

# Leo Beranek: Technology, Business, and Civic Visionary

David Walden

Email  
dave@walden-family.com

Postal  
12 Linden Road  
East Sandwich, MA 02537

## *Leo Beranek's activities outside of acoustics.*

*This article is a brief summary of what I have come to understand about Leo Beranek outside the world of acoustics.*

### **Getting to Know Leo Beranek**

I joined Leo Beranek's company, Bolt Beranek and Newman (BBN) in September 1967. Leo was president and CEO of BBN until July of 1969 when he stepped down from that position, and then he left employment of the company in 1971. During those several years of overlap, Leo and I came to know each other. Naturally, I was interested in Leo's life and impact on BBN, as I loved working for the company, thought it was a unique place, and wondered how it had come about. I heard a bit more from time to time from Dick Bolt who was still frequently around the company over the 27 years I was there, and I heard a sketch of the history from Leo one year at the company's annual Science Development Program dinner. However, I didn't really get to know Leo's history with BBN in detail until I began to delve into BBN's computing history after my retirement from BBN (Walden and Nickerson, 2005, 2006; Nickerson and Walden, 2011). For that effort, I communicated with Leo, asked him to draft an article for a journal and to later expand it for a book chapter, and he also communicated with me as he developed his paper relating to BBN-Internet history for the Massachusetts Historical Society (Beranek, 2000). I also read interviews of Leo by Janet Abbate (1996) and Michael Geselowitz (2005) and other writings such as Alperin et al. (2001), Wal-drop (2001), Beranek (2008), Melone and Wood (2005), and Swets (2010).

### **Youthful Engineer, Entrepreneur, Scholar, and Manager**

Leo Beranek has often been at the cutting (visionary) edge of technology from the time he was a young man. He grew up on a farm in Solon, Iowa, and there he learned early to tinker with things. When Leo was ten years old, his father bought a battery-operated, one-vacuum-tube radio, and Leo figured out how to assemble it, installed the antenna and ground, came to understand about radio waves, and, more generally, developed an interest in communications engineering. His family was not well off, and by the eighth grade Leo started to earn extra money for himself by taking on a sales territory of his town and a nearby village – selling from a catalog of stockings and fabrics for silk lingerie and blouses. In various ways, Leo earned enough money to pay for his first year, 1931-32, at Cornell College in Mt. Vernon, Iowa.

Leo made his way through college by living frugally, obtaining some scholarships, working some summers as a farm hand, starting a radio sales and repair business, taking on a contract to do speech recordings on aluminum disks for the

college speech department, and in other ways. He also left college for a period to work full time at Collins Radio. As required by his financial situation, Leo sold his radio business and bought it back, hired an employee or two, moved into building antenna wiring as radio sales fell off, and finally sold the business again as he graduated college. He also graduated with very close to being a Phi Beta Kappa. In some sense, Leo managed his college life like one manages a business (in this case, the business of going to college), and doing what was necessary to adapt to the environment and succeed.

Leo applied to local colleges for graduate school. Then one day Leo saw a man with a car with a flat tire on Main Street in his college town; the car had Massachusetts plates and Main Street was a step on the Lincoln Highway going from New York to San Francisco. Leo helped the man change his flat tire and they got to talking. The man was in the radio business. His name was Glenn Browning, and he had written papers about radio that Leo had read. Based on this chance event, Browning recommended that Leo apply to Harvard and later provided a reference at the behest of a Harvard dean. The overfull local colleges did not have room for Leo, but Harvard did and awarded him a scholarship.

Leo moved to Harvard in the fall of 1936, and quickly realized that his savings and scholarship were hardly enough to live on; he lost 20 pounds during his first year of graduate school. However, his grades and lab work were excellent and in his second year he began working part time with one of his professors, Federick Hunt, developing new light-weight pickups for playing phonograph records. The job would limit Leo to taking two courses per term rather than the normal four, but he would have a lab of his own in which to work. He did good work, was acknowledged in a paper by Professor Hunt, generally moved further into the study of noise and vibration, and found a thesis research topic. His research led to two papers published in the *Journal of the Acoustical Society of America* (Beranek, 1940a, b) and a Ph.D. in 1941. From there Leo went on to lead a group in Harvard's newly created Psycho-Acoustic Laboratory.



**Figure 1.** Eliot St. (left) and Moulton Street (right) offices of BBN (left photo from Leo Beranek's personal collection; right photo by BBN librarian Jennie Connolly)

The rest of Leo's career in acoustics will be covered in other papers in this issue. The important thing to note for this paper, though, is that through a combination of intellect, engineering ability, entrepreneurial skill, and practical management aptitude, Leo was preparing himself to found a company of his own when the opportunity arose. Other connections he made, travel he did, projects he led, etc., in the years immediately following his being awarded his doctorate further prepared him as a business leader.

### **Building a Culture of Innovation and Diversification at BBN**

After World War II, Dick Bolt led the newly established Acoustics Laboratory at MIT (Walden and Nickerson, 2011, Chapter 2). Dick recruited Leo from Harvard to join the MIT laboratory. In 1946 a request arrived at MIT from a New York architect for acoustical help in the design of the United Nations General Headquarters. The request was routed to Dick Bolt, who bid on the job and won it. When the drawings for the project arrived, Dick realized it was too big a job for one man and invited Leo to join in a partnership to take on the job; and Bolt and Beranek was formed. After the UN job, more acoustical work came to the partners, and they added employees and partners, including Bob Newman, while working in space rented from MIT. They incorporated as Bolt Beranek and Newman in 1953 and later moved their quarters from MIT to Eliot St. in the Harvard Square area of Cambridge, MA (Figure 1). They then built and moved to a new building on the western edge of Cambridge where BBN still resides today (Figure 1).

In time the company expanded beyond acoustics into the computing R&D arena, as described below. The staff expanded and undertook R&D contracts from clients (primarily government) who wanted work done at the state of the art or just beyond.

To develop in this way, BBN needed smart people who could find and develop appropriate contract opportunities, and corporate flexibility about working in new areas. Led by Leo (and Dick Bolt, Bob Newman, Sam Labate and Jordan Barush, the partners before incorporation), BBN developed a culture that attracted, and typically kept for many years, top people in their respective disciplines and better-than-industry-average people in every business and R&D function (Walden and Nickerson, 2011, Chapters 1 and 5).

BBN turned into sort of a halfway house between university and industry, with the best kind of colleagues and research work as would be found in universities (and fascinating development projects), and with the typical pay levels and lack of teaching duties of industry. BBN kept in close touch with the various Boston-area colleges and universities, and found ways to be involved with soon-to-be top graduates before they finished school. If a really good person was found from a university or elsewhere, BBN hired them without knowing what the person was going to do for the company.

Naturally, people such as these are going to want to do new and bigger things, or at least see their R&D efforts be used broadly in the world. Over the years BBN started a variety of subsidiaries, hatched some spin-offs, and engaged in intellectual property alliances (Walden and Nickerson, 2011, Chapter 6).

Leo was the main shaper of this culture for most of his years at BBN.

### **Lickliders and Moving BBN into Computing**

At Harvard during World War II, psychology and acoustics interacted to solve military command, control, and communication problems in Leo's Electro-Acoustics Laboratory. Psychology and acoustics were also interacting at Harvard's Psycho-Acoustics Laboratory where J.C.R. Lickliders ("Lick") led the effort to apply experimental and cognitive psychology to computers. After the war, Leo moved to MIT's Acoustics Laboratory, and there he was instrumental in bringing Lickliders to MIT where Lick headed the psychology section of a department in the School of Humanities.



*Figure 2. J.C.R. Lickliders and wife Louise in 1959 (photo from Leo Beranek's personal collection)*

At MIT, Lick was active in Norbert Wiener's activities in cybernetics and modeling computational processes in command and control in humans and machines. At MIT's Lincoln Laboratory, Lickliders became acquainted with MIT's first interactive computer, Whirlwind ([http://en.wikipedia.org/wiki/Whirlwind\\_I](http://en.wikipedia.org/wiki/Whirlwind_I)) and the other pioneering machines that followed.

After Leo Beranek and Dick Bolt founded their partnership, Bolt mostly stayed at MIT until 1956. Beranek moved more quickly to BBN and the company proceeded to develop a consulting, research, and development business across a broad spectrum of acoustics. Gradually the company moved into psychoacoustics and, desiring a contribution to the business from psychologists, Leo naturally thought of Lickliders (Figure 2).

Leo has told the story many times (Walden and Nickerson, 2011, Chapter 1). In the mid-1950s, BBN decided to look for research work in using machines to improve human performance. Lick was an outstanding experimental psychologist and knew the new field of digital computers. Leo says that he courted Lick "over numerous lunches" in 1956, and eventually pursuing Lick on a trip to Los Angeles that summer. Lick had to give up a tenured position at MIT but joined BBN, as a vice president, in 1957.

Almost immediately Lick wanted to buy an expensive, state-of-the-art, Royal-McBee computer for his department. Leo has recounted (Walden and Nickerson, 2011, Chapter 1):

"What are you going to do with it?" I queried. "I don't know," Lick responded, "but if BBN is going to be an important company in the future, it must be in computers."

Although I hesitated at first ... I had a great deal of faith in Lick's convictions and finally agreed that BBN should risk the funds."

Ken Olsen and some other members of the Whirlwind development team had left MIT to found Digital Equipment Corporation (DEC) in the suburbs of Boston. When Olsen saw that BBN was becoming interested in computing (i.e., buying the Royal McBee computer), he asked Leo if BBN could be the test site for a month for DEC's prototype PDP-1 computer. Leo agreed, and the computer was installed in BBN's visitor's lobby. Lick and others in his group spent the month discovering what the PDP-1 could do and suggested some improvements. With that experience, BBN decided to take delivery on DEC's first production PDP-1 (Figure 3), and Leo and Lick headed to Washington to find some research contracts needing a computer. Lick was correct about computing as a potential business area, and several significant contracts were obtained.

In 1960-1962, Lick spent time thinking of what he called "man-machine" symbiosis and wrote a classic paper that foreshadowed the development of personal computing and computer networks (Licklider, 1960). Then in 1962, Lick left BBN and went to head up the new Information Processing Techniques Office of Department of Defense's (DoD) Advanced Research Projects Agency (ARPA) (Norberg and O'Neill, 1996). He thus was the first in a line of office directors funding the R&D that led to much of what we now know as personal computing and computer networking.

With computing as an area of effort at BBN, various other computer people began to join the company, including Ed Fredkin who subsequently involved MIT Professors Marvin Minsky and John McCarthy as consultants in an effort to build a time-sharing system on the PDP-1. With a time-sharing system available (at first rudimentary and then much more usable), other people were attracted to BBN, including people interested in looking into artificial intelligence (AI) and who needed to develop new computing tools in order to do their research.

Over time, psychology, AI and related areas grew into a substantial information sciences research activity, and BBN also began a move into the computer systems business.



*Figure 3. BBN's PDP-1 computer in 1960 (photo courtesy of BBN Technologies)*

### **The Resulting Computer Systems Business**

In 1966-1968, a series of events happened that led to what has become BBN's most publicly visible computing innovation. Earlier in the 1960s, Leo had provided introductions that led to Jordan Baruch landing a contract with the National Institutes of Health (NIH) which resulted in one of the nation's first time-shared, hospital information systems at the Massachusetts General Hospital (MGH). Then in 1966, Baruch left BBN to lead a joint venture of BBN and the General Electric Company to provide real-time information services for hospital, medical laboratories, and other elements of the medical community. Dick Bolt took over as acting director of the BBN division working on the MGH hospital project and went looking for a permanent division director. Some BBN people knew Frank Heart (then leading a group of real-time system developers at MIT's Lincoln Laboratory), and Dick recruited Frank to take over management of the "health care" systems business at BBN.

Also in 1966, Bob Kahn joined BBN. Bob had been an assistant professor at MIT doing research on theoretical problems in communications, signal processing, and information theory, and he wanted to get a couple more years of practical experience before returning to MIT. His MIT group leader encouraged Bob to talk to Baruch at BBN, and Baruch encouraged him to join the company. He was thus hired into

BBN's information sciences division where he began to think about computer networks. Bob sent some of his research memos to ARPA, had a discussion with them, and became aware of ARPA's plan to develop a computer network, but didn't know it would actually happen.

In the latter half of 1968, ARPA did a competitive procurement for a company to develop a set of four packet-switches to form the communications backbone for a new kind of communications system to be known as the ARPANET. Although BBN may not have fully realized it at the time, BBN was well positioned to bid on the job. BBN was well-known to ARPA for its work in the artificial intelligence area and its programming language and operating system developments to support AI work; also, the leader of the ARPA office running the procurement was a computing-oriented psychologist (like Licklider). ARPA also knew and apparently appreciated the ideas in Bob Kahn's research memos because some of his ideas found their way into the request for bids to develop the packet switches. Finally, from their joint time at Lincoln Laboratory, Frank Heart was well known as a highly capable real-time systems developer to the individual in the ARPA office who was leading the procurement. Thus, even though a small company compared with some of the other bidders, BBN had good credibility.

With his real-time system-development leadership experience, BBN decided that Frank Heart was the person to lead BBN's effort to bid on, and hopefully build, the ARPANET packet switches. Bob Kahn played a key technical role of his own, in addition to bringing the other proposal team members up to speed on the concepts of packet switching. And several other real-time system software and hardware people Heart had brought to BBN helped with the system design. This small proposal team developed the design for a high performance, reliable, and innovative system.

In competition with many other companies, BBN won the contract and developed and delivered the four packet switches on-time in 1969. BBN was awarded follow-on contracts to expand the network and make it more operational. In 1972 Bob Kahn (like Licklider before him) moved from BBN to ARPA where he shaped much of the birth of the Internet. BBN continued to be one of the companies and institutions which participated in ARPA-sponsored internet working developments and experiments, activities that evolved into what today is the Internet.

During the 1966-1969 period just described, Leo was still at BBN. He supported the decision to bid on the ARPANET contract (leading to a fulfilling of an important part of the dream that Licklider first espoused while at BBN). More importantly, perhaps, the next generation of BBN people (after Licklider) had taken on the entrepreneurial, practically-based, make-it-work, hire-smart-people (even if you don't know what you will do with them, e.g., Bob Kahn), culture of innovation that Leo had created at BBN. Leo's dream of moving BBN into the computer area was settled; from then on computing and information sciences would grow in diverse ways and be a bigger part of BBN's business than acoustics (Walden and Nickerson, 2011).

### **Civic Leader**

Leo Beranek ceased to be president of BBN in 1969 and, after two years as chief scientist, left the company in 1971. This provided Leo with additional time to get involved with other activities, including his becoming an important civic leader in the Boston area.

Since 1962 Leo had been involved with a team of men and women seeking to obtain the license to own and operate Channel 5 TV in Boston. The then owners of the station had various troubles that made it difficult to get licensed for a multi-year period. The team involving Leo was granted the FCC license to operate Channel 5 in 1972, after promising to air more local programming than any other station in the United States at the time (<http://en.wikipedia.org/wiki/WCVB-TV>). Leo became president of the new Channel 5, and the channel became a great success. The New York Times, in a lengthy 15 February 1981 article, carried the headline, "Some Say This Is America's Best TV Station." Leo believes that the channel gained that status through the application of his long-stated premise that "Each new person hired should raise the average level of competence of the organization." Leo retired from being president of Channel 5 in 1982.

Leo became president of the American Academy of Arts and Sciences in 1989. After serving the normal two-year term he was requested to continue for two more years. There he raised money for their endowment fund, cut down on expenses, raised dues, changed the health system, ... prevailed on the elections committee to reduce the average age of new members and to raise the percentage of women inductees.

In the 1950s, Leo and Bob Newman did work to improve the acoustics of the Boston Symphony Orchestra's (BSO) Tanglewood's Koussevitzky Shed in Lenox, MA. Well known to the BSO partly through his Koussevitzky Shed work, Leo was asked in 1968 to join the orchestra's newly formed Board of Overseers. He became chair of this group in 1977. In 1979 Leo took the lead in raising funds to erase the orchestra's deficit and to build an endowment. He also participated in other changes that left the orchestra on a firm footing. Thus, he became known in the Boston area as a fundraiser.

From 1984-1990, Leo was an Overseer of Harvard. There his science background and business operating experience could be put to use helping on the visiting committees for the Physics Department, Loeb Drama Center, Business School, and Biology Department. He also served on the Advisory Committee on Science, Technology and Public Policy at the John F. Kennedy School of Government.

Leo became a Council member of the Massachusetts Historical Society in 1986, Vice President in 1989, and has since been an honorary member.

To BBN and to each of the organizations noted in this section, Leo brought his science and technology background, his entrepreneurial and management skill, and his civic vision for making the world a better place.

## Acknowledgments

In preparing this note, I communicated with ex-BBN people Danny Bobrow, Paul Castleman, Jerry Elkind, Frank Heart, Bob Kahn, Steve Levy, and John Swets about BBN's transition into the field computing. I also drew heavily on several of the references. I thank guest editors Carl Rosenberg and Bill Cavanaugh for inviting me to prepare this note and for guiding me in its production; and I thank *Acoustics Today* editor Arthur Popper for his editorial suggestions and guidance. Most of all, I appreciate all that Leo Beranek has done to create the company I loved and worked at for 27 years and for all he has done to make the Boston region a better place to live.

## Biosketch



**David Walden** studied mathematics at San Francisco State College and computer science at MIT. In his technology and business career, he worked as a computer programmer at MIT Lincoln Laboratory; as a computer system designer at Norsk Data Elektronik

(Oslo); and as a computer programmer, technical manager, chief quality office, and general manager at Bolt Beranek and Newman (BBN). He was on BBN's 7-person team that in 1969 developed the ARPANET packet-switches, the precursor technology to Internet routers. Since retirement from BBN, Mr. Walden has written books and published papers on methods for business improvement, computing history, and digital typesetting.

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### How Leo has Come Into My Life

Leo Beranek is well known as a brilliant physicist, with the mathematical and scientific skills to delve into serious problems with vigor and success. Even better he is always eager to question and change his mind when new ideas come along. But a lone scientist, however brilliant, is often not enough. You need a team to really make breakthroughs, and Leo has a special gift for attracting, encouraging, and guiding teams of brilliant people. One of the many friends attracted to Leo's circle changed my life by introducing me to my physicist and life partner Harriet. She was an ex-BBNer with copies and a working knowledge of Morse's 'Vibration and Sound' and Beranek's 'Acoustics,' essential companions to my work.

Leo came into my life personally many years ago when he attended one of my lectures to the Boston Audio Society, a wonderful group of music-loving, no-nonsense nerds. Leo was a member and fit right in. He was full of good questions, suggestions for articles I could read, and encouragement. Buoyed by his enthusiasm I started sending him my writing for comments. He read quickly and carefully, full of comments and suggestions. I have attempted to do the same for him. We started a too-infrequent habit of meeting for lunch or at his apartment in Harvard Square, where we talked for hours about the latest theories of hearing and acoustics. Leo became an essential part of my team, and I am enormously grateful for his encouragement and guidance, and rejoice that he is still actively questioning standard theory and searching for better. We need him.

**David Griesinger**  
 Cambridge, MA  
 Dgriesinger@verizon.net

### Treasured Praise

"This is fantastic work! We would have done the same if we'd just had those tools," commented Leo Beranek in front of a thousand-person audience after my plenary talk in ICA 2013, in Montreal. This comment meant a lot to me, since Leo—of anyone in the world—knows about the research of concert hall acoustics. Leo's all-encompassing work on concert halls, *Concert Halls and Opera Houses: How They Sound*, was published at the time when I was starting my master's thesis. It was the first and the only book that I read from cover to cover during my studies. Leo's writing style—merging music, engineering, and architecture—is so compelling that everybody can read his text. Moreover, his work and books have set the basis of all our current research and it is very easy to go forward with such well documented research.

**Tapio Lokki**  
 Associate Professor at Aalto University, Finland  
 Tapio.lokki@aalto.fi

### Quite the Charmer

I first met Leo at an ASA meeting in the late 1990s when I was a graduate student, at a book signing event for his *Concert Halls and Opera Houses 1996* book. That was the first time he flashed his wonderfully joyful grin at me; he was warm and encouraging to my young self, not at all aloof or standoffish as I may have expected from someone so famous. As the years have passed, he has always remained that way—warm and encouraging, while still telling it as he sees it. I had the opportunity to accompany Leo on a recent trip between Montreal (where we attended the ASA and ICA meetings) and Toronto (for the 2013 ISRA). One thing you may or may not be aware of is how charming Leo can be, particularly with ladies! While we were waiting (longer than seemed usual) to pre-board the plane, Leo was regaling other passengers sitting near us with stories from his life; everyone (particularly the older women) oohed and aahhed, marveling that he was 98 years old at the time as he is so apparently full of life and joy. I am grateful for every historical nugget, piece of advice, and heartwarming smile he has shared with me. Leo is an ongoing inspiration, and I am humbled to count myself now amongst his friends and not simply one of his many admirers—thank you.

**Lily Wang**  
 Professor, University of Nebraska  
 Lwang4@unl.edu

### Building on Fundamentals

When I graduated in 1971 from UCLA with a Ph.D. in engineering, I cast about and found that the field that intrigued me the most was acoustics. This was based primarily on the courses that Dick Stern taught, and the use of acoustics in the measurements I did for my experimental work. Not enthusiastic about work in the aerospace industry, I rather impulsively decided to risk opening my own consulting practice.

The initial reaction of the world to my decision was, of course, a deafening silence. Between the time I spent knocking on doors, there was a great deal of time for opportune study, and I turned to the recently published book that Leo Beranek had written, *Noise and Vibration Control*.

This proved to be a fortunate choice since Leo and his co-authors had taken great care to begin with the fundamentals in each of the topics they addressed. In the following years I sought out many of Leo's other publications for detailed study. When I was preparing my own book I frequently turned to Leo for clarification and for other references, which he generously provided. I think we all owe Leo a huge debt for his insightful publications and teaching.

Marshall Long, Ph.D., P.E., FASA  
mlacoustics@sbcglobal.net

### Pitfalls of Careful Planning

My dad (Leo Beranek) has always been extremely organized: up at 5:00 a.m., exercise, breakfast, work.... Every Saturday during my childhood was work-around-the-house day, doing chores (I was usually the gofer), while on Sunday he seceded himself in his home office to work on professional projects. Yet even I, marinated as I was from birth in his organizational skills, could be surprised. In 1994, when my dad was celebrating his 80th birthday, I arranged to meet him and my step-mother Gabriella at the North Rim of the Grand Canyon for a couple of days. I planned out in general terms what I thought our itinerary should be. When I met him there, I was shocked to see that my organizational abilities were not even vaguely in the same league as his. He had broken down the two days into 15-minute intervals specifying what we would do in each block of time: go to this overlook point, then that, then hike down the canyon for an hour, then climb back up, then have lunch, etc. I admired this, of course, but I confess to having felt a guilty pleasure when it turned out that climbing back up the canyon took 15 minutes less than budgeted, thereby upsetting my dad's schedule by one interval.

Thomas Beranek Haynes  
beygui@msn.com

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