMAN FACTORS JOB TO DIE FOR!

by Bob Blanchard



Bob Blanchard

After 30 years in the field of human factors, I was offered an enviable career opportunity in 1991 to join the Civil Aeromedical Institute (CAMI) in Oklahoma City. At that time, CAMI was an FAA laboratory involved in Aeromedical Certification, including work with Aviation Medical Examiners; research in aviation physiology, toxicology, protection and survival; and cabin safety. CAMI staff also performed personnel and training research, principally with the air traffic control (ATC) community. My job was to broaden the existing human factors program, extend it to include General Aviation (private and corporate aircraft) and build a Human Factors Research Laboratory within CAMI. Four PhD psychologists were already on board and I was given the green light to increase the staffing level to 11 PhDs and seven research technicians. What an opportunity! Over time, I was able to define, promote, and staff three program areas: 1) Advanced ATC Systems Research, which ran an ATC simulation laboratory to assess display and control concepts for future ATC systems and to conduct data link communications and task loading studies; 2) Behavioral Stressors Research, to develop sleep management methods to counter fatigue, sleep loss, and circadian dysrhythmia among pilots and controllers while also investigating color vision requirements; and 3) Aircrew Performance Research, which operated two general aviation simulators that were reconfigurable with rapid prototyping capability to evaluate candidate electronic flight displays, determine performance decrements due to hypoxia at General Aviation altitudes, investigate the effectiveness of PC-based training devices for instrument training, and conduct other projects to identify ways to protect and enhance aircrew performance and improve aviation safety. It was a challenging, sometimes frustrating, but highly rewarding opportunity to apply my organization and management skills, my experience as a general aviation pilot, and a near lifetime of human factors experience to real-world aviation human factors problems. With the program in essentially a steady-state operation, I decided that professional life couldn't get much better, so I retired in January, 1997 after nearly six years at CAMI and 38 years in the profession. I am grateful that I was able to end my career with what was one of my most gratifying professional experiences!

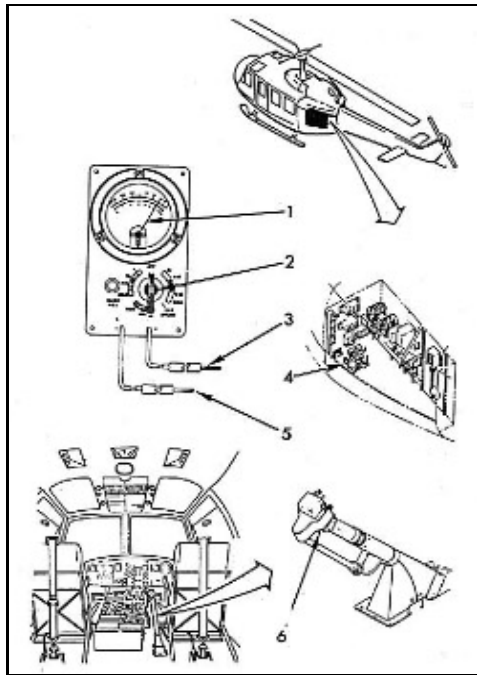
IS A PICTURE WORTH A THOUSAND WORDS?

by Bob Smillie

During the 1950s, document designers recognized that maintenance and repair of mechanical and electrical equipment required a well-designed set of procedural instructions called job performance aids (JPAs). This work took off in the 1960s, 1970s, and 1980s. HF experts recognized that providing clear, succinct instructions with appropriate illustrations based upon a task analysis and validation contributed to improved, error-free human performance. Innovative approaches to providing helicopter maintenance information to the Vietnamese Air Force started with individuals like Kay Inaba, who designed a dual-language performance aid that relied heavily on the illustrations (simple line drawings) to convey the step-by-step actions needed to perform a specified task. People like Jack Folley, Reid Joyce, Tom Elliott, and John Foley were actively improving JPAs and documenting the process. Most of the work was performed in support of the military, but there were commercial applications, as well. For example, Ed Shriver, who



Bob Smillie



introduced the concept of behavioral task analysis, extended the JPA process to power plants. Dissertations, like Hal Booher's, compared various text-only, graphics-only, and text-graphics mix formats in terms of task completion times and errors. Bob Blanchard initiated a major R&D program in the Navy that took an integrated systems approach to a personnel, training, career management system that used JPAs to ensure initial on-the-job productivity and relevance. I had the great fortune of working with all these people early in my career and enjoyed learning from the experts. Of course, one of the best times for me was when I was selected to be a part of the HFS team to produce a long-range HFS R&D plan for the Nuclear Regulatory Commission. Chuck Hopkins led the team, which included Harry Snyder, Dick Hornick, Smoke Price, Bob Mackie, and Bob Sugarman. I was a "youngster" among all these HFS Fellows, four of whom were past presidents of the Society. What a great time!

SEAGULLS LIE

by Barry Berson

During graduate school I took a job with a small consulting company that had contracts with the Navy to assess the capabilities for various species of the animal kingdom to support Navy missions. One contract was directed toward assessing the capabilities of seagulls to detect downed pilots in the ocean. I got involved fairly late in the program and did not have the opportunity to support the development of training requirements. My role was to develop the experimental design for the study, support data collection, perform the data analysis, and help prepare the final report.

The tests were conducted near San Clemente Island, off the coast of Southern California. Initially the seagulls, obtained from a behavioral laboratory in Arkansas, were to fly from their cages to touch a target in the water (a medium-sized orange life support inner tube). During the first set of trials, the experimental seagulls were attacked by local seagulls immediately upon their release from the cages. More than 50% of the experimental birds were lost during the attack.

This led to a decision to train the seagulls to perform the search while in cages overlooking the water. The birds were trained to peck a response paddle to indicate a detection; pecking at the paddle when a target was present dispensed food pellets into the cage. There was no trained response for indicating that no target was detected. I developed a very academic experimental design: a five-by-five Latin square that attempted to counter balance all variables (whether a target was presented or not, location of the target—near, far, center, right, left, etc.). As it turned out, it took about 15 minutes to remove the target from view and only about five minutes to move the target. The design called for approximately 50% of the trials to be no-stimulus trials.

I showed up approximately one week into the testing and looked at the results: approximately 95% hits and 86% false alarms. After observing a few trials and talking to the test team, it became obvious that the team was not using my test matrix. They said that it was too time consuming to follow the design and that they randomly selected trials based on target proximity; they also ran about 95% of the trials with the stimuli in the water.

Observations showed that the seagulls were not searching for a target. Several of the birds continuously pecked the response paddle, and others turned in tight circles and pecked at the response paddle when they faced it during each revolution. With 95% of the trials being stimuli trials, and with no response paddle to indicate no target conditions, the birds were consistently rewarded for pecking the response paddle. It was a classic case of shaping superstitious behavior. I informed the test team that they must conduct more nonstimulus trials (approximately 50%).

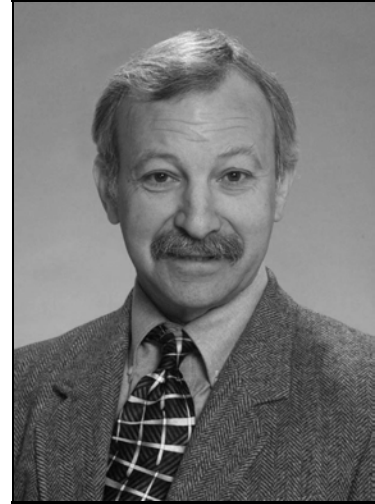
I left the island and returned about one week later to review the new data. During the latest set of trials, the hit rate was reduced to about 60% and the false alarm rate dropped to about 40%. I asked the test team how they accounted for these dramatic differences. They told me that they had a few more nonstimulus trials and whenever the bird pecked the response paddle for a nonstimulus trial, the trainer would pick up the offending bird's cage and shake it vigorously.

After a set of trials, the trainers had to transfer the seagulls from their working cages to their home cages. When the trainers reached into the cages, the birds would clamp down on their fingers with their powerful beaks. To convince the birds to stop biting, the trainers would grab a bird around the neck and squeeze until the bird released its grip on the trainer's fingers.

Management personnel from the consulting company used the data from this experiment to develop Receiver Operating Characteristic curves to document the capability of the seagulls to detect downed pilots. After reviewing the results of the study, the Navy canceled the program and freed the seagulls.

Lessons Learned From This Study

- Develop experimental designs based on realistic environmental conditions and resource demands;
- Provide response indicators for stimuli and non-stimuli trials;
- Seagulls lie.



Barry Berson

SUSHI FOR BREAKFAST

by Barry Berson

One of the requirements of my first job was to be a note taker at the annual Navy conference on Dolphin Training. The conference brought together all of the Navy and Sea World trainers with the aim of swapping training tips. During one of the conferences, a trainer told a story about a young dolphin that had been born in captivity and had worked with only one trainer. The dolphin was performing remarkably well, having learned all of the required behaviors during several months of intensive training, when the dolphin trainer came down with the flu. Another trainer stepped in to continue with the dolphin's training, but the dolphin would not cooperate and flatly refused to interact with the substitute. This defiance lasted for several days until the original trainer recovered and returned to work. When the young dolphin saw his trainer approaching for the first time after the long absence, it dove down into the tank, grabbed a fish, and presented it to his trainer.

"MISSED IT BY THAT MUCH!"

by Barry Berson

A long time ago when I was relatively young and naive, I received clearance to work on black programs for LM Skunkworks. After receiving the security briefing, I was told to go to the first trailer on the left to have a photograph taken for my Advanced Development Program (ADP) Badge. I exited the Security Building and walked to the first trailer on the left. As it turned out, the trailer was a men's restroom! Well, this was during the days of Maxwell Smart (Don Adams in the TV show, *Get Smart*), so I thought it was part of the super-secret procedure and pretty cool. I sat down in one of the stalls and smiled. Realizing after a few minutes that no one had said "smile" and there was no camera flash, I "smartly" stood up, left the trailer, and continued my search for the real ID Trailer.

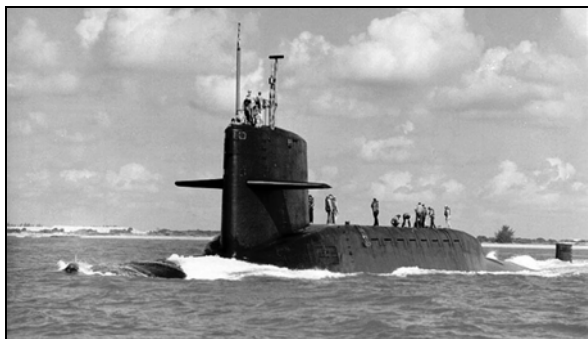
AND THEY ALL MOVED ON DOWN THE PASSAGEWAY

by Stuart Parsons

From 1960 to 1962, I was working for the Missile Systems Division at Lockheed. My job was to participate in the early submarine-launched ballistic missile readiness tests, which required each submarine to come down to Cape Canaveral, Florida, and fire two instrumented Polaris missiles on the range. Because I was the only human factors engineer on this test program, I would evaluate the man-machine aspects of the Lockheed Missile, the Westinghouse Launcher, the GE Fire Control System, the North American Navigation System, and the Electric Boat Submarine, and was responsible for a portion of the total report that went to the Navy and the contractors. I received a call one afternoon from a support systems engineer back at our plant in Sunnyvale, California, informing me that he couldn't find the prints for the interface between the submarine launcher hatch and the missile guidance package port and asked if I would provide a few measurements. It was about 7:00 PM on a June evening when I drove down to the dock. It was still light as I approached the dock, and I could see from a distance that there were three white sedans parked next to the submarine. This was quite strange because personal cars were not usually permitted so close to the boat.



Stuart Parsons



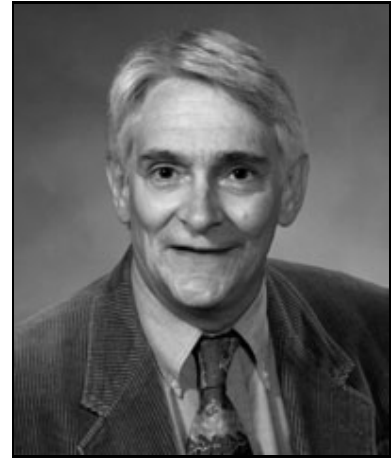
I walked over to the submarine and climbed down the hatch to the upper deck, which took me past the captain's quarters. I glanced into his room as I walked by and there, sitting in a chair, was Werner Von Braun, who had apparently driven from Huntsville, Alabama, with his staff. I continued walking to the top deck of "Sherwood Forest," where the 16 missile launch tubes were located, and began recording measurements for my engineering friend back at the plant. About that time, I heard a voice and looked up to see a group of people coming toward me. "I'm the engineering officer and just showed you the reactor and ship's propulsion, but I'm not too familiar with the missiles and their related systems," the voice said. Another person with a deep German accent responded, "Dat is no problem, here is a Lockheed engineer who vill explain ze whole thing." The four people from Von Braun's staff and the submarine's engineering officer then walked into the missile area. I started talking and explained the fire control system, launch system, propulsion system, guidance system, and final missile checkout procedures for about 15 minutes. I was then fortunate to be able to answer their questions. Finally, the leader said, "Dat vas very gut," and they all moved on down the passageway, leaving me to finish my measurements. Looking back, I consider this to be one of the highlights of my career. Those pioneer German rocket scientists from Peenemünde and Huntsville would never know that they had been briefed on an advanced missile system by a psychologist.

NEVER A PROPHET IN ONE'S OWN LAND (OR COMPANY)

by John M. Carroll

I spent many years as a researcher for IBM at the Watson Research Center. The Watson Center has a wonderful applied research culture. It understands the value of applied science, but of course, it also highly values technology transfer.

One of the continuing themes in my early career there (mid-1970s to mid-1990s) was trying to figure out how to transfer human factors technology—iterative system development, measurable usability specifications, and in general, moving usability testing and user-centered design further upstream in the system development process. It is notoriously more difficult to change what people do than to get them to adopt your software or hardware! But we had very strong support from IBM management and solid empirical results.



John M. Carroll

I am proud that our group came up with many solutions. One that is well known to HFES folks is the Boies-Gould Speech Filing System, a successful product developed inside the Watson Center using the human factors methods we were trying to transfer to the product development labs. We called this a “model farm” approach to transfer.

We also discovered somewhat ironic routes to successful technology transfer. One of our technologies was the “minimalist” information model (basically, guidelines and rationale for streamlining instructions, help, and other documentation to make them more effective in use). We worked for two to three years to transfer this technology in conventional ways, through joint projects, consulting, tutorial briefings, and even cross-divisional assignments. However, what worked best was publishing our research work in the open scientific literature and having it adopted by our competitors, Xerox and Hewlett-Packard. That was when the phone really started ringing.

I am not suggesting that anyone propose this transfer strategy to their management, but in retrospect, it is not surprising that the approach works. Our development lab colleagues kept a sharp eye out for innovations that our competitors were making, but paid less attention to what the in-house “eggheads” in Yorktown were up to.

A TREASURED MEMORY

by Martin Helander

I made a study trip from Sweden to the USA in 1976. We were setting up education in Human Factors and I felt that this was a good reason to visit Al Chapanis at his laboratory in Baltimore—it was a great day when I could meet the famous man. He took me around his lab and demonstrated the ongoing research on voice and computer communication. There were people communicating via terminals, and others were passing written messages under doors. A person was assembling a mechanical artifact, and another person located on the other side of the door held a drawing and tried to instruct the first person how to put the artifact together.

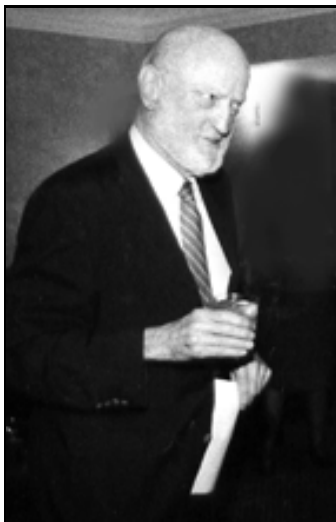
I thought this was just about the strangest research I had seen in my entire life, but I did not tell Dr. Chapanis that. About 10 years later I realized that Al was way ahead of everyone else. He had already foreseen the future use of computers. At that time, computers were not used for communication—only for calculations. There were many issues to study if one assumed that communication also would be possible.

I asked Dr. Chapanis, “What is the most important problem to solve?” I received another unexpected answer: “Inflation.” Here was a man with different perspectives. I was expecting him to identify a human factors problem, but suddenly he detached himself from what he had just demonstrated!

Al was a great host. He took me to lunch, and when I left in a cab, he stood patiently outside the entrance and waved goodbye. It was a great day, and I treasure the memory.

AGE IS RELATIVE

by Gerald P. Krueger



Mac Parsons reciting a limerick.

One of my fondest memories of Mac Parsons traces to 1973, when I was a student at Johns Hopkins and Professor Alphonse Chapanis asked me to “critique Mac’s chapter manuscript on designing the environment for the aged.” Mac, the older gentleman over age 60, and I had a lot of fun with that one, me helping him write about “aging.” Little did we know then it would strike up a friendship of more than three decades that saw Mac live into his 90s. And now I am past age 60. Ha!

Mac’s hobbies included sailing and travel, and he remained an ardent skier into his 80s. Mac was beloved. He was always ready with a joke or a limerick that he had composed, collected, and published (many with clever double entendres). Mac Parsons also was a stable fixture at our Society’s annual meetings, where his lectures and panel discussions were always packed. With his white beard and bald “Mr. Clean” look, Mac was one of the most recognized and well-liked grand old men of HFES. Who among us can forget the several years when Mac and Marjorie, his wife of 42 years, both then octogenarians, would kick off the first dance at our annual HFES banquet? We miss you, Mac Parsons.

A SOCIETY BY ANY OTHER NAME

by H. W. Sinaiko

I served as liaison scientist at the U.S. Office of Naval Research, London Branch, during 1967 and 1968. It was the job of a lifetime—living in London for a year, visiting mostly academic psychologists anywhere in Europe and the Middle East that I wished to go. Among other duties, I attended and reported on several meetings of professional societies. The case in point here was the 1968 Annual Conference of the Ergonomics Research Society in Birmingham, England.

A month or so before the meeting I was invited to “toast the health of the Society.” Although the annual meetings of our Human Factors Society included a banquet, the programs didn’t include a ritual toast to the health of the organization. I asked a Brit friend about the nature of such after-dinner events, and he replied, “Say anything you like, but it ought not to be too serious.” That sent me to Mac Parsons, coincidentally the president of HFS at the time. Mac and I had been close friends since the early 1950s, and I knew of his creative talents, which probably were the result of his having been a reporter on the *New York Herald Tribune* for several years. Among his many skills, Mac was an accomplished limericist. Give him a subject and he would create a limerick, almost immediately, that was always relevant and very funny.

Mac didn’t take the time to reply, yes or no, to my request. By return mail (there was no e-mail 37 years ago), Mac provided the toast I needed in the form of the following limerick, titled “A Society by Any Other Name.”

I say, old chaps, have you heard
Of anything quite so absurd?
Though we’re not detractors
of quote HUMAN FACTORS
ERGONOMICS is rightly the word.

ERGONOMICS? Say, what is this jazz?
It sounds like it’s got no pizazz.
It’s all Greek to me,
While it’s easy to see
HUMAN FACTORS is real razaamatazz!

Instead of this verbal defiance,
We ought to support our alliance.
Without being comic,
Let’s make HUMANOMIC
ERGOFACTORS the name of our science!

Mac added a note of instructions for delivering the toast: “In reading aloud, the words in upper case should be emphasized. The first verse should be spoken in a British accent, the second one in an American accent, and the third in the accent of an ONR representative who has been stationed in London.” Mac’s toast was a great hit at the ERS banquet. One of the attendees, an eminent academic, later told me, “I didn’t know you Americans had a sense of humor.”

OH, TO BE A STAR by Lewis F. Hanes

The National Cash Register company (now known as NCR) decided in the late 1960s to develop a bar-code scanning system to speed grocery store checkout. I managed a small group of human factors specialists at the NCR Research Center in Dayton, Ohio, and we were assigned the job of 1) describing the movement of the bar code on the package by the scanner, including maximum speed, height above the scanner surface, and left-right and fore-aft tilt; and 2) recommending the feedback to be provided to the user regarding “good” and unsuccessful scans. This information was important because of the very limited technology capabilities in the 1960s for this application. The most demanding conditions (fastest scan, maximum height of code over scanner, and maximum tilt) defined the requirements that the hardware and software engineers needed to meet to achieve user and market acceptance.



Lewis Hanes

We set up a simulated supermarket checkout counter equipped with a simulated scanner. The scanner and surrounding area were instrumented with various sensors to measure the important parameters, and simulated bar codes were placed on groceries that we had purchased at a local market. It was then time to make a test run to verify that the recording system was working properly and that the test procedures were adequate. We let it be known to some of the staff that we needed a female volunteer to serve as a subject for the filming of a pilot test (almost all supermarket checkers at that time were female).

One secretary in particular was very interested. We described the test scenario and mentioned that a movie camera would be used to record the session. The secretary agreed to participate, and we scheduled the test for the following morning. She arrived at the appointed hour, but she was not dressed as a checkout clerk or as a secretary. She had obviously gone to the beauty shop the previous afternoon and arrived wearing heavy makeup, spike heels, and a slinky, low-cut micro dress. We conducted an abbreviated test because her performance could in no way represent a supermarket checker. I talked with her about her appearance after the so-called test and she said that she thought that NCR would show the film of her at trade shows and maybe even use it in advertising on television. She hoped that the exposure might give her a shot at Hollywood.

Needless to say, she did not make it to Hollywood. But we succeeded in our testing and provided performance requirements for the scanner, and the design engineers eventually built a scanner that accommodated the defined requirements. On June 26, 1974, Marsh Supermarkets, Inc., used an NCR scanner to “ring up” a 10-pack of Wrigley’s Juicy Fruit gum in a store in Troy, Ohio, marking the first in-store use of a bar-code scanning system that became a very successful commercial product.

MY INTRODUCTION TO HUMAN FACTORS

by Arnold M. Lund

My first experience with human factors was as a victim of bad design. I was working in a sheet metal shop on a machine that was fondly known as “old number 5,” for the number of fingers that had been lost on it. When I left the shop, it was known as “old number 6,” but that isn’t the story I wanted to tell. The story I want to share is about my introduction to human factors as part of the solution.

My professor in graduate school was Dr. B. J. Underwood, an amazing and fascinating man and wonderful scholar in human learning, memory, and experimental psychology. Over drinks one evening (and we had many), he shared where the funding came from that was paying my way as his assistant. During WWII, he had received a call about a new bomber sight that the Navy was installing in planes. They were frustrated because the people pressing the buttons to drop the bombs were doing a terrible job of hitting their targets. He had the Navy send him a bomb sight and set it up in his lab. He looked through the sight, pressed the button, and immediately a flap came up and covered the sight. There was no feedback! There was no way to improve your aim. It was a lesson in how applying a simple law based on an understanding of human performance and learning could make a huge difference.

Based on the “aha” that Professor Underwood provided to the Navy, ONR (the Office of Naval Research) began funding him and stood by him, his work on human learning, and humble assistants like myself, until the professor retired. While the expectation for people going through his lab was that they would go into an academic career focused on some area of cognitive psychology, I was pleasantly surprised to have Ben Underwood enthusiastically support my career in human factors as I took my first job at Bell Laboratories. He knew the potential.

DON’T YOU KNOW ANYTHING?

by Arnold M. Lund

Some time ago when I was managing a user experience team at Ameritech, I was talking to my boss, Joel Engel, about the iterative user-centered design plan that we had laid out for our products. He was an engineer by training, and quite well known and respected in his field. He had even managed a human factors department at the original AT&T Bell Labs, where they worked on an early precursor to many Web services. As such, I assumed that he was informed about what human factors professionals do. However, while we talked, he leaned toward me, took another bite of his sandwich, and said in all seriousness, “Don’t people in your field actually *know* anything?” He was obviously coming from a discipline—engineering—where design is based on principles derived from science. What he was hearing was an iterative design and testing story, but it sounded like a mix of art and a testing method where the results are applied at the time but then are lost. Fortunately, I could step back and talk about the research-based HFES ANSI standards work, the defining of a body of knowledge suitable for teaching in engineering programs and testing suitable for certification. That was the moment when human factors as a science and engineering discipline messaging was seared into my consciousness. I never told the story of the process we use to drive business and user value in quite the same way again.

CEO MEETS HUMAN FACTORS

by Arnold M. Lund

The best memory in my human factors career has to be when I had a chance to introduce human factors to my CEO—well, my future CEO. I was working for Ameritech at the time, and the CEO was in the process of attempting to drive a radical transformation of the company. He had sent his existing direct reports out to “pursue other opportunities” and had replaced them with the wildest, most out-of-box-thinking executives he could find in the company. One of them had just been made president of the unit housing my human factors team, which was chartered with supporting the entire company. He had called a management meeting to introduce himself.

I was sitting in the audience awaiting the start of the meeting. Someone sat down next to me, I smiled at him, he smiled at me and he said, “So what do you do?” I said I managed the human factors group and described what we did. He loved it, which was fortunate because he then hopped up and went to the front of the room. He was the new president. More important, he won the contest of the change agents and became the CEO. The reason he loved the message is that he grew up in the company through the sales side. As a salesperson, he knew that what one must do is to understand what people want and need, and then help them understand that what you have meets those wants and needs. When he heard that what *we* do is to understand what people want and need, and then design things to meet those wants and needs, the dots connected.

This approach made so much sense to him that the company built usability into the Ameritech brand attributes and created an advertising campaign around our work that ran for years. We became poster children for the ad campaign and were used for public relations (appearing in newspaper articles, on radio and TV, and even *almost* getting on Oprah). All of the managers in the company were trained on what we were doing as part of preparing the company for the marketing initiative and we briefed the board of directors on our work (who themselves were CEOs of Fortune 100 companies). They even put up 10-foot-high pictures of us on the headquarters building in Chicago, although I have to say when I went there to stand nonchalantly in front of my picture, no one seemed to recognize me. I don’t know that I ever again had a chance to get so many people excited about human factors and ergonomics. Fifteen minutes of fame, but it was clearly fun and rewarding.



Arnold Lund

A TIME OF WASTE by Steve Rogers

I was hired by Douglas Aircraft, Huntington Beach, in 1967 to work on the Air Force's Manned Orbiting Laboratory Program (MOL), which was planned to be the first space station. The longest mission of the earlier Gemini Program had been only four days and the MOL mission was to be 40 days, so a huge amount of crew quarters and workspace development had to be done, and fast. These were the "space race" days, this was my first human engineering job, and I was excited but uneasy.

My first assignment was to determine the light transmission characteristics of the MOL window. Originally, there was no window in the plans, but the astronauts had flat-out rebelled. The window had to be clear enough to permit the least visible light to be used for emergency navigation, yet dark enough to protect against retinal damage from the sun. I asked my supervisor how many months I had for the research and he said, "Two weeks, max." Now I was *really* concerned.

When I returned at the allotted time with an 80-page research paper, my supervisor told me to cut it to one page with no references. "We're not going to check your research; we're going to build a window to your specifications." I still remember the mixed feelings of horror and exhilaration. This wasn't graduate school; this was the big time—and my recommendations had better be right.

Concurrently with various projects, I was expected to be available at any time for design questions from the engineers. Many of the projects pertained to visual and auditory capabilities and control panel design issues, but they also included body dimension and strength data applicable to activities performed when working, eating, sleeping, and particularly in personal hygiene. MOL would have the first "outhouse in space," as the engineers liked to say.

Although I had been concerned about working with the 14 MOL astronauts, they immediately put me at my ease and were unfailingly helpful and immensely likable. They were, however, very competitive with each other. For example, when I was doing strength measurements to identify mission equipment limitations, they twice broke my torque wrenches while trying to outdo each other.

My relationship with the engineers was sometimes a little more difficult because my reviews of their designs might highlight problems that could cost them rework time. We were all on the same team, but the engineers couldn't resist a few practical jokes on the psychologist now and then, such as giving me fictitious metrics (e.g., hatch clearance of 1 RCH) for my reports. They would also submit unlikely but humorous scenarios for potential hygiene compartment events, requesting my design inputs. I found data on how much, how often, how big, time course, product weight, and answers to a variety of "what-if" questions that I had certainly never been asked in graduate school.

When there simply was no research data to support design for zero-G activities, I was assured by higher-ups that we could always add some tests to the Keplerian trajectory flights in the "Weightless Wonder" KC-135 aircraft at Wright-Patterson Air Force Base later in the program. However, when I reviewed the fine print in the contracts, it turned out that we were already on the hook for about 300 manned tests—10 times more than Douglas had estimated and bid.

Fortunately, the Air Force agreed to our hurriedly written plan for underwater “neutral buoyancy” simulation of most of the tasks. We got the astronauts, engineers, photographers, and a secretary scuba qualified. We then spent weeks in an underwater mockup verifying restraint and locomotion aids and other gear for the MOL tasks until the wrinkles on our fingertips stretched to our armpits. We quickly demonstrated that the 90-degree knee and hip angles from 1-G seating were not appropriate in zero-G and the appropriate, more extended angles caused a major redesign of some workspaces.

However, we couldn’t test the hygiene compartment functions underwater. After investigating a variety of bizarre waste collection schemes, the Air Force selected a form-fitting seat with air jets moving materials into a bag. International agreements forbade the dumping of solid waste overboard, where it could become a hazardous projectile. So, the bag would be manually sealed and flattened, then put into a “toaster” to dry. The liquids could be vented to space and the residue was labeled and saved in a cabinet for later study.



Steve Rogers in simulated weightlessness, 1967.

There were many equipment tests to be conducted during the two weeks of actual zero-G flight tests, but the successful demonstration of operational waste collection equipment use was mandatory. This would involve filming the entire sequence from several angles simultaneously with bright lighting and a dozen people observing closely. The test subject would also have to complete the initial activity within 30 seconds of initiating zero-G, so that gravity would not assist with waste capture in any way.

As might be imagined, things did not go perfectly in the first few days. The camera lights, tied to a G-meter, malfunctioned. The test subject became camera-shy and couldn’t perform in the required 30 seconds. At one point, beautiful yellow spheres of urine floated through the aircraft until the end of the zero-G maneuver brought them down abruptly on unlucky individuals. On top of these problems, several of the support crew members suffered from motion sickness and vomited, not always in their assigned plastic bags. It was only after several days of attempts that everything finally worked.

When I returned to Huntington Beach I wanted nothing more than to put the hygiene equipment issues behind me and get back to display and control design. But, there on my desk in the bullpen was a new addition. The engineers had gifted me with a very nicely crafted and lettered executive-style nameplate reading, “Mr. Waste.”

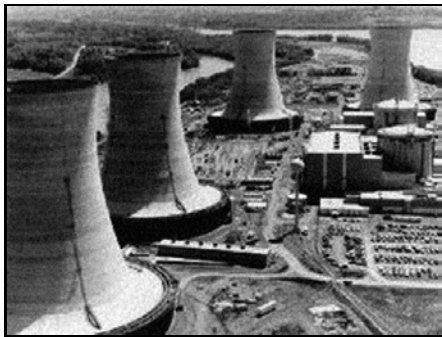
GLOWING REVIEWS

by Stuart Parsons

The Electric Power Research Institute (EPRI) became interested in Human Factors after Alan Swain made some disparaging comments about control rooms as a member of the MIT Wash 1400 study back in 1976–1977. Randy Pack at EPRI called Alan and asked him to come out to Palo Alto to brief the institute staff on human factors technology. Alan said that they could go down the road 15 miles and talk to the

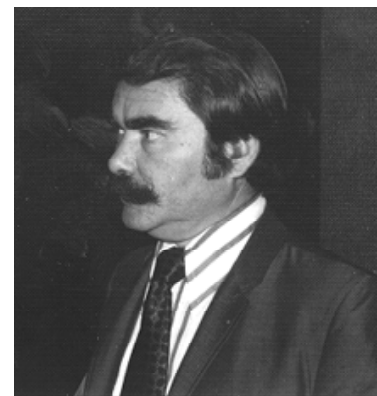


people at Lockheed, thus saving him a trip out from New Mexico. We bid and eventually won the first contract for the review of five representative control rooms. The big companies, like Westinghouse and GE, had human factors staffs in their defense organizations, but none in their commercial nuclear power systems groups when they designed the early plants. Joe Seminara, Wayne Gonzalez, and I wrote the report (*Human Factors Review of Nuclear Power Plant Control Room Designs*, EPRI NP-309, 1977), which turned out to be the most requested report in EPRI's history. After completing the study, we were asked by the Nuclear Regulatory Commission to come to Washington, D.C., and present the results. There were 30 or 40 engineers and scientists in the room (the NRC didn't have any HF staff at the time). When we finished the



presentation, one engineer got up and stated bluntly, "We are only concerned about circuitry in the panels, not human factors which is a Black Art." Needless to say, after the Three Mile Island incident, the NRC hired Dan Jones, J. J. Persensky, Jerry Wachtel, and other competent human factors specialists. In 1990, I told this story and showed slides illustrating nuclear power plant control rooms to the USSR's Secretary of Energy and his staff during a presentation in the Kremlin. They had a hard time believing it.

Chuck Hopkins was the chairman of the HFS group that reviewed a number of nuclear plant control rooms after the Three Mile Island accident. In the final report Chuck wrote that many of the control rooms looked like someone had picked up a pile of parts and thrown them at the control room boards. Chuck's comment was later published in the magazine *Machine Design*. No new nuclear power plants have been designed and installed in the United States since 1978. However, the USNRC has published detailed Human Factors Standards for systems development and detailed design, which were developed by John O'Hara and staff at Brookhaven National Labs. The major contractors, like Combustion Engineering, General Electric, and Westinghouse, have hired competent human factors professionals for design and independent review of advanced systems. Orders are now being placed for new U.S. plants, and these should include good human engineering of control rooms and other operational and maintenance activities based upon the current NRC-approved standards and advanced designs.

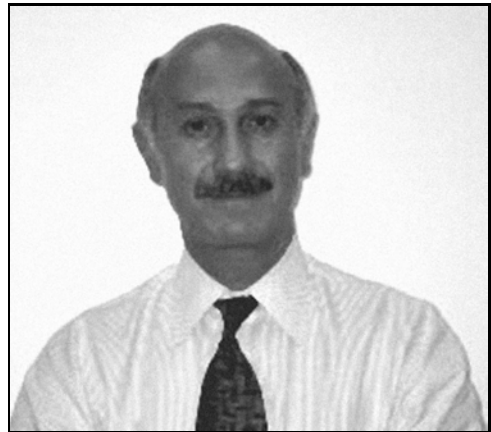


Chuck Hopkins

CHERNOBYL

by Najmedin Meshkati

In the early morning hours of April 26, 1986, a testing error caused an explosion at Reactor Number 4 at the Chernobyl nuclear power station in northern Ukraine. The major consequences of the Chernobyl event fall into three categories: 1) physical impacts, in terms of health and environmental effects; 2) psychological and social impacts on the nearby populations; and 3) the influence of the accident on the nuclear power industry worldwide. The Chernobyl accident caused a radioactive fire that burned for 10 days and released 190 tons of toxic materials into the atmosphere. The wind blew 70 percent of the radioactive material into the neighboring country of Belarus and the rest of the world, causing 23% of prime Belarusian farmland to become, and to this day remain, dangerously contaminated. At the time of the accident, about seven million people lived in the surrounding area.⁷



Najmedin Meshkati

Dr. Mohamed ElBaradei, Director General of the UN International Atomic Energy Agency, reported on September 6, 2005, that the first lesson that emerged from Chernobyl was the direct relevance of international cooperation to nuclear safety and that nuclear and radiological risks transcend national borders. In his words, "An accident anywhere is an accident everywhere."



"I advocate the respect for human engineering and sound man-machine interaction. This is a lesson that Chernobyl taught us."

The late Academician Dr. Valeri A. Legasov, the First Deputy Director of the Kurchatov Institute at the time of the Chernobyl accident, and the head of the former Soviet delegation to the Post-Accident Review Meeting of the IAEA in August 1986.

"The Chernobyl accident illustrated the critical contribution of the human factor(s) in nuclear safety."
The International Atomic Energy Agency's (IAEA) *Nuclear Safety Review for 1987*.

⁷ In response to a request by the United Nations, Professor Meshkati inspected the control room of the only operating reactor (No. 3) of the Chernobyl facility in May 1997, studied the Sarcophagus and its environmental health and safety problems for the EBRD, and visited the Exclusion Zone and the deserted town of Pripyat. – Ed.

COMMON SENSE

by Ken Laughery

I have been doing human factors/ergonomics expert witness work in personal injury and product liability litigation for the past 26 years. One of my memorable experiences took place in a Birmingham, Alabama, courtroom in 1989. I was working on the plaintiff's side of a case in which a man lost an arm while lubricating a large conveyer belt system in an industrial setting. I was serving as a rebuttal witness regarding human factors issues associated with the task the man had been performing as well as warnings issues associated with the lubricant product. After answering the plaintiff attorney's "friendly" questions, the defense attorney grilled me on cross exam. The cross exam seemed to go reasonably well from my perspective, as evidenced by the defense attorney showing a hint of frustration. Finally, in what turned out to be the last question, he asked: "Really Dr. Laughery, isn't all this human factors stuff just common sense?"



Kenneth Laughery

Anyone who has read the chapter on "Common Sense" in Al Chapanis's classic book, *Research Techniques in Human Engineering*, will quickly realize that such a question is an invitation to give a lecture on the pitfalls of "common sense," especially for a university professor like me. So, I gave an answer that amounted to a somewhat abbreviated form of my standard classroom harangue about "common sense." I ended my testimony with the statement: "Furthermore, sometimes common sense is just plain wrong. For example, it was once common sense that the world is flat and women are dumb. And we know both of these things are false." These words were no more than out of my mouth when I realized that all six members of the jury were women!

I will never know how the jury reacted to my comment, or if they reacted at all. But, they awarded the plaintiff \$3.8 million.



Harry Snyder, Richard Pew, Mac Parsons, and Arnold Small (1987)

DRIVING THE DESIGN

by Richard Roesch

I was a saturation diver during the 1970s performing deep-water salvage and piloting submersibles and unmanned vehicles on scientific and commercial projects. Much of the work was for the Navy, for example, I was the lead diver for the recovery of artifacts from the Civil War Ironclad USS *Monitor*, and I made the first transfers at more than 2,000 feet from a submersible to another chamber, which involved making the record breath-held dive at that depth. The many fatal and near-fatal accidents in this hazardous environment and my tendency to look for ways to improve our equipment and procedures led to consulting in which I provided an operator's perspective on equipment design. In 1980, I learned from Dr. Fred Perryman, at the then Naval Equipment Center in Orlando, that there was a discipline called human factors, and he suggested that I select a graduate program. I attended Virginia Tech and studied under Drs. Snyder, Kroemer, Williges, and Wierwille. I worked for NASA during graduate school as a diver in the Weightless Environment Training Facility, helping to train astronauts and evaluate suit and tool design until the *Challenger* disaster greatly reduced my chances for astronaut candidacy. At about this time, the Navy called again, asking me to work on human factors issues concerning the diving equipment, high-speed boats, and submersibles used by Navy SEALs.



Richard Roesch (1979)

I attended a meeting on the first day of my new job in which the engineers who were involved in the design of a submersible presented their recommendations. The electrical engineer presented his plans for the display of battery data, which included lots of information on volts, amps, amp hours, and the like but little of what a Navy SEAL who is cold, tired, and thinking about his mission needs. The SEAL operator only wants to know if he has enough power to get to the mission area and then return to the rendezvous. After the presentation, the Chief Engineer introduced me as the newest member of the team, noting that I was a human factors engineer, adding, "...whatever that is," and suggesting that I comment on what had been presented so far. I took a moment to ask myself whether I should commit professional suicide or let this pass? I chose the former and proceeded to explain what it is like to pilot a fast-moving vehicle in the underwater environment without an outside view—that is, to be totally dependent on instruments while also being wet and cold and wearing diving equipment that



requires the monitoring of life support systems. I suggested that all of the battery information should be fed into the computer to produce a single indicator that shows the operator how many minutes of running time remain. My point was that we should give the SEALs the information they need, not what the engineers consider to be important, interesting, or possible. With that, the electrical engineer jumped up, slammed his fist on the table and said, "We are not going to let any DAMN SEALs drive the design of this SDV." My first thought was that I had made a

horrible mistake by coming to the Navy. But then, questions started flying at me: What would I do differently? How would I determine what should be displayed? Were graphic displays better? I started a task analysis the next day, and soon I was meeting with SEALs to determine exactly what information they needed during each phase of a mission and in what resolution and format. Within weeks I “owned” all user interfaces, was building mockups, and was putting fully dressed SEALs in the water and in the mockup. To this day I use the term “drive the design,” but over the years the phrase has evolved to, “Users’ and maintainers’ needs, their tasks, tools and equipment, and the operational environment must *drive the design*.”

THE IMPORTANCE OF BEING EARNEST

by Richard Roesch

I was invited to a kick-off meeting by the new Special Forces command in Tampa, Florida, and only upon arrival did the participants learn that we were to design a new high-speed, medium-range insertion/extraction boat for the Navy SEALs. The Program Manager, a Navy Captain and very experienced SEAL operator, asked if I knew why I had been invited. I had no idea, as my previous work had been rather obscure and human factors issues were less than appreciated and rarely understood throughout much of the Navy at that time. The captain then informed me that he had once heard me talk in earnest about involving users in the design process and that he had a bad back and many frustrating experiences with equipment and vessels. He wanted me to talk to the engineers, help them appreciate the value of listening to the operators, and, in particular, to do something to save others from the debilitating back injuries that he suffered as a result of riding in high-speed boats in rough seas. My first task was to find or build a seat that absorbed some of the impact forces. The second task was to build the boat around the users and the new seat. I jumped at the opportunity! Later during a program review, I was attacked by an admiral who realized that we were spending more money on seats than on engines. However, before I could explain, the captain responded and then several crew members joined in, emboldened by the realization that for the first time, the engineers were acknowledging them as the most important component of their boat and recognizing that their needs were paramount. The admiral was convinced and accepted the importance of the seat. I consider that meeting to be a milestone in my career as a human factors professional.⁸



⁸ Roesch witnessed a dizzying array of human factors problems while working as a diver during the 1970s: divers killed in a bell that was overpressurized by topside personnel who were monitoring the wrong gauge (the correct gauge had been moved from the normal location); diver’s intestines sucked out when a tender opened the evacuation valve while the diver was still on the toilet; a submersible that hit the bottom so hard that it knocked off the 5,000-pound negative weight and rocketed to the surface, barely missing the ship overhead; a diver’s breathing mixture that switched from gas to air at depth, rendering one diver unconscious and nearly incapacitating the rescue diver (Roesch!). In the latter incident, Roesch had difficulty getting the incapacitated diver’s limp body through the overhead hatch and into the sub. He eventually forced him in, administered mouth-to-mouth and got him breathing. The experience prompted Roesch to develop a winch and procedures for rescuing unconscious divers. – Ed.

CLASSIFIED INFORMATION

by Jack Stuster

Human factors engineering emerged as a professional discipline in response to the urgency to improve the performance of people and their machines during World War II. Many of the founding members of our Society contributed immensely to that effort, and many others have followed in the tradition of providing research and design support to the armed services.

Conducting human factors research for the military can be exciting but often is made difficult or frustrating by the constraints imposed by dealing with classified information. I learned a lot about this topic while conducting a series of studies concerning the work performed by U.S. Naval Special Warfare (NSW) personnel, which include special boat crews, Navy SEALs (for Sea-Air-Land), and the pilots and navigators of Swimmer Delivery Vehicles (SDVs). SDV crew also are SEALs but have specialized in the operation of submersible craft that can be launched from surface vessels or from the deck chambers of specially configured submarines and are used to insert NSW personnel long distances into denied waters. I interviewed dozens of SEALs and SDV operators, observed them perform their work, compiled task and skill inventories, and conducted formal analyses that involved the participation of hundreds of NSW personnel. I then developed a guide for designing equipment and procedures that are intended for use in the extreme environments in which NSW personnel routinely operate (i.e., underwater and in extreme cold, heat, altitude, and danger). The document described human capabilities, limitations, and the effects of stressors on sustained performance. It also included 100 design recommendations for many specific items of equipment and transportation.

The research was interesting, and I was genuinely impressed by the high levels of skill and motivation of the NSW personnel, from the most recent graduates of BUD/S training to the highly experienced Master Chiefs and Warrant Officers, who were reluctant to discuss their experiences because most of what they do is classified. I lost track of the number of times I was told, "I could tell you, but then I'd have to kill you." The stories eventually flowed, as if released by a floodgate, after I had demonstrated a legitimate "need to know."

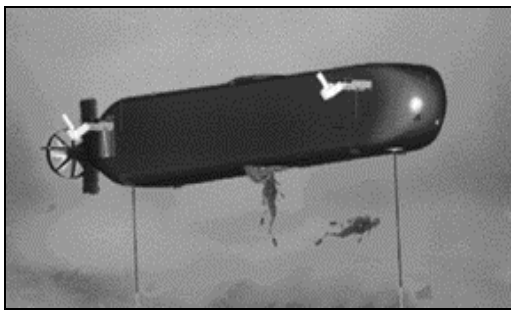


Jack Stuster

Several common themes emerged from the interviews. For example, I found that a disproportionate number of SEALs had endured substantial adversity during their childhoods, which might have predisposed them for the monumental perseverance required to survive the infamous BUD/S training. The bodybuilders, athletes, and others for whom success usually comes easily tend to drop out, which contributes to the SEAL belief that success in the field is 10% physical and 90% mental.

As a consequence of my research and development of the design guide, I was asked to speak to a group of managers and engineers about the importance of considering human factors issues when designing equipment for use in extreme environments. The audience was skeptical, and one man even asked the rhetorical question that defines popular ignorance about our discipline: "Isn't this really going to be about common sense?"

My response included a description of a limpet attack, which is the basic operation of the NSW repertoire and a mission for which all SEALs are trained. It involves swimming a long distance at night in cold, turbid water to reach the hull of a ship in an enemy harbor. The swimmer attaches the mine to the hull, sets the timer on the detonation initiator, then departs quickly. I described how setting the clock is made difficult by the bulky gloves that the swimmer must wear to prevent hypothermia. It was at this point that the engineer who had asked the “common sense” question raised his hand, this time to ask, “You mean they don’t set the timer while they’re on the surface before putting on their gloves and entering the water?” I recited the several reasons that prevent the swimmers from setting the timer until they are actually under the target, to which the engineer responded (unimaginatively), “Well, I guess it’s back to the drawing board for us.” He was the designer of the next-generation detonation initiator and had just failed the common sense test.



I received a call a few years later from Navy human factors specialist Rich Roesch to inform me that several of my design recommendations had been incorporated in a new, high-tech SDV that had just been launched. I was delighted to learn that I had contributed to such an important project and asked eagerly, “Which recommendations were used?” His answer was disappointing, but not unexpected: “I can’t tell you. That’s classified information.”

STEALTH HUMAN FACTORS by Rodger Koppa

When I became involved in the Apollo lunar landing program as an on-site GE contractor at what is now Johnson Space Center in Houston, I was cautioned by fellow contractors not to reveal my psychology background to the astronauts with whom I was in daily contact. The astronauts tended to associate psychologists with white coats and medical people, and white coats sometimes made trouble for pilots! I had been practicing human factors for about six years by then and was very proud of my then-young field. But, I kept mum as I worked crew-spacecraft interface problems and then transitioned into helping to plan lunar surface operations and training the Lunar Module astronauts to carry out those procedures. One day, Fred Haise (Apollo 13 and backup 16) asked me pretty point-blankly, “Just what is your background—what are you?” I improvised, “Oh, I’m a time-and-motion study specialist.” From then on, I was “time-and-motion study man.” That’s part of industrial engineering, in which I had no background whatsoever. Today, human factors and ergonomics is a recognized field at NASA-JSC, with laboratories and training facilities. After Apollo, I earned a PhD in industrial engineering and became kind of a “time-and-motion study man,” but during the Apollo Program I was one of the stealth human factors guys!

A FAILURE TO COMMUNICATE

by Jack Stuster

It required months to refurbish the orbiter between launches during the early days of the space shuttle program, instead of weeks, as had been planned. Then, a series of accidents, culminating in the deaths of two technicians while conducting tests inside the engine compartment, prompted Rockwell International to ask Anacapa Sciences for an objective, outside opinion concerning the problems. I had been hired only a few months previously (November 1981) and was honored when Doug Harris selected me to accompany him to the Kennedy Space Center, where we reviewed procedures and incident reports, observed task performance, and interviewed dozens of workers, from the director of launch operations to the folks who swept the floor of the Vehicle Assembly Building. We discovered many systemic procedural and cultural problems that contributed to errors and delays. Perhaps most revealing, we learned that engineers consistently refused to discuss the feasibility of change orders when they were approached by technicians, even though the technicians were highly experienced (some having worked on space craft since the Mercury program) and most of the engineers had never actually seen the hardware themselves. As a consequence, weeks routinely were wasted while attempting to implement impossible modifications to the orbiter.

Among our recommendations, presented in 22 categories, was the obvious suggestion to add a senior technician to the “chop chain” of reviewers who must approve a change order before it is sent to the floor of the Shuttle Processing Facility. Several additional recommendations also were intended to address the institutional obstacles to communications and cooperation that were identified by our research. We were delighted to learn several months later that many of our recommendations had been implemented and that they had contributed to a measurable reduction in critical incidents and improved orbiter turnaround performance. It also was revealed to us at that time that the Rockwell managers had expected the product of our research to be a motivational poster, rather than actual changes to the manner in which work was performed.

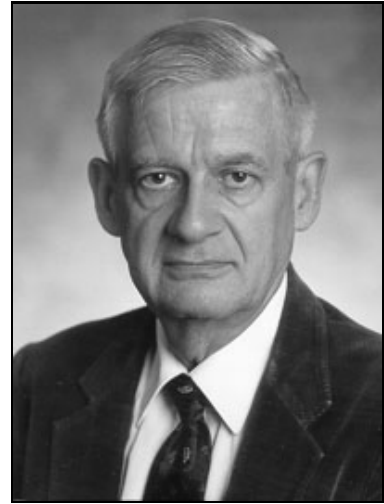
The institutional and “cultural” barriers to communication that we discovered during our study of orbiter turnaround procedures in 1982 are disturbingly similar to those identified in subsequent years as contributing factors to the losses of both *Challenger* and *Columbia*.



PUSH FORWARD TO GO, PULL BACK TO STOP

by Rodger Koppa

About 20 years ago a great controversy raged in the very small teapot of automotive adaptive equipment for drivers with disabilities: Which way should a powered servo control for gas and brake move? Mechanical controls, simple levers and rods attached to the pedals, worked in a push-pull fashion: push for brake and pull toward the driver for gas. Some controls substituted a right-angle pull-down for gas, or even a rotary motion like a motorcycle throttle, but all mechanical controls had push (away from the driver) for brakes. I remembered a committee on which I served during the Apollo program where the same question came up for motion conventions for the “joystick” on the Lunar Rover. We invoked the *Human Engineering Guide for Equipment Design*, the forerunner of MIL-STD-1472 (*Department of Defense Design Criteria Information Report: Human Engineering*), to follow what pilots were accustomed to doing: shoving the control in the direction they wanted to go! Push forward for go, pull back on the handle to stop. Most drivers with severe disabilities were using power wheelchairs, and their joystick controls were set up the same way as the Lunar Rover: push the control in the direction you want to go. The argument was that servo controls should work like mechanical hand controls because drivers were used to them; however, most drivers for whom servo controls were provided had never used mechanical controls because their disabilities were too severe.



Rodger Koppa

The automotive adaptive equipment industry specifically embraced MIL-STD-1472 and adopted the Lunar Rover convention, with provision for special cases in which driver expectancies were to push for brake and pull for gas, or where vehicle dynamics might cross-couple with control inputs. The Human Engineering Standard is now routinely invoked or referenced in automotive adaptive equipment-related state and federal standards, SAE Recommended Practices, and industry guidelines.



Marion Knowles and Smoke Price (1985)



Chuck Hopkins, Gloria Grace,
Wes Woodson, and Stan Deutsch (1972)

JOIN THE HUMAN FACTORS PROFESSION AND SEE THE WORLD

by Joseph L. Seminara

I have always had the itch to travel and see the world ever since I was a boy in Brooklyn confined to the excursion limits of a New York City subway system and a ferry to Staten Island. When I was an undergraduate senior at New York University, I took an exam given by the State Department to select candidates for foreign country postings. There were hundreds of applicants, and regrettably, I was not one of the chosen few. However, when I embarked on my Human Factors Engineering career I never lost sight of travel opportunities that complemented my HFE interests. In the early 1970s, upon returning from a vacation trip to Eastern Europe and the Balkans, I had lunch with Jerry Lucas, then with the Stanford Research Institute. I described the wonderful experiences that we had in Romania when our bus broke down and how the natives treated us with remarkable hospitality. I vowed that I would return to Romania when I retired and learn more about that country. Jerry then told me that I didn't have to wait that long. He informed me of the National Academy of Sciences (NAS) exchange program for scientists in the USA, Eastern Europe, and the USSR.

I checked into the NAS exchange program, and my family and I soon found our way to a six-month stint in Bucharest hosted by the Romanian Institute of Psychology. I lectured on American human factors programs and gathered information on Romanian research efforts. My Lockheed employer was pleased to see me take this assignment because at that time the aerospace industry was very sick and work was sparse. This visit, and a side trip to meet a ton of relatives in Italy, was so much fun that several years later, I proposed to the NAS and was granted a six-month assignment in Bulgaria. I also learned that there was another agency that sponsored similar exchanges, the International Research and Exchanges Board (IREX). In subsequent years, between NAS and IREX programs, I was able to conduct exchange visits to the USSR, Czechoslovakia, Poland, Hungary, Yugoslavia, and the German Democratic Republic.

In the mid-1970s, my human factors research dealing with power plant control rooms and plant maintainability, sponsored by the Electric Power Research Institute (EPRI), gathered international attention, especially after the Three Mile Island accident. The Israeli Ira Memorial Foundation, headed by Sascha Gertzberg, extended invitations to conduct a series of workshops on human factors aspects of control room design and maintainability. These two-week workshops were attended by power generation, water industry, and chemical plant personnel, among others. It was very satisfying to see recommendations implemented in actual plant designs on each successive visit. A side benefit of these workshops was the opportunity to jump off to the Kenyan game farms and the marvels of ancient Egypt. Also, during the 1980s, the International Atomic Energy Agency (IAEA) designated me an expert in human factors in power plant control rooms, and I made several visits to Korea (after stopping off in Japan and Hawaii for fun) to review their control rooms and recommend enhancements. Similarly, workshops were conducted in Sweden that were sponsored by the Swedish Power Board, and, under the auspices of the General Electric Company, I reviewed several Taiwanese power plant control rooms. These reviews led to follow-up visits to conduct workshops on control room review and enhancement possibilities. I quite naturally stopped over in Bangkok to recover from all the arduous labor in Taiwan.

I hope that I have inspired those among my colleagues with itchy feet to explore some of the international travel opportunities that I have enjoyed.

INITIATION INTO THE HUMAN FACTORS COMMUNITY

by Charles Holmes Irwin

Chance played a greater role in my choice of professional direction than I like to think. Shortly before I graduated from Stanford University in 1954, during a moment of panic as to what awaited in the “real world,” a kindly instructor in psychology (Robert Irwin, no relation) led me to a posted announcement of an assistantship available under an Office of Naval Research grant at San Diego State College. I was accepted into the psychology master’s program with half-time employment to develop bibliographic material for use in creating *The Human Engineering Guide to Equipment Design*. While my contribution was not specifically identified, this work was ultimately published under the authorship of Woodson and Conover and became a landmark in the emerging human engineering literature. The academic program led to my degree in industrial and experimental psychology. Abstracting countless scientific articles for potential use in the *Guide* was truly an education as well as an initiation into the human factors scientific community. In addition to curricular fundamentals, the literature analysis provided an in-depth exposure to the basic and applied research that was the foundation of this new field of human engineering.

Following completion of the bibliographic work, I was assigned under the ONR grant to assist David Craig and Mal Lichtenstein in the Man Machine Dynamics Interaction Laboratory at the Navy Electronics Lab (NEL), in San Diego. Arnold Small was director of the NEL human factors program. Not only was that assignment fertile ground for my master’s thesis, but it also brought me into contact with others on the staff, including Max Lund, David Meister, John Stroud, and Carroll White. Arnold later



Charles Irwin

hired me (1957) to join the NEL staff. Thus was launched my career of 30 years in the profession. In addition to meeting and working with the staff, I met my wife of now nearly 50 years, Willa Brice. She also was a student doing data reduction and analysis for David Craig. Finally, among our distinguished visiting mentors to NEL in the summers around 1956 and 1957 were Alphonse Chapanis, Paul Fitts, and Walt Grether. Very close to that time, about 1958, I joined several NEL colleagues including Charlie Harsh, Dick Coburn, and Wes Woodson for a drive to Santa Monica. There, at The Rand Corporation headquarters (or its newly formed scion, Systems Development Corp.), we met for the very first formative session on the West Coast with Mac Parsons and others in what was then to become The Human Factors Society of America.

Following a brief excursion into space technology at Convair, General Dynamics, to work on Atlas Missile crew proficiency measurement, I proceeded in 1960 to the Naval Missile Center, in Point Mugu, California, to join Lloyd Searle’s Human Engineering program. The Airborne Tactical Data System (ATDS) was coming under test and evaluation there; it was a natural progression from a shipboard tactical data system to an airborne one. However, it was frustrating to see the lack of objective engineering standards for assessing operator performance.

I transferred to Navy Headquarters, in Washington, D.C., in 1965 to take over from Eddie Kemp as Human Factors Coordinator for Naval Ships Systems Command (NAVSHIPS). While I was looking after (quasi-managing) the interests of human factors programs at several Navy labs, Dick Coburn initiated an effort at NEL to develop and publish a design guideline/standard for Navy equipment. My part in that effort was to shepherd the draft standard through the NAVSHIPS engineering codes for approval and sign off, and ultimately to see to its publication. It was the first official Navy human engineering directive, *NAVSHIPS Design Standard 1472*. Subsequently the standard was revised and reissued as Mil-H-24148, *Human Engineering Requirements for Bureau of Ships Systems and Equipment*, 15 November 1965. That specification was ultimately incorporated into and superseded by the first DoD-wide human engineering specification, Mil-H-46855, *Human Engineering Requirements for Military Systems and Equipment*, 16 February 1968. It is noteworthy that the DoD specification incorporated NAVSIPS Mil Std 1472.

Incidentally, while specifications and standards require broad engineering review and signatures, Admiral Rickover (father of the nuclear Navy whose office was on the floor above and directly over my little cubicle) would never approve or sign off on anything having to do with psychology or human factors. Old timers will remember the Admiral's comment comparing human factors to "teaching one's grandmother to suck eggs." He did not sign, thus exempting the nuclear Navy. One expects things to have changed over the years.⁹



⁹ Admiral Rickover's infamous letter is reproduced on the next page. – Ed.

ATOMIC ENERGY COMMISSION
WASHINGTON, D.C.

January 10, 1970

MEMORANDUM for the CHIEF OF NAVAL MATERIAL

Subj: Human Factors

Ref: (a) Proposed NAVMATINST -- Human Factors dated 15 October 1969

Reference (a) which was forwarded to me for comment, it is a proposal to establish and promulgate a HUMAN FACTORS PROGRAM on all Research, Development and Engineering Programs as well as Production Programs under the cognizance of the Naval Material Command.

My comments apply specifically to the work under my cognizance-design, development and construction of nuclear power plants. However, these comments are generally applicable to all shipbuilding.

It appears that the HUMAN FACTORS "program" is another of the fruitless attempts to get things done by systems, organizations, and big words rather than by people. It contains the greatest quantity of nonsense I have ever seen assembled in one publication. It is replete with obtuse jargon and sham-scientific expressions which, translated into English from its characteristic argot-where this is possible-turns out to be either meaningless or insignificant. It is about as useful as teaching your grandmother how to suck an egg.

Those who compiled the instruction demonstrate a lack of knowledge as to how work in this real world is actually done. They assume that engineers who design naval equipments have no awareness that these are to be operated and repaired by average human beings, and for this reason, they need the guidance of Human Factors "engineers" with the elucidations such "engineers" will give, the simplest everyday problem will be come incomprehensible.

This proposal is typical of present day social "sciences" concepts-that one needs no detailed expertise in a given field; he can with little or no training or experience "solve" a problem by the exercise of his intellect and the use of concepts. This may be true in pure sciences; it certainly is not in engineering. To advocate the contrary demonstrates a lack of insight on how engineering problems are actually solved.

To implement the Human Factors "program" will require about as many additional people as now are engaged in doing technical work. Now large organizations-a vast new social "science" bureaucracy contributing absolutely nothing to the building of ships-will have to be set up in the Headquarters of the Naval Material Command, in all the Systems Commands, and in contractor organizations. Should Human Factors succeed in its "objective" it will likewise succeed in stopping all useful work.

The proposed directive cannot be undertaken by rational persons interpreted in getting the job done; it cannot be accomplished; it will add another monstrosity to our already vast administrative burden; it will increase the cost of shipbuilding; it will make us a laughing stock.

I recommend that the Human Factors "program" be forgotten as fast as possible. There will of course be objections by those who by now have already established a vested interest beachhead, but the good of the Navy should prevail.

/s/ H. G. Rickover

cc:

VADM J. D. Arnold, MAT 09
RADM D.G. Baer, MAT 01
RADM N. Sonenshein, SHIPS 00
RADM R. C. Gooding, SHIPS 09
RADM J. Adair, SHIPS 01
CNO



Thirteen Former Presidents of HFES

**TALES FROM
THE HUMAN FACTORS AND ERGONOMICS SOCIETY**

SERENDIPITY

by Harry Wolbers

I searched my old files and found a copy of the invitation to the Constitutional Convention in Tulsa in 1957. It lists the proposed slate of officers and committee members, and I am sad to report that nearly all of these folks have passed on. Only two of this group are still members of HFES—John Senders and Ken Teel. If either of them will be attending the Annual Meeting, I am sure they would have interesting comments to offer.

A summary of the various meetings in 1952, 1953, and 1956 leading to the First National Meeting and Constitutional Convention of the Human Factors Society of America were well documented by Dave Meister and are summarized in the introduction to the *HFES Annual Directory and Yearbook*. However, I can offer some insight as to why the meeting was held in Tulsa.



Harry Wolbers

The military agencies of the government provided the principal focal points for people who were interested in the design and development of man/machine systems during the early 1950s. On a national level, one of the main symposia was the annual Human Engineering Conference, which was sponsored by the Navy Department's Office of Naval Research (ONR). Max Lund was the key player at ONR, in this regard, and also had personally been involved in discussions in previous years concerning the potential value of a formal organization to bring people together from various disciplines involved in man/machine systems and to provide a forum for information exchange.

Douglas Aircraft Company was the Prime Contractor for ONR's Integrated Instrument Development Program, which was directed toward the goal of achieving a true all-weather flight capability for Navy aircraft. When the Army joined in the support of the program, it became known as the Army Navy Instrumentation Program (ANIP). The Douglas Aircraft Company agreed to host the annual ONR Human Engineering Conference, scheduled for September 1957, because it was to include discussions of the ANIP. The company's Tulsa Division was assigned the task because the location would provide a central and more convenient meeting point for East Coast, West Coast, and mid-country participants. Arrangements were made to hold the meeting at the Mayo Hotel in Tulsa, Oklahoma, on Thursday and Friday, September 26 and 27, 1957.

The serendipity provided by the attendees coming to the Human Engineering Conference in a geographically central location, combined with the timing of the emerging movement toward forming a Human Factors Society of America, provided an ideal opportunity to call for and schedule a Constitutional Convention in conjunction with the ONR Human Engineering Conference. Accordingly, the First National Meeting and Constitutional Convention of the Human Factors Society of America was scheduled for the 25th of September, the day before the ONR Human Engineering Conference was to convene at the Mayo Hotel in Tulsa. The rest is history!

THE TULSA MEETING

by Ezra Krendel

I was the Head of the Engineering Psychology Branch of the Franklin Institute Research Laboratories, a non-profit research facility in Philadelphia that no longer exists. At the time, I had two contracts with the Department of the Navy for which the final reports were *Desk Calculator Determinations of Human Dynamics*, Psychological Psychology Branch, ONR, October 1957; and *Manpower*, Psychology Branch, ONR, January 1958. Max Lund was head of the Human Engineering Branch of ONR's Psychological Sciences Division at this time. Max was the mover behind the Tulsa meeting. He invited me to attend the meeting in Tulsa and arranged my passage on a MATS flight. I have no recollections of paper presentations or technical discussions in Tulsa, but I do recall preparing for the meeting in "dry" Tulsa by buying a bottle of scotch at Central Liquor in Washington, D.C., before departing for Oklahoma. To my surprise, when I arrived at the Tulsa hotel, the doorman offered me my choice of whiskeys. He held his great coat wide open, revealing an array of pocket flasks of name brands neatly arranged on either side! The prices, as I recall, were as good as or better than Washington's.

I don't know why Max chose Tulsa for the meeting. I think he wanted to escape from the constant interruptions in Washington; he wanted a central location; and it was easier to arrange a MATS flight to Tulsa than to choice locations such as San Francisco. My dim recollection is that forming a new society was not on the preflight revealed agenda of the meeting. I think I attended because when you are a DoD contractor and you are invited to a meeting by the sponsor, you go. I also was sure to meet people I knew and it seemed worthwhile. I regret that I neglected to sign up as a founding member because it was important to Max and he had devoted so much effort to the event.

THE TULSA MEETING

by H. W. Sinaiko

I attended the Tulsa meeting that led to the formation of the Human Factors Society. At the time of the meeting, I had just moved from the Naval Research Laboratory in Washington to the Control Systems Laboratory at the University of Illinois. Unfortunately, I can't remember much about the content of the meeting in Oklahoma. However, on the return flight from Tulsa, my seat mate (name long forgotten) and I considered compiling a set of papers we felt were seminal to the emerging human engineering, later human factors, field. I subsequently edited a book, *Selected Papers on Human Factors in the Design and Use of Control Systems*, published by Dover Press in 1961. The contributing authors were Alphonse Chapanis, on the analysis of errors in man-machine systems; H. P. Birmingham and F. V. Taylor, on a design philosophy for man-machine control systems; Jack Adams, on the design of dynamic flight simulators; G. H. Mowbray and J. W. Gebhard, on the senses as informational channels; John Lott Brown, on acceleration and human performance; N. H. Mackworth, on the measurement of human performance; and Paul Fitts and R. E. Jones, on the analysis of factors contributing to pilot error in the operation of aircraft controls, and the interpretation of aircraft instruments. Edward Buckley and I wrote the introductory chapter, on the human as a component in large systems. I can only speculate that at least several of the book's topics were addressed at the Tulsa meeting.

LOCAL CHAPTERS AND PROFESSIONAL AFFILIATIONS

by John Duddy

In the wake of the Society's Annual Meeting in Palo Alto, California, in 1963, I volunteered to 1) develop a *Handbook for Organizing Local Chapters of the Society* and 2) develop a collaborative, interdisciplinary relationship with the Industrial Designers Society of America (IDSA). The *Handbook* was based on our experiences organizing the Bay Area Chapter to assist in planning and supporting the Annual Meeting. That effort also involved the creation of archetype bylaws for new chapters; Stan Roscoe was particularly interested in that aspect of the organizational effort, and he provided encouragement and yeoman service in creating that document. As chairman of the new Affiliations Committee, I assisted a number of interested groups in forming new professional chapters in various cities around the country. Many are still active and thriving, making important contributions to the professional lives of their members and the organizations that employ human factors engineering and ergonomics specialists in their communities.

As part of an overall plan to foster common interests, and perhaps future collaborative national meetings between the HFES and IDSA, I served as the Special Editor of an issue of *Human Factors* devoted to industrial design, and invited practicing designers to write papers about projects and issues I believed would be of interest to our membership in HFS. The lead article was written by Henry Dreyfuss, one of the founders and most famous practitioners of industrial design as a recognized profession. This issue was published in August 1966 as Vol. 8, No. 4, and was well received by our members and the Board of Directors of IDSA. As a result, I was invited to be the Guest Editor of an issue of the *Journal of the Industrial Designers Society of America* by its editor, George Nelson, and Dick Latham, the Chairman of the Board of IDSA. It was a labor of love. I was able to assemble a constellation of stars to write for this issue: Ross McFarland, Bill Knowles, Dave Meister, Wes Woodson, and Jack Kraft, plus some promising specialists in the application of human factors in small aircraft, pleasure boat, and crew station design. This issue was published in June 1970, as Vol. 3, No. 2. In later years, this particular intersociety relationship has been fostered by one of our special interest groups.



John Duddy

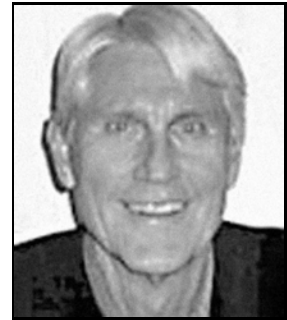
In the wake of those efforts, I was invited to join the Editorial Board of *Human Factors*, and also volunteered to establish a new Intersociety Affiliations Committee and serve as its first Chairman. The goal of this new committee was to pursue collaborative relationships with other learned and professional societies, and to identify HFS members who would then represent our interests in and to those organizations. Personally, my first objective for the committee was to apply on behalf of our Society for affiliation with the American Association for the Advancement of Science, the distinguished society of societies. This effort was ultimately successful and led in following years to the affiliation of HFS with a number of other national and international organizations.

BEWARE OF THE SWEATY PALM

by Doug Harris

Some thought that it was over the affections of a cocktail server at the hotel. Others would say that a heated discussion of confidence intervals versus null hypothesis testing just got out of hand. But it wasn't like that at all.¹⁰

We were at the 10th annual meeting of the Human Factors Society (Ergonomics was not part of the name then) at the Disneyland Hotel in Anaheim, California. I was on the steering committee for the event, serving as public relations chairman. The opening reception was in full throttle, having been helped along by several pre-receptions held in hospitality suites, as was the custom back in the "candy is dandy, but liquor is quicker" days.



Doug Harris

I was making pleasantries with a small group of friends in the center of the ballroom when a male person unknown to any of us barged into the center of our circle and demanded to shake everyone's hand. When it was my turn I refused, stating that I never shake a hand with a sweaty palm. The comment appeared to have the desired effect as the intruder retreated, seemingly humiliated and defeated. But a little later, in the middle of a hilarious anecdote, I was spun around from behind and felt a fist smash into my face.

As a high school wrestler I wasn't much good—never made the varsity and lost most of my junior varsity matches. I did develop some skill at takedowns—dropping to the knees, lifting the legs of the opponent, and slamming his back to the mat. That's what I did to my assailant, dropping my glass (which broke) and spilling its alcoholic contents in the process. Before I could inflict any real damage, two burly "Good Samaritans" grabbed me and held my arms behind my back. Memory of what happened next remains a blur, but not the result—my nose was sliced open and blood was flowing freely. Witnesses reported later that my takedown victim had grabbed my broken glass and attacked my face with it.

The next day, while driving to Los Angeles International to pick up our dinner speaker, consumer activist Ralph Nader, I reflected on the evening's events. I had been taken to the hospital and fixed up by the on-call plastic surgeon—56 stitches, he said. (The concept of an on-call plastic surgeon was new to me; I had thought one of the reasons for entering that profession was never having to be on call.) My nose and half my face were covered by a large bandage, and I was thinking about what I would be telling Nader when he asked what had happened to me. I was considering a few embellishments that might actually make the story more entertaining during the hour's drive back to Anaheim. I might tell him the joke that was making the rounds: "Where is our public relations chairman? Oh, he is over there on the ballroom floor fighting with one of the meeting attendees." But Nader never asked.

¹⁰ Three accounts of the same event are related on this and the following two pages. — *Ed.*

1966 HFS CONVENTION AT DISNEYLAND: PUBLIC RELATIONS CHAIRMAN INVOLVED IN HOSPITALITY HOUR BRAWL

by Robert Besco

When the HFS chapter that was scheduled to host the 1966 Annual Symposium canceled its commitment, Julien Christensen, President of the Dayton Chapter and President-Elect of the Society, called me, the Chair of the LA Chapter, to ask if we could put together a committee to organize and host the Symposium. We had many prominent HFS founders and officials in the LA area who could form the nucleus of a steering committee, so we agreed to host the meeting. The members of the steering committee are listed below.



Robert Besco

Chair: Charles O. Hopkins
Program: Kenneth S. Teel, Alan A. Burrows, William C. Biel
Public Relations: Douglas H. Harris
Local Arrangements: Robert E. Blanchard, James D. Goff
Finance: Robert O. Besco Registration: Richard M. De Callies
Exhibits: Joseph W. Wulfeck Sponsors: Richard Kaehler
Publications: Leland G. Summers Reprint Sales: Joel P. McCalpin

The Committee organized and hosted a very successful meeting of the Society and the large attendance provided revenue that allowed the 10th Annual Meeting to become first to show a significant financial surplus for the Society's operating budget. Marian Knowles used the surplus of several thousand dollars to upgrade the equipment and facilities of the Central Office, to the permanent benefit of HFS.

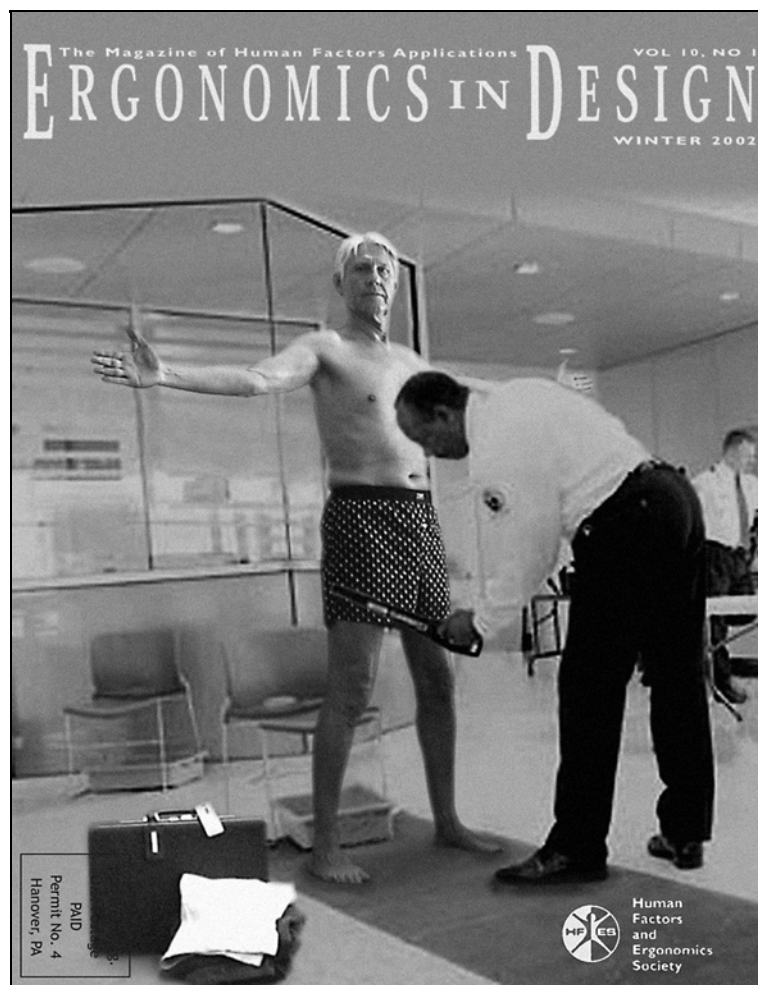
As a special event to entertain the attendees at the reception, the Steering Committee's Public Relations Director, Doug Harris, arranged and participated in a special bare-knuckled fist fight. Doug allowed a toilet-mouthed assailant to throw the first punch, and then he decked him with a well-trained, Navy commando, hand-to-hand self-defense blow to the jaw. Two of Doug's friends feared for the safety of the assailant and grabbed Doug's upper arms to prevent him from doing irreparable damage, not only to the assailant but to the public image of HFS.

It was unfortunate, but the assailant took the opportunity of Doug's temporary restraint to jump to his feet with a cocktail glass in his hand and strike Doug directly in the face with it. The glass shattered and cut Doug's nose deeply; he was gushing blood. Doug's face was in need of serious medical attention, and the assailant was in need of incarceration.

Thanks to Charlie Hopkins (HFS President 1973–1974), Doug got what he deserved at the emergency room of a local hospital, and thanks to the Anaheim police force, the assailant got what he deserved. The honor and public relations image of the Society was preserved by Doug's adept and instantaneous response to the first blow. Never in the history of the Society have so many had their professional image threatened so much by so few without permanent damage to either professional reputation or physical beauty. The message to be handed down to future generations is DMWD: Don't mess with Doug.

THE “HARRIS INCIDENT” by Bob Blanchard

Bob Besco’s account of the “Harris Incident,” those many years ago (40 this year), is essentially as I recall it, except I remember the cut on Doug’s face being caused by a sizable ring his opponent was wearing. I don’t remember the glass, but maybe so. That the event is still newsworthy is due largely to the disbelief that Doug would ever have become involved in fisticuffs at a human factors convention! Very uncharacteristic. As I recall, though, his *casus belli* was entirely justified. Another noteworthy event of the 10th Annual Meeting was that the guest speaker was Ralph Nader, shortly after he published *Unsafe at Any Speed*. He was a very interesting speaker and charismatic individual. Of course, none of us foresaw his unfortunate involvement in the 2000 presidential election.



This “cover” was used to introduce Doug Harris 37 years after the original “Harris Incident,” as he received the Best EID Article Award at the 2003 HFES Annual Meeting for his article, “How to *Really* Improve Airport Security.”

THE SPLASH AT MYRTLE BEACH

by **Richard J. Hornick**

As a result of the Three Mile Island Accident, HFS coordinated with the Nuclear Regulatory Commission to appoint a select study team to evaluate human factors design and process issues in the nuclear power industry, especially in control rooms. I was part of that select team, along with Harry Snyder, Bob Mackie, Chuck Hopkins, Bob Smillie, Smoke Price, and Bob Sugarman. We delivered our three-volume report to the NRC in 1982.



Richard Hornick

The team attended a nuclear engineering conference in Myrtle Beach, South Carolina, in 1981, and several of us brought our wives with us, including Chuck Hopkins and myself. One evening, as we met to go to dinner together, Bobbie, Chuck's wife, was late in joining the group. So, we got to the restaurant late, but it was no big deal. Even though Chuck and Bobbie got along very well generally, on that evening Chuck engaged in a constant harangue about her being late to join the group. After dinner, we returned to the hotel and lounged around near the swimming pool, relaxing after a day of work and pleasure. Even at that time, near midnight, Chuck kept on needling Bobbie.

Well, we ended the evening by walking back to the hotel; the walkway was next to the pool. I happened to be next to Chuck. The temptation was too great to resist. I shoved him into the pool with all my resolve! He popped up, sputtering, obviously surprised. Consider that he was wearing a sport jacket, nice shirt, watch, good shoes, and carrying a wallet... and was in about eight feet of water. Bobbie, having had enough of the harangue, grabbed me, gave me a big hug, and exclaimed, "Thank you, thank you!!!"

The next day, Chuck vowed to get even with me when I'd least expect it. Every time we met after that, during the remainder of the contract with the NRC as well as at every annual meeting of the Society, he repeated the threat! Unfortunately, he died this past year, and he never evened the score. We remained good friends through all those years. But, I'll always remember the splash at Myrtle Beach!

TELEPHONE CALLS TO THE HFES OFFICE

by **Lynn Strother**

We do get some bizarre calls, for example, "There's a possum in my back yard," "My rabbit died," and "Do you have any puppies?" This is because, for some reason, Directory Assistance operators often refer callers to us when actually they want the Humane Society.

Gene Shalit called me once. I just picked up the phone and he said, "This is Gene Shalit." He wanted information on HFES, which I provided, but never received any feedback that he used anything on the *Today Show*. But it was great to talk with him.

HOW I JOINED THE STAFF OF HFES

by Lynn Strother

It was June of 1981, and I was a young mom with a two-year-old toddler. I was itching to get back to work after having had the luxury of mostly taking two years off, with only a little freelance writing and editing to keep me in the job market. I saw an ad in the classified section of the local newspaper for a production editor for a scholarly journal. This was right up my alley, as most of my experience since college had been in scientific and technical publishing. So, I called the number and spoke with Marian Knowles, the executive administrator of the Society. The location was great—only five blocks away, and the schedule of 12 to 15 hours per week was perfect. Marian asked me to come over for an interview.

At the office, which was located above a row of retail shops on Montana Avenue in Santa Monica, I saw a small sign on the front door—"The Human Factors Society, Inc." I immediately suspected that this was yet another of the many organizations in California at the time, such as EST, that were involved in the "human potential movement." I was even further confused when I learned from Marian that the field involved a blend of engineering and psychology. But the interview went well, and a few days later I started my career with (then) HFS.

At that time the staff was very small—just Marian, a part-time receptionist, a part-time membership assistant, and me. There were no computers, no fax machines, not even credit card payment for dues! I believe we had a photocopier and some IBM Selectric typewriters, but other than that, the hold button on the telephone was the most complicated piece of technical equipment.

My first HFES annual meeting was the 25th, in Rochester, New York. For those who were there, it was unforgettable because the fire alarms kept going off in the middle of the night, and everyone had to troop outside in their pajamas. Also memorable was the opening reception in Rochester's beautiful City Hall, where some members were seen holding a mock city council meeting in the chambers.

Over the next six years, the job grew. We took on the production of the *Bulletin* and the annual meeting proceedings, and I gradually became a full-time employee. I hired a part-time editorial assistant to help with the expanding role of what became the Publications Department. We got our first computer around 1983. It cost more than \$20,000 and had 64K of memory. And a Space Invaders game.

Since then, we've grown a lot, and computers and the Internet have dramatically changed how we do our jobs at the Central Office. Marian retired in 1989, and I became HFES's executive director on January 1, 1990. But we are still in the same location, which has turned from a sleepy little street with a lot of mom-and-pop shops into one of the trendiest shopping areas in the Los Angeles area. My little toddler is now a graduate student in Northern California. But I still live five blocks away, and whenever I go to an HFES Annual Meeting and see so many familiar faces that I have known for so many years, somehow it seems that not much has changed at all.



Lynn Strother, Executive Director of the HFES, ready to start first grade during the month of the Society's founding.

SERIOUS BUSINESS

by Richard J. Hornick

Probably the most humorous and unexpected event that ever happened during an HFES Executive Council meeting occurred when Dave Post was President in 2001. Hal Hendrick and I were the instigators of a plot to stun the Council and challenge Dave Post's control of the meeting. At the end of the first of the two days of meetings, Dave made the mistake of making a remark about how smoothly things had gone and took some (deserved) credit for keeping things moving along without discord. Big mistake. That evening, after a few cocktails, Hal and I plotted an attack for the next day. We enlisted one or two other Council members to aid in the eventual deception.

About two hours into our second day of Council meetings, Hal made a verbal report; I commented negatively on his report; he rejoined; I escalated in decibels; he did the same; I insulted him; he accused me of not appreciating his efforts; and so it went for about a minute, then two, with both of our faces turning red. I could see Lynn looking aghast; Dave getting up and asking for order; then demanding it; then pounding the gavel over and over; and Nancy Larson (one of two collaborators) starting to make a comment; me, telling her to shut up; and Dave pounding and pounding the gavel to no avail until Hal and I, who had been sitting, then standing facing each other during the "confrontation," started laughing and embracing! Dave's complexion, which had turned white, started to return to normal as he gradually realized that he "had been had." The bulk of Council was NOT aware of the plot except for Nancy Larson and probably Barry Beith. Consequently, it was not only Dave and Lynn whose jaws had dropped! The balance of Council also thought somebody had flipped out here! In fact, I never saw eyes as large as Mica Endsley's as this was going on.

Comments from Council members ranged from nominations for Oscar awards to "I thought you both had totally lost it." Lynn believed that I had suffered an aneurysm, and she was utterly speechless as she watched the debacle. To this date, I am surprised that the wood handle on the gavel did not splatter as Dave repeatedly and forcefully pounded it on the table (after vainly hitting a water pitcher with it). Needless to say, Dave risked no further comments about harmonious deliberations during his presidency. From my perspective, this tale illustrates the inherent interaction of serious business with joyful and collegial humor based on mutual respect.

Hal Hendrick adds...

Richard has provided a reasonably accurate account of our EC meeting "incident" while Dave Post was President. About the only thing I can add is that, at the end, I said "1, 2, 3" and all of us involved yelled "GOTCHA"; then Richard and I embraced.

Lynn Strother...

I can still vividly recall how thoroughly flummoxed I was by these characters' performance. We should ask Richard about his acting career; he was well prepared for the role he played in this very funny episode in HFES history!

Dave Post...

During a break immediately before the prank, I encountered Richard in a hallway, hustling to check out of the hotel with his suitcase in tow. When he snapped at Hal, my first thought was that the exertion had induced a stroke that had affected his mind, so I became concerned. But when Hal responded angrily—which was totally out

of character—and then Barry Beith—who, like me, is very fond of Richard—started shouting at Richard, I was dumbfounded. I'd experienced a few tense moments in Council meetings, but never seen anything remotely like the riot that was unfolding. I became so desperate to restore decorum that I was truly on the verge of vaulting the table to douse Hal and Richard with the water pitcher I'd been banging when the culprits turned to me and shouted "Gotcha!"—much to my relief.

I've always felt honored that this group of people, for whom I have great respect and affection, took the trouble to haze me this way. And I look forward to honoring them someday, too! :>)

FRIENDLY PERSUASION

by Hal Hendrick



Julien Christensen (1986)

Another humorous incident that I recall occurred during the 1982 Annual Meeting in Seattle. A featured speaker for a session on Human Factors in Organizational Design and Management, organized by Ted Brown and myself, canceled at the last minute. Ted and I asked ourselves who might be able to step in at the last minute and fill the gap, and came up with Julien Christensen. Our next task was to convince him to do it. Accordingly, on the boat ride to our wonderful salmon dinner on an island the evening before, Ted and I found Chris and fed him three martinis at our expense. (Chris loved martinis.) With the mood now set, we hit him with our request. With a little more persuasion, he accepted and, the following day, he did a beautiful job winging it, based on his own extensive experience.

A FRUGAL FAUX PAS

by Stuart Parsons

I joined the Human Factors Society in 1960 and went to my first national meeting in New York City in 1962. Being young and naive, I let George Rowland and Jack Kraft talk me into being the General Chair for the 1963 meeting, which we held at Rickey's in Palo Alto, California. I had lots of great help from Joe Seminara and the newly formed Bay Area Chapter under John Duddy. Chuck Simon, who was then acting in the capacity of Executive Director, would call about once a week and tell us to be frugal and make lots of money for the Society. Paul Fitts was the President that year and came out in the spring from Michigan to check on our progress. However, being inexperienced and trying to save money, I didn't realize that we should reserve and pay for a suite for the President. Poor Paul arrived at the meeting and had to pay for his own room. He was such a gentleman that he never mentioned it to me, and it was only years later that I realized my terrible *faux pas*.

SCORECARD ON THE 1987 ANNUAL MEETING IN NEW YORK CITY by Ed Israelski

Among my most vivid memories of annual HFES meetings are those of the 1987 meeting that I chaired with the help of 32 very competent and hardworking members of the New York Metropolitan Chapter. This was also one of the early meetings where Steve Marlin's professional services helped make the meeting a success. The 31st Annual Meeting set a record with 1,350 attending. We chose to switch hotels in the preceding year because the originally booked hotel's rates climbed to \$165, a hefty sum in 1987. We got the rate down to a more affordable \$105 and treated some guests to examples of typical New York-style rudeness, which was delivered by the hotel staff, thereby meeting many people's prior expectations of the Big Apple. One singular event was Wall Street's "Black Monday" on the opening day of the meeting, when the stock market lost 23% of its value. This has remained the largest market downturn ever.



Ed Israelski

We only had one mugging, which was a fear the organizing committee had for attendees who were not city savvy. Fortunately, no one was hurt, and two undercover cops apprehended the perp. One was disguised as a bag lady and the other as a male hooker. Only in New York!

Another related memory was when I first made the case to have the annual meeting in New York at an earlier midyear Executive Council meeting. I was pitching the Big Apple against Baltimore and New Mexico. The New Mexico Chapter's presenter showed videotape extolling the virtues of Albuquerque and its Wild West history, complete with a mock cowboy shootout in the streets. I got a good laugh when I interrupted to say, "We have that in New York all the time." We got the nod to have the meeting in New York after Baltimore. A few Executive Council members were apprehensive.

I also have great memories of Bell Labs, which gave me my start in human factors after I was initially hired as a systems engineer to work on the ill-fated Picture-Phone video telephone system. John Karlin gave me a chance to intern and later stay in his historic department. John started the first HF group in industry after World War II at Bell Labs in 1948. I am most grateful to him and to my mentors in his department, who include Ed Klemmer, Tony Marsh, and Max Schoeffler. They all encouraged me to become active in the Society and urged me to attend my first HFS meeting, which was in Huntsville during the mid-1970s, and I haven't missed one since.

ANOTHER TOUCHING HFES MOMENT

by Dave Post

I was chairing the National Program Committee (NPC) at the 1994 Annual Meeting when fellow NPC member Jeff Kelley caught me in a hallway with the news that something important had come up.¹¹ We were all to convene at the HFES booth at noon for an emergency NPC meeting. I was accustomed by then to spending much of each morning putting out little fires and trying to help ensure that things ran smoothly, so I wasn't overly surprised. Still, we'd never needed an emergency meeting, so I was certainly concerned, especially because Jeff refused to describe the problem.

I arrived at the booth at the appointed hour, resigned to facing some weighty issue. Still, no one wanted to say what was up. Moments later, though, a cake was rolled in and everyone shouted "Happy birthday!" and sang the birthday song to me. I had quite forgotten that it was my birthday, but Lynn hadn't and had arranged this lovely surprise with the cooperation of the committee members. It was the most touching HFES moment I have experienced, and I'm not ashamed to say that it brought tears to my eyes. If I never receive any further recognition as a volunteer, that occasion will have been more than enough.



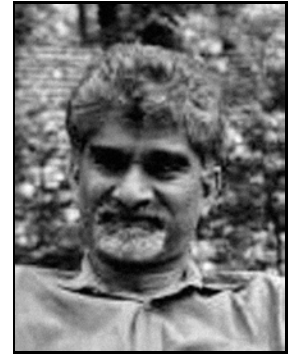
A Dozen Former Presidents of HFES

¹¹ The National Program Committee became the Technical Program Committee in 1995. – Ed.

THE HUMANE FACTORS OF BEING FIRST—AND LAST

by Raja Parasuraman

As the 50th anniversary of the Human Factors and Ergonomics Society approaches, many may be reviewing the achievements of its leaders—those who have passed, such as Paul Fitts and Donald Broadbent—as well as the current preeminent scholars in the discipline of human factors and ergonomics. Undoubtedly, Peter Hancock belongs in the latter group. As such, many of us would rate him at the top of the field, perhaps as *The First*? It is instructive, therefore, to retell an incident in which Peter was the opposite—*The Last*—and yet managed to transform his experience. I think the event shaped him in more ways than we realize, and emphasizes the importance of *humane* factors in one's scientific development (with apologies to Neville Moray, 1993).



Raja Parasuraman

The incident has been told many times, but many in the Society may be unaware of it, and given its hilarity, the tale is especially worth recounting. The event took place in the fall of 1983. The occasion was the Annual Meeting of the (then) Human Factors Society, held in Norfolk, Virginia. Peter had not yet made his mark on the field, being a brand new Assistant Professor at the University of Southern California. He had recently completed his PhD from the University of Illinois, Champaign. Peter was to give his first major talk at the Norfolk conference. It proved to be a memorable experience, though, as we shall see, for completely unexpected reasons.

Every graduate student or beginning faculty member knows the relief of being listed to give a talk on the first or second day of a conference, so that one can be done with it, rather than having to endure the anxiety associated with being scheduled on the last day. Peter was not so lucky. He not only had to talk on the last day of the meeting, he was scheduled to give the last talk of the last session. And in a further twist of cruelty, whereas all the last day sessions ended at 12 noon, *only his* session was scheduled to end at 12:30 PM!

Norfolk was then and is now a medium-sized city but not a bustling metropolis. Because flights were somewhat limited, especially to the West Coast, many last-day speakers had to give their talks and then leave without waiting for the end of the session. In Peter's fateful session, each speaker gave his or her talk and then apologetically and somewhat sheepishly headed for the exit to catch taxis to the airport.

As the session progressed, it became painfully clear that the people in the audience consisted mostly of the remaining speakers and the Session Chair! One by one, speakers left and the audience dwindled. Six, five, four, three... When Peter's turn to speak came, the Chair of the session (incidentally, a good friend both of myself and of Peter) rose to introduce him, and then apologized and left, saying that he was late for his plane. There was only one person left in the audience!

Now consider what you would do in similar circumstances. Would you continue with your talk? Or, would you tell the sole audience member, "Let's just forget it" or perhaps even, "Let's continue this in the bar"? But, Peter is no ordinary person, as we now know. He strode to the podium, determined to give his full 20-minute talk. In Peter's own words, "True to myself, I resolved to give full measure, and for the next 20

minutes, with unstinting effort, I endeavored to lay before my solitary listener the nuances of 'Space-time and motion study.'" (Hancock, 1999, p. 42).

Peter is justifiably proud of this presentation (Newell & Hancock, 1983), and moreover he tells me that over his long and distinguished career, this was one of the few proceedings papers for which he has received a reprint request! And his choice of topic—space, time, and motion—is especially pertinent. Given Peter's Minkowskian bent and predilection for curved time, the 23 years between then and now is but a small matter in the grand scheme of the space-time plane!



Peter Hancock

But back to the talk. And, then there was one. A middle-aged female audience member sitting at the back of the room, but listening attentively nonetheless. Peter patiently and systematically expounded further on space, time, and motion. At the end of his talk, the woman walked up to the front and said to Peter in a clear, loud voice, "Well, young man, I've only heard one or two talks at this conference, but yours was clearly the best." What praise! And what a vindication of Peter's unusual determination to go through with his talk under such difficult, stressful circumstances! (I'm sure this experience is a major determining factor in the genesis of the famous Hancock and Warm model of stress and sustained attention!).

But that is not the end of the story. As Peter basked in the glow of the effusive praise, he noticed that she was not wearing a conference badge and asked to which university she belonged. Her reply is seared forever in Peter's memory, and also in that of this storyteller: "Oh! I'm not from any university. I'm here to clean the room, would you leave now please!"

Among the lessons that Peter has drawn from this experience, which he has written about but perhaps not in a very widely available publication (Hancock, 1999), is the necessity for humility and humor in the scientific enterprise. And I see evidence of humane factors at work in the transformation of Peter Hancock from Last to First.

A final note: Every time I tell this story, people double up with laughter. But no one has ever asked me, "Raja, you are such a good friend, colleague, and frequent coauthor of Peter Hancock, why were *you* not at his talk?" Well, I had a plane to catch, too!

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Moray, N. (1993). Technosophy and humane factors. *Ergonomics in Design*, 1(4), 33–39.

Newell, K. M., & Hancock, P. A. (1983). Space-time and motion study. In *Proceedings of the Human Factors Society 27th Annual Meeting* (pp. 1044–1048). Santa Monica: Human Factors Society.



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as we
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Annual
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The Human Factors and Ergonomics Society will wind up a year of celebrations in honor of our 50th Anniversary during the 51st Annual Meeting in Baltimore. You won't want to miss it!



Baltimore Marriott Waterfront Hotel



The meeting will take place on October 1–5, 2007, at the Baltimore Marriott Waterfront Hotel on the beautiful Inner Harbor. The hotel is in walking distance of numerous shops and restaurants.

The meeting will feature special events to recognize the achievements of HFES members in the past 50 years. In addition, the meeting will include

- **Workshops**
- **Technical Sessions**
- **Student Forum Track**
- **Interactive Posters and Demos**
- **Social Events**
- **HFES Awards Ceremony**
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... and much more.

We look forward to seeing you in Baltimore for the HFES 50th Anniversary!