George H. Heilmeier

GEORGE H. HEILMEIER

1936–2014

Elected in 1979

"Contributions to liquid crystal technology."

BY NIM CHEUNG AND JACK HOWELL

GEORGE HARRY HEILMEIER, one of the most influential technology leaders of our era, passed away on April 21, 2014, in Plano, Texas, at the age of 77. His death was attributed to complications from Alzheimer's disease.

He was born May 22, 1936 in Philadelphia, the only child of George and Anna Heilmeier. His father was a janitor, his mother a homemaker. He graduated from Abraham Lincoln High School and went on to earn his BS in electrical engineering from the University of Pennsylvania and his MSE, MA, and PhD in solid state materials and electronics from Princeton University.

Heilmeier is internationally recognized for his pioneering work in 1964–1965 on electro-optic effects in liquid crystals, performed at RCA Laboratories in Princeton, and his subsequent demonstration of the first working liquid crystal display (LCD). This breakthrough is the basis for the subsequent developments, spanning five decades, that led to the billions of LCD devices deployed today in products ranging from digital clocks and calculators to flat panel TVs and computer

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monitors, gaming devices, cameras, and smartphones. LCDs are expected to become even more ubiquitous with the advent of the Internet of Things, which is expected to have tens of billions of interconnected computing devices over the next couple of decades.

Equally important, but less well known to the general public, are Heilmeier's contributions as a research leader during his tenures as director of the US Department of Defense Advanced Research Projects Agency (DARPA), senior executive at Texas Instruments, and CEO of Bellcore (Telcordia Technologies). He had the uncanny ability to spot key problem areas of great importance in a research field.

He is famous among technology managers for the "Heilmeier Catechism," a set of questions he posed at DARPA for reviewing new R&D projects or funding proposals. He continued to use these questions as a management tool in his subsequent positions. The philosophy has spread to numerous organizations in the United States and many other countries.

The Heilmeier Catechism

- What are you trying to do? Articulate your objectives using absolutely no jargon.
- How is it done today, and what are the limits of current practice?
- What is new in your approach and why do you think it will succeed?
- Who cares?
- If you are successful, what difference does it make?
- What are the risks and the payoffs?
- How much will it cost?
- How long will it take?
- What are the midterm and final "exams" to check the success?

Heilmeier won numerous awards and accolades for his invention of the LCD and as a research leader, including the US National Medal of Science (1991), IEEE Medal of Honor

(1997), and NAE Founders Award (1992) and Charles Stark Draper Prize for Engineering (2012). He was also selected for the IEEE David Sarnoff Award (1976) and Kyoto Prize in Advanced Technology from the Inamori Foundation (2005), among others.

He is survived by his wife of 52 years, the former Janet Faunce; daughter Beth Heilmeier Jarvie; and three grandchildren.

Tribute by Bob Lucky

I first met George in 1967. He and I were the two runners-up in the annual Eta Kappa Nu selection of the most outstanding electrical engineer. George was then working at RCA and had invented the LCD display technology. I had no idea how important it was to become, nor how long it would take to become so important. The next year George was selected for the main honor of the most outstanding young engineer. That was a very significant honor then, which was based not only on technical achievement but on abilities and accomplishments outside the technical area. The winners of that award nearly always became famous engineers. (That became less true in the decades to follow, and I think it is impossible today to identify such exceptional young engineers.)

George went on to government positions and was appointed director of DARPA at a time when technology was blossoming with potential. Integrated circuits, the laser, and the Internet were poised to change the world, and George was right there with the vision and the funding to make it happen.

About this time I was a member of the Scientific Advisory Board of the Air Force, and later became its chairman. George was an active participant, and I renewed my acquaintance with him.

After George left government he joined Texas Instruments, and in 1992 I heard that he had been named the CEO of Bellcore. I remember being thrilled that he would be moving to New Jersey, and I hoped that he would be a neighbor. I had forgotten that the headquarters of Bellcore was then in Livingston, NJ, which was nowhere near my home.

In the summer of 1992 I was executive director of the communications research division of Bell Labs. One day I received a call from George, who wanted to have lunch with me. I had a feeling that he was going to offer me a job, as the vice president of research in Bellcore was retiring. However, I had no intention of accepting an offer. I never thought that I could leave Bell Labs. But as I left that lunch, I knew that my life had been changed, and that I would join George at Bellcore.

I worked directly for and with George for some years. Once again, George was where things were undergoing tectonic shifts. The realities of the AT&T breakup were starting to set in, and the funding model for Bellcore—a consortium of the so-called Baby Bells—was about to disintegrate. Bellcore had to be sold, and George was the person in charge. I remember those months of meetings with potential buyers. George was at his best in knowing the people and managing the process of the sale.

George was easy to work for, and he had a knowledge and affinity for research. He looked for vision, and was famous in the company for his "catechism" of basic questions that every project had to answer. I was always aware that mv boss knew as much as I did about the work we did.

Of course, the sale of Bellcore ended George's tenure as CEO. This is usual and had been ordained from the start. Bellcore became Telcordia Technologies and the research division became increasingly funded through government proposals.

I retired in 2002, but I wasn't through seeing George—not by a long shot. I joined the Defense Science Board—the half-dozen or so of the most respected defense scientists in the country; George was a senior fellow of the board. In the years to follow I had many meetings with him, and, freed from corporate responsibilities, we had wide-ranging conversations.

One little reminiscence sticks particularly with me. Several times George talked about playing baseball when he was young. He was an infielder—maybe third base—and had aspirations about playing at higher levels, maybe even the major leagues. In my mind I see him at third base, hollering at the

players around him to get their game up, staring intently at the batter and positioning himself based on the statistics of that batter—a student of the game and so competitive that he refuses to lose.

His life was like that.

Comments from Stu Personick

George had the ability to identify and articulate key problem areas that were of great importance to the sponsors of applied research and that were ripe for solution via innovative thinking and the innovative application of available and emerging technologies.

Under his leadership, DARPA focused its strategy on six overarching themes that were elegant in the simplicity with which they were framed and the transparency of their prospective impacts:

- Create an "invisible aircraft."
- Make the oceans "transparent."
- Create an agile, lightweight tank armed with a tank killer "machine gun."
- Develop new space-based surveillance and warning systems based on infrared focal plane arrays.
- Create command and control systems that adapt to the commander instead of forcing the commander to adapt to them.
- Increase the reliability of our vehicles by creating onboard diagnostics and prognostics.

George had the ability to recognize the prospective, far-reaching implications of a discovery such as the underlying ferroelectric effects in liquid crystals, to create solutions for important unmet market needs, and to follow through on the applied research and development needed to turn a new discovery into high-impact, marketable products [1, 2]. It is important to note that this follow-through includes the ability to evolve the prospective application domain and the

underlying technology as the applied research and development provide new scientific and market insights [3].

While at DARPA, George formulated a set of questions for evaluating prospective/proposed research projects. Discussions of those questions, and case studies using those questions, should be part of any course on innovation and incorporated into the practices of all committees that select research projects for funding, all research program managers, and all principal investigators conducting research projects. Answers to all of these questions should be a mandatory section of every research proposal submitted for funding and every doctoral candidate's thesis research proposal [4, 5].

Comments from Vincent Chan

George was a personal friend, and we spent a lot of time together in the last few years working on Defense Science Board studies and as members of other US government advisory boards and committees. He was a person who had a very high quality metric, and a nose for finding problem areas. He also was not shy about letting the US government representatives/sponsors of those boards and committees know the bad news about their programs and initiatives, even if they didn't want to hear it. I am a strong supporter of the Heilmeier catechism and I have preached it in my group and to others worldwide! I think George's courage to speak out under difficult situations is unique, and is something young people should emulate (with appropriate moderation and judgment).

Comments from Beth Heilmeier Jarvie

The real story of what undergirded all the contributions my dad made, what made him "tick" and the thing that made him unique and totally special, was his integrity, humility, and work ethic. He came from a poor neighborhood in Philadelphia (no one in his family went past middle school) but his parents instilled strong values in him. He lived a life of gratitude to God for all the gifts he felt God had bestowed

on him (although by the world's standards, he had nothing). Even I did not know all the contributions he made until after he died because he never spoke of his awards, honors, etc. I could go on and on about my dad. As one of his friends, Jack Woodmansee, said, my dad was a "national treasure" in many ways.

References

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