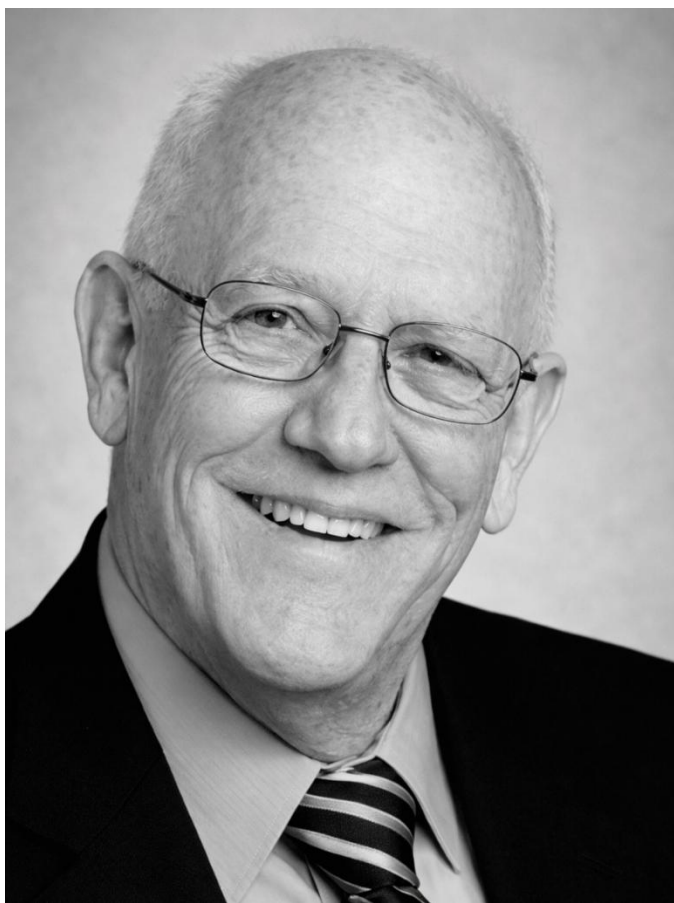


DAVID H. GUSTAFSON

MEMORIAL TRIBUTES

Volume 29

NATIONAL ACADEMY OF ENGINEERING



DAVID H. GUSTAFSON

1940-2026

Elected in 2013

“For industrial and systems engineering methods to improve the care of aging, lung cancer, severe asthma, and drug addiction patients.”

BY TIMOTHY B. BAKER AND FIONA MCTAVISH
SUBMITTED BY THE NAE HOME SECRETARY

DAVID HAROLD GUSTAFSON was born on Sept. 11, 1940, in Kane, Pennsylvania, and passed away on March 3, 2026, at age 85 in Madison, Wisconsin. Dave received his Ph.D. in industrial engineering from the University of Michigan in 1966 and immediately began his six-decade career in the Department of Industrial and Systems Engineering at the University of Wisconsin. Over the course of his career, Dave was elected to the National Academy of Engineering, won numerous awards for his work (including the 2009 Award of Merit from the University of Michigan College of Engineering and the Robert A. Ratner Professorship in Industrial Engineering), and received countless National Institutes of Health research grants, including multiple center grants. During his career, he published more than 350 papers that accumulated over 20,000 citations. These achievements are

impressive but do not fully capture the profound impact of his work.

Perhaps a brief vignette best captures what I, and many others, see as a defining characteristic of Dave as both a person and a scientist. In 2003, I attended a meeting of researchers who had just been awarded center grants as part of the National Cancer Institute's Centers of Excellence in Cancer Communication Research (CECCR) initiative. The CECCRs all involved communication research related to cancer prevention and treatment. Dave was the principal investigator (PI) on our award, and I was a co-investigator.

The meeting featured presentations by the PIs who described their projects and their potential benefits. Even though Dave was scheduled to present our project, I had spent considerable time mulling over what I would have emphasized: the creative experimental designs, the conceptual bases of the interventions being tested, the planned statistical analyses, and the ways the research would address gaps in the existing literature. That was what the other PIs did—and they did so impressively.

Dave did none of that. Instead, he simply and clearly portrayed the challenges and burdens faced by breast cancer patients and explained, in straightforward terms, how our research could improve their lives and support their recovery.

This vignette reveals several things about Dave. First, he was not trying to impress anyone with his expertise or burnish his image. He was in service to his audience and his customers (e.g., patients), not to himself. He also shared Enrico Fermi's belief that things should be made only as complicated as necessary. Second, his vision and motivation were always focused on improving outcomes for the people he served and how best to help them. While many would endorse this notion, Dave was

especially dedicated to understanding patients at a deep and comprehensive level. Finally, he had a remarkable knack for being able to identify what was truly important and communicate it clearly and powerfully. One definition of intelligence is the ability to separate peripheral factors from core ones. Dave communicated so effectively because he understood the seminal issues so clearly.

Beginning in the 1960s, Dave's research focused on exploring how technology and enhanced data systems could be used to address challenging health problems. He maintained those interests throughout his career. One early conceptual effort focused on how health systems could engineer operational processes to make data quickly available to clinicians for decision-making. In many ways, this vision foreshadowed today's interoperable electronic health record systems. Another focus of his work was identifying barriers to implementing health programs within health care systems, anticipating the surge of interest in implementation science that would emerge decades later. Dave also developed and published research on a computer-aided diagnostic system based on subjectively estimated patient attribute-disease relationships. This harbinger of AI-assisted diagnostic systems outperformed other computer-based systems and performed at a level comparable to clinician diagnosis. Even early in his career, Dave seemed to see the future.

Throughout the 1970s and 1980s, Dave focused on how advanced technology and data systems could enhance health care and health policy decision-making. Two foci in this regard were improving care in nursing homes and developing methods to predict suicide attempts.

In 1987, Dave published a landmark paper in the *Annual Review of Public Health*: "Computer-Based Health Promotion: Combining Technological

Advances with Problem-Solving Techniques to Effect Successful Health Behavior Changes.”¹ In this article, he and his co-authors observed that most of the extant computer applications in education and health care treated computers as surrogates for human providers. Instead, Dave and his colleagues argued for capitalizing on the special affordances of computers – that is, using them to execute tasks that could surpass what humans could effectively or feasibly deliver.

Dave and his colleagues further noted that many computer-based resources were designed primarily to provide information but did little to engage users in experiences or interventions that directly addressed their problems. The article outlined strategies for optimizing computer-based support and described BARN: the Body Awareness Resource Network, a computer-based health promotion system developed for teenagers and their families. BARN provided information and decision support on issues such as alcohol and drug use, sex, smoking, stress, and body management. This work represented the first clear manifestation of Dave’s vision that computer-based resources could become powerful agents of change, providing multiple integrated tools to address challenges and improve lives.

BARN’s development reflected the approach that Dave would take in his later engineering of digital resources: 1) identify the key motivational factors that impede change and science-based methods for addressing them, 2) determine how technology could provide support and leverage the expertise of

¹ Gustafson DH, Bosworth K, Chewning B, Hawkins RP. 1987. Computer-based health promotion: Combining technological advances with problem-solving techniques to effect successful health behavior changes. *Annual Review of Public Health* 8:387-415,

others in a timely and effective manner, and 3) identify the key obstacles users face and develop strategies to mitigate them. While maintaining this basic approach, Dave continually incorporated new technologies (e.g., GPS monitoring, just-in-time alerts) and adopted a quality-improvement cycle. He implemented new intervention strategies, evaluated them through rigorous research, and refined the resource based on the findings, setting the stage for the next cycle of development and evaluation.

Four key themes influenced Dave's subsequent development of digital resources. First, he wanted customers to have substantial autonomy in how they engaged with a resource. Second, he insisted that interventions be grounded in strong theoretical and evidentiary support. Third, because he recognized that one size does not fit all, he provided multiple options, further enhancing customers' sense of agency. Finally, he remained relentlessly focused on the user's perspective – what people said they needed and obstacles they faced. It was Dave's goal "to obsessively understand the customer."

In the early 1990s, Dave founded the Center for Health Enhancement Systems Studies (CHESS). The center developed CHESS intervention systems that offered integrated decision support and tools to help people make better decisions, change behavior, and enhance their health and well-being. Over time, the CHESS team developed versions tailored to a wide range of health challenges, including AIDS, cancer, and substance use disorders.

Ultimately, these systems offered a broad array of tools, including discussion groups, blogs, decision-support tools, and patient education resources. One of Dave's last major projects was the development of A-CHESS, an addiction-focused version of CHESS. Built on a smartphone platform rather than a computer, A-CHESS enabled support to be delivered regardless of time or place. It

provided access to discussion groups, live chat and text messaging, a panic button, virtual counseling, assertive outreach, counselor contact, video conferencing, education and training, games and relaxation tools, tailored information, personal stories, a healthy-events newsletter, location tracking, risk alerts, clinician alerts, a meeting locator, and real-time assessments of system use. A-CHES not only offered an omnipresent tool but also tightened the connection between the patients and clinicians.

ElderTree is another example of the close fit between consumer and resource. Designed for older adults, ElderTree was intended to provide social connection and support to combat loneliness and isolation, improve quality of life, and address a range of practical concerns, including transportation, medication adherence, and aging in place. Like A-CHES, ElderTree was designed to aid multiple stakeholders – the primary customer, caregivers, family members, and clinicians – all with the goal of enhancing the user's well-being.

Dave and his colleagues engaged in repeated cycles of evaluation to determine whether and how CHES benefited the customer. Results showed that most patients who were given access to CHES used it heavily, often in the middle of the night, to participate in chat and discussion groups. The version developed for breast cancer patients increased participants' feeling that they possessed the knowledge needed to make informed decisions regarding their care, strengthened their feelings of social support, improved their quality of life, and enhanced their confidence in their physicians. When ElderTree was provided to individuals with high health care needs, it improved mental health-related quality of life, increased feelings of support, and reduced depression. Research also showed that A-

CHESS reduced the intensity of substance use and aided recovery.

The development of tailored CHESS resources for multiple user populations was a notable achievement. However, their broader impact may have been even greater through their influence on the development of digital resources more generally. The large numbers of health websites, apps, and related services that now exist owe much to Dave's vision of how and why such resources should be built, as well as to his demonstrations of their effectiveness.

Remarkably, the development of CHESS was only one of many notable achievements in Dave's career. For instance, he co-founded the Institute for Healthcare Improvement (IHI), an international organization dedicated to improving health care and reducing errors. This work led to his leading a Robert Wood Johnson Foundation national program office, Paths to Recovery, that elicited and funded addiction treatment programs seeking more effective and efficient ways to improve treatment outcomes. The initiative expanded with support from the Substance Abuse and Mental Health Services Administration's Center for Substance Abuse Treatment, leading to the development of NIATx (the Network for the Improvement of Addiction Treatment), which in turn taught participating treatment centers to use Plan-Do-Study-Act cycles to create positive organizational change in about 4,000 community-based treatment organizations. These efforts significantly reduced delays in service delivery and increased treatment completion rates in replication samples.

Subsequent research awards from the National Institute on Drug Abuse and the National Institute on Alcohol Abuse and Alcoholism amplified these efforts to improve treatment for individuals with substance use and mental health disorders,

including a large-scale test of NIATx enhancements in 200 treatment centers across five states. Over twenty years, Dave and his colleagues promoted the adoption of evidence-based interventions, improved treatment delivery, addressed co-morbid disorders, and expanded treatment capacity. A cornerstone of this work was Dave's deep commitment to understanding the experiences and perspectives of patients and consumers. His efforts to do so were extraordinary. Before initiating the work to improve treatment for alcohol and drug use disorders, Dave sought admission to a county detoxification center as a patient. After a month of waiting and calling every day, he spent a night in the facility. The experience exposed him firsthand to the inefficiencies and dehumanizing aspects of care delivery and helped inform his subsequent work.

In all of his efforts, Dave was supported by a large team of highly competent and dedicated collaborators, colleagues, and staff. These individuals were steadfastly dedicated to the work because it offered such a clear path to aiding individuals facing great challenges and profound need. It was also exciting to be involved in instantiating Dave's vision – a vision that led to groundbreaking work that transformed health care and that so greatly influenced the development of digital health resources. That dedication also reflected Dave's personal qualities: his compassion, his genuine interest in the perspectives and ideas of others, his sense of fairness, his non-defensive openness, and his generosity in supporting those around him. Dave's influence was transformative not only through the work he accomplished but also through the people with whom he worked and whom he inspired.